

# NPTEL

NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING



Jul - Dec 2019



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# NPTEL IS OFFERING ONLINE CERTIFICATION COURSES

<https://onlinecourses.nptel.ac.in>



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**358 COURSES AVAILABLE ACROSS VARIOUS DISCIPLINES**  
**<https://onlinecourses.nptel.ac.in>**

AEROSPACE ENGINEERING

AGRICULTURE AND FOOD ENGINEERING

ARCHITECTURE

BIOTECHNOLOGY & BIOENGINEERING

CHEMICAL ENGINEERING

CHEMISTRY AND BIOCHEMISTRY

CIVIL ENGINEERING

COMPUTER SCIENCE & ENGINEERING

ELECTRICAL ENGINEERING

HUMANITIES & SOCIAL SCIENCES

MANAGEMENT

MATHEMATICS

MECHANICAL ENGINEERING

METALLURGICAL & MATERIALS ENGINEERING

MULTIDISCIPLINARY

OCEAN ENGINEERING

PHYSICS

TEXTILE TECHNOLOGY

# A B O U T N P T E L

National Programme on Technology Enhanced Learning (NPTEL) is a project of MHRD created to provide quality education to anyone interested in learning from the IITs. NPTEL was initiated by seven Indian Institutes of Technology (Bombay, Delhi, Kanpur, Kharagpur, Madras, Guwahati and Roorkee) along with the Indian Institute of Science, Bangalore in 2003. Five core disciplines were identified namely, Civil Engineering, Computer Science and Engineering, Electrical Engineering, Electronics and Communication Engineering and Mechanical Engineering. 289 courses in web/video format were developed in this phase.

The main goal of NPTEL Phase II (2009-14) was to build on the engineering and core science courses launched previously in NPTEL Phase I. An additional 600 web and video courses were created in all major branches of engineering, physical sciences at the undergraduate and postgraduate levels and management courses at the postgraduate level. Several improvements such as indexing of all video and web courses and keyword search were implemented.

## N P T E L O N L I N E C E R T I F I C A T I O N

From March 2014 onward, NPTEL started offering online certification courses. Every January and July, anywhere between 250-300 courses are offered online - free of cost - for anyone to enroll and learn from. The certification involves writing an exam that is proctored and conducted in 120+ cities across India. 1300 online certification courses have been completed as on date with 358+ courses currently open for enrollment at [onlinecourses.nptel.ac.in](http://onlinecourses.nptel.ac.in). Through an online portal, 4, 8, or 12 week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered.

### **NPTEL online courses for certification** **[onlinecourses.nptel.ac.in](http://onlinecourses.nptel.ac.in)**

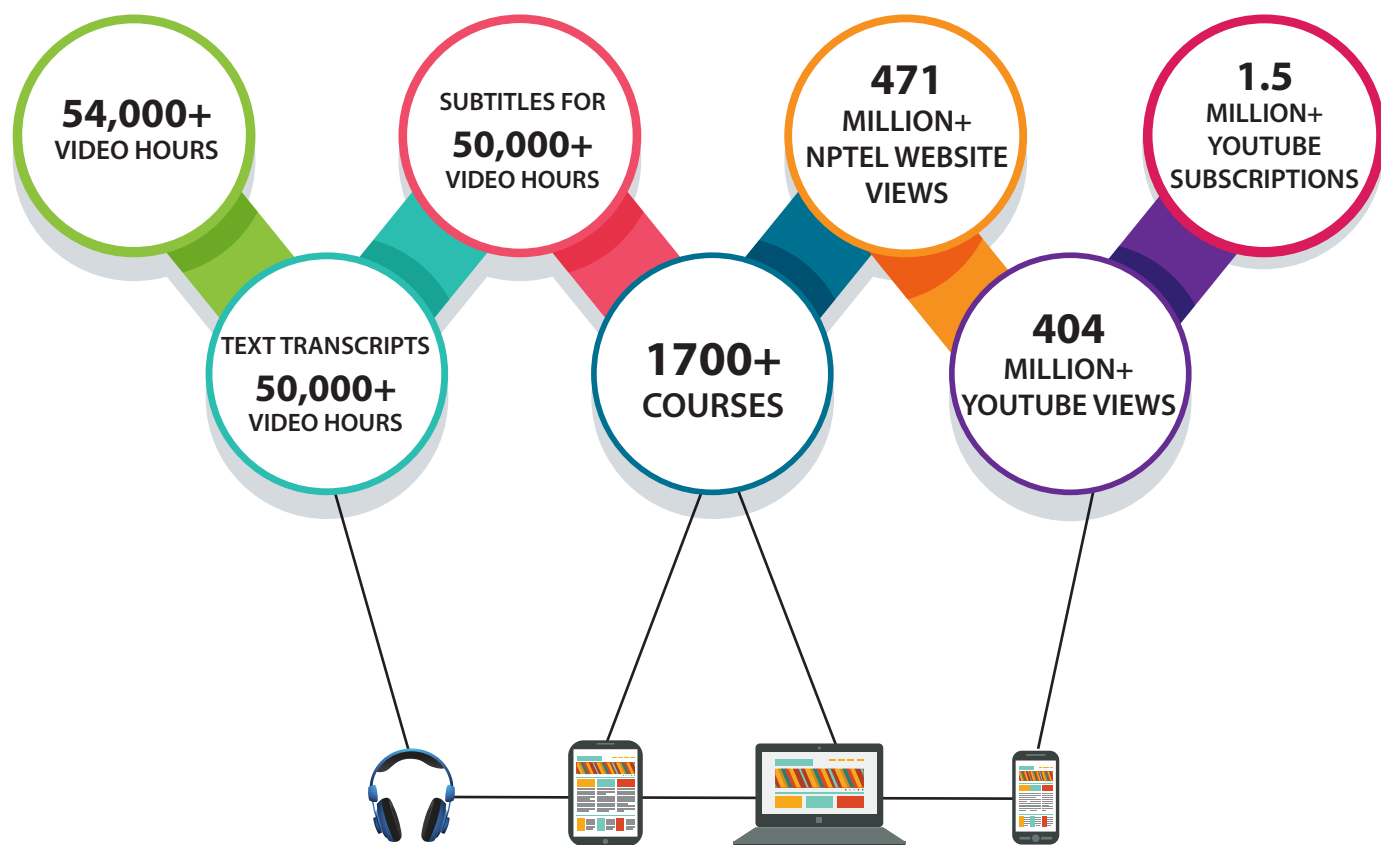


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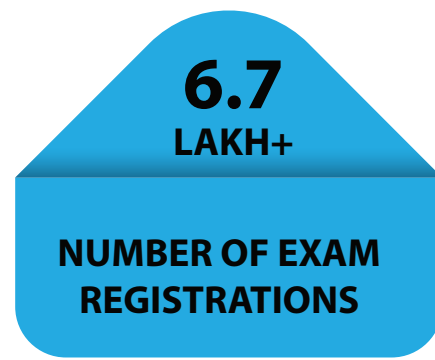
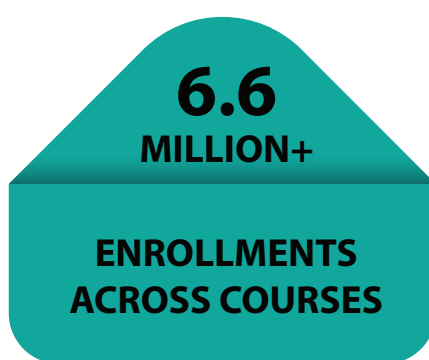
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## STATISTICS ON OPEN ONLINE COURSES FROM MARCH 2014 TILL APRIL 2019



### TRANSCRIPTION OF VIDEOS AND TRANSLATION OF THE TRANSCRIPTS

All videos are being transcribed in English and are also subtitled. As a pilot project, Translation of text transcripts into regional Indian languages is also being carried out so that language barrier does not stop any interested learner in participating in the e-learning process.

## NPTEL-SWAYAM LOCAL CHAPTERS (NPTEL.AC.IN/LOCALCHAPTER)

NPTEL partners with 2500+ colleges (Engineering / Management / Arts and Science / Polytechnic colleges) in the form of SWAYAM-NPTEL Local chapters. Each college has a coordinator with whom NPTEL works closely to encourage maximum participation of students as well as faculty. Local Chapters are rated in each semester based on performance, further motivating the colleges to participate in full rigour. To encourage more students across colleges to participate in NPTEL online certification courses, we motivate colleges to set up NPTEL-SWAYAM Local Chapter which also serves as a way for NPTEL to partner with them.

### NPTEL-SWAYAM LOCAL CHAPTER COLLEGES

**Growing at the rate of 5-8 LCs every week**



ANDAMAN & NICOBAR ISLANDS	01	MAHARASHTRA	501
ANDHRA PRADESH	212	MANIPUR	01
ARUNACHAL PRADESH	01	MEGHALAYA	02
ASSAM	08	MIZORAM	02
BIHAR	17	ODISHA	26
CHHATTISGARH	26	PONDICHERRY	14
DELHI	16	PUNJAB	41
GOA	09	RAJASTHAN	51
GUJARAT	93	SIKKIM	02
HARYANA	35	TAMIL NADU	429
HIMACHAL PRADESH	08	TELANGANA	143
JAMMU AND KASHMIR	13	TRIPURA	07
JHARKHAND	24	UTTAR PRADESH	368
KARNATAKA	153	UTTARAKHAND	30
KERALA	145	WEST BENGAL	122
DAMAN & DIU	02	KABUL(01), ETHIOPIA(02) UAE (01)	04
MADHYA PRADESH	79	GRAND TOTAL	2586



### NPTEL ONLINE CERTIFICATION COURSES FOR CREDIT TRANSFER

UGC and AICTE have approved that colleges can take these MOOC courses for credit in their Gazette notification of August 2016. These courses are being used by students to avail internship opportunities and prepare for the GATE exam too. About 15-20% of the total exam certified participants are faculty members from various colleges and hence these programmes are helping in faculty development and improvement. The advanced courses are recognized by AICTE as FDP.

NPTEL wishes to bring in an industry perspective to its technically rich courses. This led to the inception of NPTEL INDUSTRY ASSOCIATE (NIA). NPTEL aims to partner with organisations in a mutually beneficial manner by offering courses to train the freshers and to cross-skill and up-skill the existing workforce. NPTEL would act as a liaison between the Industries and Academia and expose learners to the current market trends, while connecting the Industries to the best skillset. CSR initiatives are also welcomed as part of this association.

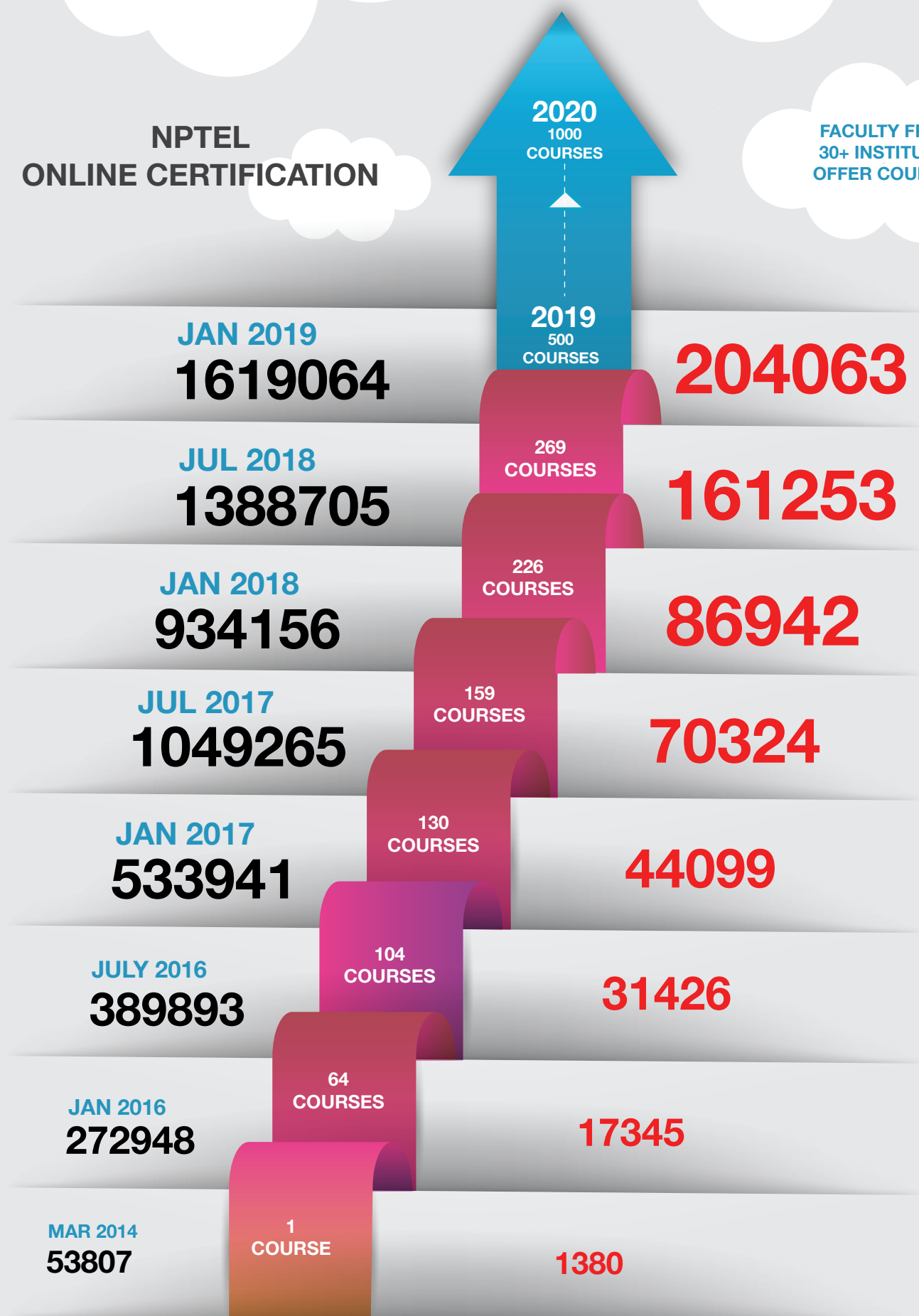
## INTERNSHIP

From 2018 summer onward, NPTEL has started offering internships to NOC exam toppers with the respective course instructors. Such internships will be offered twice a year.



**NPTEL  
ONLINE CERTIFICATION**

FACULTY FROM  
30+ INSTITUTES  
OFFER COURSES



■ ENROLLED

■ EXAM REGISTRATIONS

## AEROSPACE ENGINEERING

### 08 weeks

01. Design of fixed wing Unmanned Aerial Vehicles	3
02. Introduction to Ancient Indian Technology	4
03. Vibration and Structural Dynamics	5

### 12 weeks

01. Introduction to Rocket Propulsion	6
02. Introduction to Aerospace Engineering	7
03. Aircraft Stability And Control	8

## AGRICULTURAL & FOOD ENGINEERING

### 08 weeks

01. Organic Farming for Sustainable Agricultural Production	11
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### 12 weeks

01. Farm Machinery	12
02. Fundamentals of Food Process Engineering	13
03. Irrigation and Drainage	14
04. Dairy and Food Process and Products Technology	15
05. Thermal Operations in Food Process Engineering: Theory and Applications	16
06. Thermal Processing of Foods	17

## ARCHITECTURE

### 08 weeks

01. Architectural Acoustics	20
02. Disaster Recovery And Build Back Better	21
03. Culturally Responsive Built Environments	22
04. Contemporary Architecture and Design	23
05. Role of Craft and Technology in Interior - Architecture	24

## BIOTECHNOLOGY & BIOENGINEERING

### 04 weeks

01. Plant Developmental Biology	27
02. Functional Genomics	28
03. Biomicrofluidics	29
04. Biomedical nanotechnology	30

### 08 weeks

01. Bioenergy	31
02. Plant Cell Bioprocessing	32
03. Introduction to Biostatistics	33
04. Nanotechnology in Agriculture	34
05. Computer Aided Drug Design	35
06. Introduction To Proteomics	36
07. Introduction to Mechanobiology	37
08. WildLife Conservation	38
09. Tissue engineering	39

### 12 weeks

01. Genetic Engineering: Theory and Application	40
02. Industrial Biotechnology	41
03. Drug Delivery: Principles and Engineering	42
04. Introduction to Proteogenomics	43
05. Fundamentals of micro and nanofabrication	44
06. Principles Of Downstream Techniques In Bioprocess	45

## CHEMICAL ENGINEERING

### 04 weeks

01. Unit operations of particulate matter	48
02. Infrared Spectroscopy for Pollution Monitoring	49

### 08 weeks

01. Natural Gas Engineering	50
02. Phase Equilibrium Thermodynamics	51
03. Technologies For Clean And Renewable Energy Production	52

### 12 weeks

01. Chemical Engineering Thermodynamics	53
02. Chemical Process Intensification	54
03. Chemical Process Safety	55
04. Chemical Reaction Engineering-I	56
05. Flow through porous media	57
06. Fluid and Particle Mechanics	58
07. Heat Transfer	59
08. Continuum Mechanics and Transport Phenomena	60
09. Introduction to Polymer Physics	61
10. Fundamentals of Particle and Fluid Solid Processing	62
11. Mass Transfer Operations - II	63
12. Mechanical Unit Operations	64

## CHEMISTRY AND BIOCHEMISTRY

### 04 weeks

01. Bioinorganic Chemistry	67
02. Introductory Non-Linear Dynamics	68

### 08 weeks

01. Stereochemistry	69
02. Mechanisms in Organic Chemistry	70
03. Metals In Biology	71

### 12 weeks

01. Chemical Crystallography	72
02. Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries	73
03. Introductory Organic Chemistry I	74
04. Principles Of Organic Synthesis	75
05. Reagents In Organic Synthesis	76
06. Thermodynamics: classical to statistical	77
07. Ultrafast Optics and Spectroscopy	78
08. Analytical Chemistry	79
09. Coordination Chemistry	80
10. Quantum Computing	81
11. NMR spectroscopy for Chemists and Biologists	82
12. Biophysical chemistry	83
13. Organic Chemistry in Biology and Drug Development	84

## CIVIL ENGINEERING

### 04 weeks

01. Reinforced Concrete Road Bridges	87
02. Scheduling Techniques in Projects	88
03. Structural Dynamics for Civil Engineers – SDOF systems	89
04. Geosynthetics Testing Laboratory	90
05. Geotechnical Engineering Laboratory	91
06. GPS Surveying	92
07. Global Navigation Satellite Systems And Applications	93

### 08 weeks

01. Fluid Mechanics	94
02. Principles of Construction Management	95
03. Project Planning & Control	96
04. Matrix Method of Structural Analysis	97
05. Photogeology in Terrain Evaluation (Part-1 and 2)	98
06. Remote Sensing and Digital Image Processing of Satellite Data	99
07. Remote Sensing and GIS	100
08. Geomorphic Processes: Landforms and Landscapes	101

### 12 weeks

01. Strength of Materials	102
02. Foundation Engineering	103
03. Concrete Technology	104
04. Design of Masonry Structures	105
05. Design of Reinforced Concrete Structures	106
06. Design of steel structures	107
07. Structural analysis-I	108
08. Integrated Waste Management for a Smart City	109
09. Wastewater Treatment and Recycling	110



10. Environmental Geotechnics	111	<b>08 weeks</b>	
11. Sustainable Materials and Green Buildings	112	01. Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink	169
12. Glass In Buildings : Design And Applications	113	02. Principles of Communication Systems - Part II	170
13. Glass Processing Technology	114	03. Principles of Modern CDMA/ MIMO/ OFDM Wireless Communications	171
14. Advanced Concrete Technology	115	04. Digital Switching - I	172
15. Structural Geology	116	05. Electrical Distribution System Analysis	173
<b>COMPUTER SCIENCE &amp; ENGINEERING</b>		06. Dc Microgrid	174
<b>04 weeks</b>		07. Introduction to Smart Grid	175
01. C Programming and Assembly Language	119	08. Fundamentals of Electric Drives	176
02. Introduction to parallel Programming in Open MP	120	<b>12 weeks</b>	
03. Python for Data Science	121	01. Mapping Signal Processing Algorithms to DSP Architectures	177
04. Demystifying networking	122	02. Introduction to Computer Vision	178
<b>08 weeks</b>		03. Fundamentals of Electrical Engineering	179
01. Programming in C++	123	04. Basic Electric Circuits	180
02. Programming, Data Structures And Algorithms Using Python	124	05. Power Electronics	181
03. Introduction to Programming in C	125	06. Analog Electronic Circuit	182
04. Data Base Management System	126	07. Op-Amp Practical Applications: Design, Simulation & Implementation	183
05. Design and analysis of algorithms	127	08. Fabrication Techniques for MEMs- based sensors: clinical Perspective	184
06. Object oriented analysis and design	128	09. Sensors and Actuators	185
07. Introduction to Operating Systems	129	10. Control engineering	186
08. Introduction to Machine Learning	130	11. Linear System Theory	187
09. Data Science for Engineers	131	12. Electrical Measurement and Electronic Instruments	188
10. Scalable Data Science	132	13. Analog Communication	189
11. Advanced Computer Architecture	133	14. Introduction to Wireless and Cellular Communications	190
12. Cloud Computing	134	15. Digital Signal Processing	191
13. Hardware modeling using verilog	135	16. Digital Circuits	192
14. Spatial Informatics	136	17. Neural Networks for Signal Processing – I	193
15. Modern Algebra	137	18. Microelectronics: Devices To Circuits	194
16. Theory of Computation	138	19. Digital Image Processing	195
17. Introduction To Haskell Programming	139	20. Pattern Recognition and Application	196
18. Practical Machine Learning with Tensorflow01	140	21. Microwave Theory and Techniques	197
19. Human Computer Interactions	141	22. Principles and Techniques of Modern Radar Systems	198
<b>12 weeks</b>		23. Computational Electromagnetics	199
1. An Introduction To Programming Through C++	142	24. Electrical Machines - I	200
2. The Joy of Computing using Python	143	25. Power System Analysis	201
3. Problem Solving through Programming in C	144	26. Fiber-Optic Communication Systems and Techniques	202
4. Discrete Mathematics	145	27. Microwave Engineering	203
5. Operating System Fundamentals	146	28. Electrical Machines	204
6. Introduction to Machine Learning	147	<b>HUMANITIES &amp; SOCIAL SCIENCES</b>	
7. Deep Learning	148	<b>04 weeks</b>	
8. Reinforcement Learning	149	01. Body language: Key to professional Success	207
9. Natural Language Processing	150	02. Artistic Exploration in Scientific Research And Technology	208
10. Applied Natural Language Processing	151	03. Population Studies	209
11. Computer Vision	152	04. Inclusion and Technology Design	210
12. Blockchain Architecture Design and Use Cases	153	05. Water, Society and Sustainability	211
13. Introduction to Internet of Things	154	06. Psychology of Everyday	212
14. Social Networks	155	07. The Victorian Gothic Short Story	213
15. Discrete Mathematics	156	08. Cognition, Transformation and Lives	214
16. Ethical Hacking	157	09. Gender Justice and Workplace Security	215
17. Software Engineering	158	10. Visual Perception and Art: A Survey Across the Cultures	216
18. Software Project Management	159	11. Patent Drafting For Beginners	217
19. Software testing	160	<b>08 weeks</b>	
20. Synthesis of Digital Systems	161	01. Technical english for engineers	218
21. Switching Circuits and Logic Design	162	02. Interpersonal Skills	219
22. Machine Learning for Engineering and Science Applications	163	03. Developing Soft Skills and Personality	220
23. Artificial Intelligence Search Methods For Problem Solving	164	04. Ethics in Engineering Practice	221
24. Programming In Java	165	05. Energy Economics And Policy	222
25. Deep Learning – Part 1	166	06. The Psychology Of Language	223
<b>ELECTRICAL ENGINEERING</b>		07. Intermediate Level of Spoken Sanskrit	224
		08. Disability Studies: an introduction	225
		09. Development Research Methods	226
		10. Folk And Minor Art In India	227

11. Positive Psychology	228	<b>12 weeks</b>	
12. Consumer Psychology	229	01. Integral Transforms And Their Applications	286
<b>12 weeks</b>		02. Higher Engineering Mathematics	287
01. Soft skills	230	03. Mathematical Finance	288
02. Appreciating Linguistics: A typological approach	231	04. Stochastic Processes	289
03. Applied Linguistics	232	05. Introduction to Fuzzy Set Theory, Arithmetic and Logic	290
04. History of English Language and Literature	233	06. Regression Analysis	291
05. Introduction to Japanese Language and Culture	234	07. Introduction to Methods of Applied Mathematics	292
06. Indian Fiction in English	235	<b>MECHANICAL ENGINEERING</b>	
07. Short Fiction in Indian Literature	236	<b>04 weeks</b>	
08. German - II	237	01. Product Design Using Value Engineering	295
09. German-I	238	02. A short lecture series on contour integration in the complex plane	296
10. Text, Textuality and Digital Media	239	03. Two-Phase flow with phase change in conventional	297
11. Introduction to Film studies	240	& miniature channels	
12. Patent Law For Engineers And Scientists	241	04. Computer numerical control CNC of machine tools and processes	298
<b>MANAGEMENT</b>		05. Smart Materials and Intelligent System Design	399
<b>04 weeks</b>		06. Selection Of Nanomaterials for Energy Harvesting & Storage applications	300
01. Leadership	244	07. Manufacturing Automation	301
02. Cost Accounting	245	<b>08 weeks</b>	
03. Decision-Making Under Uncertainty	246	01. Manufacturing of Composites	302
04. Business Analytics & Data Mining Modeling Using R Part II	247	02. Robotics	303
05. Design Thinking - A Primer	248	03. Design for Quality, Manufacturing and Assembly	304
<b>08 weeks</b>		04. Refrigeration and air-conditioning	305
01. Project Management	249	05. Principles of Metal Forming Technology	306
02. Marketing research and analysis	250	06. Fluid Machines	307
03. Practitioners Course In Descriptive,Predictive & Prescriptive Analytics	251	07. Design Practice	308
04. Corporate Social Responsibility	252	08. Steam Power Engineering	309
05. The Ethical Corporation	253	<b>12 weeks</b>	
06. Financial Accounting	254	01. Engineering Fracture Mechanics	310
07. Decision making using financial accounting	255	02. Fundamentals of manufacturing processes	311
08. Economics of Health and Health Care	256	03. Manufacturing Systems Technology	312
09. Innovation, Business Models and Entrepreneurship	257	04. Work System Design	313
10. Marketing Management-I	258	05. Concepts of Thermodynamics	314
11. Knowledge Management	259	06. Energy Conservation and Waste Heat Recovery	315
12. Toyota Production System	260	07. Heat Exchangers: Fundamentals and Design Analysis	316
13. Educational Leadership	261	08. Fundamentals of Surface Engineering: Mechanisms,	317
14. Intellectual Property Rights and Competition Law	262	Processes and Characterizations	
15. Patent Search for Engineers and Lawyers	263	09. Engineering Metrology	318
16. Business Analytics & Text Mining Modeling Using Python	264	10. Noise Management and Control	319
<b>12 weeks</b>		11. Convective Heat Transfer	320
01. Project management for managers	265	12. Fundamentals of Gas Dynamics	321
02. Training Of Trainers Or Managerial Skills For Interpersonal Dynamics	266	13. Industrial Safety Engineering	322
03. Management Accounting	267	14. Advanced Concepts in Fluid Mechanics	323
04. Financial Derivatives & Risk Management	268	15. Applied Thermodynamics For Engineers	324
05. Working Capital Management	269	16. Dynamic Behaviour Of Materials	325
06. Data Analysis & Decision Making - III	270	17. Engineering Mechanics	326
07. Human Resource Development	271	18. Fundamentals Of Artificial Intelligence	327
08. Performance and Reward Management	272	19. Fundamentals of Conduction and Radiation	328
09. E-Business	273	20. Plastic Working Of Metallic Materials	329
<b>MATHEMATICS</b>		21. Turbulent Combustion: Theory and Modelling	330
<b>04 weeks</b>		22. Mathematical Modeling Of Manufacturing Processes	331
01. Mathematical Methods for Boundary Value Problems	276	23. Aircraft Propulsion	332
<b>08 weeks</b>		24. Solid Mechanics	333
01. Calculus of One Real Variable	277	<b>METALLURGICAL AND MATERIALS ENGINEERING</b>	
02. Calculus of Several Real Variables	278	<b>04 weeks</b>	
03. Numerical methods	279	01. Fundamentals of electronic device fabrication	336
04. Introduction to Abstract and Linear Algebra	280	02. Welding of Advanced High Strength Steels for	337
05. Introduction to Abstract Group Theory	281	Automotive Applications	
06. Introduction To Rings And Fields	282	03. Structural Analysis of Nanomaterials	338
07. Matrix Analysis with Applications	283	<b>08 weeks</b>	
08. Operations Research	284	01. Biomaterials for bone tissue engineering applications	339
09. Introduction to R Software	285	02. Corrosion - Part II	340
		03. Thermo-Mechanical And Thermo-Chemical Processes	341

04. Fundamentals and Applications of Dielectric Ceramics	342
05. An Introduction to Materials: Nature and Properties (Part 1: Structure of Materials)	343
06. Nanotechnology, Science and Applications	344
<b>12 weeks</b>	
01. Advanced Materials and Processes	345
02. Physics of Materials	346
03. Transport Phenomena In Materials	347
04. Welding Metallurgy	348

## MULTIDISCIPLINARY

### 04 weeks

01. Teaching And Learning in General Programs: TALG	351
02. Designing Learner-Centric MOOCs	352
03. Introduction To Learning Analytics	353
04. Stress Management	354
05. Designing learner-centric E-learning in STEM disciplines	355
06. Sustainable and Affordable Sanitation Solutions For Small Towns: Policy, Planning and Practice	356
07. Biology for engineers and other non-biologists	357
08. Ergonomics In Automotive Design	358
09. Ergonomics Workplace Analysis	359

### 08 weeks

01. TALE 2: Course Design and Instruction of Engineering Course	360
02. Accreditation and Outcome based Learning	361
03. Introduction to Research	362
04. Ecology and Environment	363
05. Manage TB	364
06. Game Theory	365
07. Health Research Fundamentals	366

### 12 weeks

01. Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	367 368
02. Neuroscience of Human Movements	
03. Numerical Methods for Engineers	369
04. System Design for Sustainability	370
05. Control systems	371

## OCEAN ENGINEERING

01. HSE Practices for Offshore and Petroleum Industries	374
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## PHYSICS

### 08 weeks

01. Introduction to Electromagnetic Theory	377
02. Introduction To Statistical Mechanics	378
03. Numerical Methods And Simulation Techniques For Scientists & Engineers	379
04. Theoretical Mechanics	380
05. Solar Photovoltaics Fundamentals, Technology And Applications	381
06. Path Integral and functional methods in Quantum Field theory	382

### 12 weeks

01. Experimental Physics - II	383
02. Physics of Turbulence	384
03. Solid State Physics	385
04. Computational Physics	386
05. Waves and Oscillations	387

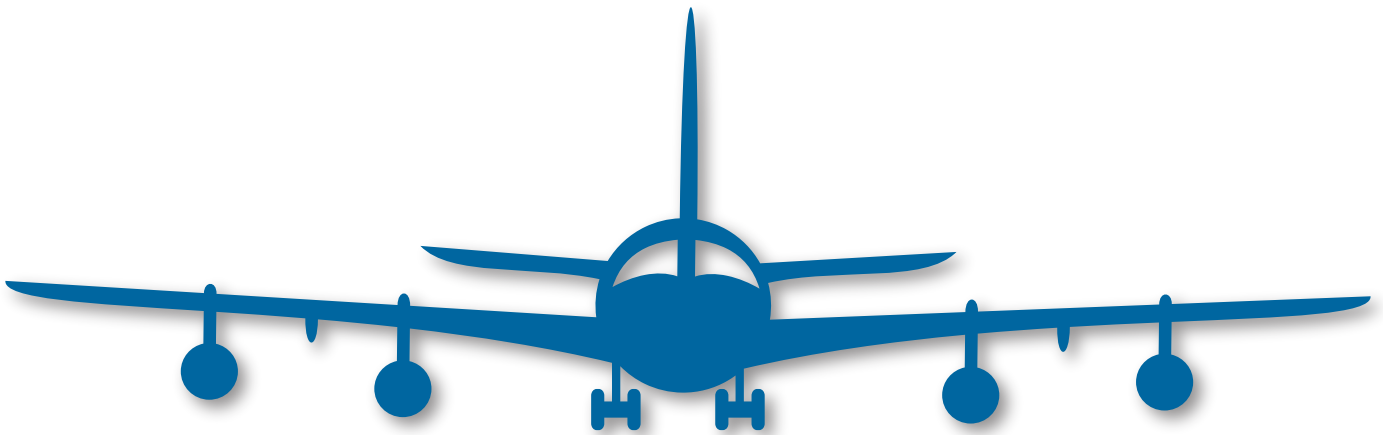
## TEXTILE TECHNOLOGY

### 08 weeks

01. Yarn manufacture I : Principle of Carding and Drawing	390
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### 12 weeks

01. Science of Clothing Comfort	391
02. Science and Technology of Weft and Warp Knitting	392
03. Textile Finishing	393
04. Principles of Combing, Roving preparation & Ring spinning	394



# AEROSPACE ENGINEERING



# AEROSPACE ENGINEERING

## **8 weeks**

- 01. Design of fixed wing Unmanned Aerial Vehicles
- 02. Introduction to Ancient Indian Technology
- 03. Vibration and Structural Dynamics

## **12 weeks**

- 01. Introduction to Rocket Propulsion
- 02. Introduction to Aerospace Engineering
- 03. Aircraft Stability And Control





# DESIGN OF FIXED WING UNMANNED AERIAL VEHICLES

**PROF. SADERLA SUBRAHMANYAM**

Department of Aerospace Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : B.E/B.Tech, M.E/M.Tech, Ph.D

**INTENDED AUDIENCE** : Introduction to Aerodynamics

**INDUSTRIES APPLICABLE TO** : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

## COURSE OUTLINE :

This course introduces the initial designing and sizing process for rapidly growing fixed – wing UAV technology, integrated with its performance and stability analysis and prototype testing.

## ABOUT INSTRUCTOR :

Dr. Subrahmanyam Saderla obtained his B.Tech (Aeronautical Engineering) from JNTU, Hyderabad in 2008, M.Tech and Ph.D (Aerospace Engineering) from IIT Kanpur during 2010 and 2015 respectively. Later he joined as a postdoctoral fellow in the department of aerospace and software engineering at Gyeongsang National University (GNU), South Korea. At present he is working as an Assistant Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. His current area of interest lies in real time system identification of unmanned aerial vehicles. His research interests also include design, flight tests and parameter estimation, high angle of attack aerodynamic modelling and dynamic wind tunnel testing as well as experimental flight dynamics, chaotic modelling (of cancer cell growth, seismic data & material properties etc.) using Artificial Neural Networks.

## COURSE PLAN :

**Week 01** : Introduction to fixed-wing UAVs, Introduction to Design, Basic Design Parameters.

**Week 02** : Basic Design Parameters contd., Design Algorithm: Case Study, Design Algorithm: Mission Requirements.

**Week 03** : Design Algorithm: Feasible Design Parameters, Configuration Layout: Airfoil Selection Configuration Layout: Planform Geometry selection

**Week 04** : Weight and CG Estimation Analytical Parameter Estimation Analytical Parameter Estimation contd.

**Week 05** : Performance and Stability Analysis Performance and Stability Analysis contd. Performance and Stability Analysis contd.

**Week 06** : Simulation, Detailed Sizing

**Week 07** : Estimation of inertial properties using 3D modelling, Prototype Fabrication

**Week 08** : Wind Tunnel Testing, Aerodynamic Characterization through Wind Tunnel Testing



# INTRODUCTION TO ANCIENT INDIAN TECHNOLOGY

**PROF. D.P. MISHRA**

Department of Aerospace Engineering  
IIT Kanpur

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**PRE-REQUISITES** : Open to All

**COURSE OUTLINE :**

This course is designed for undergraduate students, interested in learning about the ancient Indian Technology which is the hallmark of glorious Indian civilization, only living civilization of the world that exists till today. The main emphasis is placed on nature centric aspects of ancient Indian technologies that can be adopted in modern time. As this is an introductory course, care has been taken to present the materials in a gradual manner to instill confidence in the minds of the students. Attempts have been made to keep the deliberation as simple as possible with intriguing questions so that students can take exploratory route to learn more about it in future. Adequate emphasis is given in this course for exposing the students to ancient science and technologies which can be adopted for modern technological development. The tenets of various technologies which are essential for human living are discussed in details to encourage the students to develop a feel for ancient Indian and technologies.

**ABOUT INSTRUCTOR :**

Prof . D.P. Mishra is a professor in the Department of Aerospace Engineering at Indian Institute of Technology (IIT) Kanpur, India where he was instrumental in establishing a combustion laboratory. He currently holds the Indian Oil Golden Jubilee Professional Chair in IIT Kanpur. He was a Visiting Professor in 2002 at the Tokyo-Denki University, Japan. His areas of research interest include combustion, computational fluid dynamics, atomization, etc. He is the recipient of the Young Scientist Award in 1991 from the Ministry of New and Renewable Energy, Government of India. He was conferred the INSA-JSPS Fellowship in 2002. In recognition of his research, Dr. Mishra received Sir Rajendranath Mookerjee Memorial Award from the Institution of Engineers (India). Dr. Mishra is a recipient of the Samanta Chadrasekhar Award for his contributions to science and technology. For technological contribution for the common people, he has been conferred with the Vikash Prerak Sanman in 2010. Currently he is serving as an Assistant Editor, International Journal of Hydrogen Energy, Elsevier, USA. Besides this, he also serves as an editorial board member of Journal of the Chinese Institute of Engineers, Taylor & Francis, and International Journal of Turbo and Jet engines. Dr. Mishra has six Indian patents and around 200 research papers in refereed Journals and in conference proceedings to his credit. He has authored a textbook titled "Fundamentals of Combustion", published by Prentice Hall of India, New Delhi. Two other text books on "Experimental Combustion" and "Engineering Thermodynamics" have been published by Taylor and Francis, USA and Cengage India Pvt Ltd., New Delhi, respectively. He has published a text book titled as "Gas turbine propulsion" (MV Learning, New Delhi/London). He is also serving as a managing trustee of the International Foundation of Humanistic Education.

**COURSE PLAN :**

- Week 1** : Introduction: Why are ancient Indian science and technology relevant today? What is science? How is it different from technology?
- Week 2** : Philosophy of ancient Indian technology, how is different from modern technology? Ancient Indian Scientific methods.
- Week 3** : Glimpses of ancient Indian science and technology?
- Week 4** : Material Technology : Mining, Metals and Metallurgy, Iron Making and craftsmanship, Wootz Steel Technology
- Week 5** : Extraction of Zinc in ancient India, Glass making, Bead making Techniques, Ceramic Technology
- Week 6** : Water Harvesting Technology, Irrigation Systems
- Week 7** : Town planning, Building construction, Sanitation
- Week 8** : Agriculture and Textile Technology



# VIBRATION AND STRUCTURAL DYNAMICS

**PROF. MIRA MITRA**

Department of Aerospace Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Engineering Mechanics

**INTENDED AUDIENCE** : Aerospace Engineering, Civil Engineering, Mechanical Engineering

**INDUSTRIES APPLICABLE TO** : Automobile, Aerospace, Infrastructure, Wind Turbine Industries

**COURSE OUTLINE :**

The course aims at imparting fundamentals of vibration and structural dynamics to senior undergraduate and graduate students. The course primarily consists of four modules, namely, single degree of freedom, multi-degree of freedom, continuous system, and analytical methods. The objective of the course is to deliver problem solving capabilities, both for industrial problems and academic research. The course will start from basics of vibrations and gradually deal with more complex problems.

**ABOUT INSTRUCTOR :**

Prof. Mira Mitra is currently Associate Professor in the Department of Aerospace Engineering, IIT Kharagpur. Prior to joining IIT Kharagpur, she was a faculty member in the Department of Aerospace Engineering, IIT Bombay, between 2007 to 2016. She obtained her PhD and Masters from IISc, Bangalore, both in Aerospace Engineering. She has authored more than 50 papers in International Journals and conferences. She is the recipient of INAE Young Engineering Award, DST-SERB Women Excellence Award, and IIT Bombay Hotch and Lala Excellence in Teaching Award.

**COURSE PLAN :**

**Week 1:** Introduction, Equation of motion, Single-Degree of Freedom (SDOF), Undamped and Damped, free vibration of SDOF

**Week 2:** Examples on free vibration, forced vibration, harmonic loading, Examples on harmonic Loading

**Week 3:** Response to arbitrary loading: Duhamel's integral, Impulse Loading

**Week 4:** Multi-degree of freedom (MDOF), Normal modes of vibration, natural frequencies and mode shapes

**Week 5:** Modal Superposition Theorem, Examples on MDOF

**Week 6:** Continuous system, Axial vibration in Rod, Natural frequencies & Mode Shapes, forced vibration of rods

**Week 7:** Flexural vibration in beam, natural frequencies and mode shapes, forced vibration of beams

**Week 8:** Hamilton's principle, euler-lagrange equation



# INTRODUCTION TO ROCKET PROPULSION

**PROF. D. P. MISHRA**

Department of Aerospace Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Core&Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18th Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : +2 Science

## **COURSE OUTLINE :**

This is an introductory course on rocket propulsion. The objective of this course is to impart knowledge about rocket propulsion to both UG and PG students. In this course, fundamentals aspects of rocket propulsion namely Solid, Liquid and Hydride rocket engines are to be covered extensively. Besides this, performance of rocket engine and heat transfer aspects of various components are to be covered briefly.

## **ABOUT INSTRUCTOR :**

Prof. Debi Prasad Mishra is a Professor in the Department of Aerospace Engineering at Indian Institute of Technology (IIT) Kanpur, India. His areas of research interest include combustion, computational fluid dynamics, atomization, etc. He was conferred with the Indian Oil Golden Jubilee Professional Chair in IIT Kanpur. He has authored five textbooks and has delivered several lectures on ancient Indian Science and Technology and culture and tradition to more than 45, 000 students across India.

## **COURSE PLAN :**

**Week 1:** Introduction, Types of Rocket Engines, Applications of Rocket Engines

**Week 2:** Aerothermodynamics of Rocket Engines, Fundamentals of Aerodynamics, Elements of thermodynamics

**Week 3:** Combustion, Ideal Rocket Engine

**Week 4:** Thrust Equation, Rocket Engine parameters, Rocket Engine Nozzles

**Week 5:** Space Flight Performance, Rocket Propellant

**Week 6:** Introduction to Solid Propellant Rocket Engine, Components of SPRE, Regression rate relation

**Week 7:** Liquid Propellant Rocket Engine, Injector, Feed system

**Week 8:** Hybrid rocket Engine, Rocket Heat transfer

**Week 9:** Liquid Propellant Rocket Engine, Types of liquid rocket engines, Combustion of liquid propellant

**Week 10:** Combustion Chamber Geometry, Types of liquid rocket engines, Injectors, Feed system

**Week 11:** Combustion Instability, Ignition System, Hybrid rocket Engine

**Week 12:** Rocket Heat transfer, Types of Cooling System



# INTRODUCTION TO AEROSPACE ENGINEERING

**PROF. RAJKUMAR PANT**

Department of Aerospace Engineering  
IIT Bombay

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Any discipline of Engineering

**INDUSTRIES APPLICABLE TO** : DRDO, HAL, NAL, IAF

**COURSE OUTLINE :**

The aim of this course is to provide a general overview of the field of Aeronautical Engineering to interested students. Each Lecture will cover a specific concept or area relevant to the subject. An attempt will be made to cover the contents in an interesting manner, by a judicious use of a mix of powerpoint presentations, in-class activities, quizzes, innovative and hands on assignments that will not only increase the awareness of the students, but also satiate their curiosity and desire to know more about the various concepts related to the subject.

**ABOUT INSTRUCTOR :**

Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, IIT Madras where he did his Masters in Aeronautical Engineering, and PEC Chandigarh where he underwent his undergraduate studies in Aeronautical Engineering. He has also worked for five years in Hindustan Aeronautics Limited, in the Design and Engineering Department. He has published and presented 220 scientific papers, of which 170 are in international journals and conferences.

**COURSE PLAN :**

**Week 1** : Nomenclature of aircraft components & Atmosphere and its properties

**Week 2** : Fluid Mechanics – I : Streamlines + Steady flow + Incompressible flow

**Week 3** : Fluid Mechanics – II : Bernoulli's Equation + Coanda Effect + Mach No.

**Week 4** : Aerodynamics – I : Airfoils, and Lift generation Theories

**Week 5** : Aerodynamics – II : Critical Mach no., Wave Drag, Swept wings, Finite Wings, Induced Drag

**Week 6** : Propulsion & Structures : Types of Propulsive systems, V-n Diagram

**Week 7** : Aircraft Performance - I : Steady Level Flight and Altitude effects

**Week 8** : Aircraft Performance- II : Ceilings, Steady Climbing Flight, Sustained Level Turn, Pull up Maneuver

**Week 9** : Aircraft Performance- III : Range and Endurance, Takeoff and Landing

**Week 10** : Aircraft Stability and Control : Longitudinal Static Stability, Control Systems and Neutral Point

**Week 11** : Airports : Planning & Design of Airports, ILS system

**Week 12** : Aircraft Operations : Introduction to Air Traffic management





# AIRCRAFT STABILITY AND CONTROL

**PROF. A.K. GHOSH**

Department of Aerospace Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Core course for UG students

**INDUSTRIES APPLICABLE TO** : NAL Bangalore, ARDE Pune, ADE Bangalore, ADA Bangalore

## COURSE OUTLINE :

This course is designed to understand stability and control aspects of an airplane. This course will also help in creating a background to design an airplane from stability and control aspects

## ABOUT INSTRUCTOR :

Prof. A.K. Ghosh is a faculty of Aerospace Engg. Department of IIT Kanpur. He is also the in-charge of the flight laboratory and unmanned aerial vehicle of IIT Kanpur. His research areas include system identification through flight tests using conventional and neural network based methods, design of aircrafts and airborne projectiles, supercavitation, unmanned aerial systems. Before joining IIT Kanpur, he worked as a scientist with Defense Research Development Organization (DRDO). He has published many peer reviewed journal papers and conference papers, guided 13 doctoral students, and 38 masters students. He is also a mentor of multiple aerospace start-up companies, and also been associated with major industry contributions of high speed low drag aircraft bomb, Pinaka Mk-I, 105mm sabot round for tracked vehicles, etc.

## COURSE PLAN :

**Week 1:** Overview of aerodynamics and atmosphere; Wing stall and maximum lift coefficient.; Wing aerodynamic center & pitching moment.; Introduction to static and dynamic stability.; Revision.

**Week 2:** Introduction to static and dynamic stability.; Wing contribution.; Tail contribution.; Canard and fuselage contribution.; Revision.

**Week 3:** Power plant contribution & its effect on NP.; Stick fixed neutral point.; Static margin.; Stick fixed : maneuvering point.; Revision.

**Week 4:** Elevator effectiveness, Elevator angle of trim.; Flight measurement of  $X_{np}$ ; Elevator hinge moment. Stick forces (trim tab & stick force gradient); Revision.

**Week 5:** Stick free neutral point.; Stick free : maneuvering point.; Roll stability and roll control.; Yaw stability and yaw control.; Revision.

**Week 6:** Newton's second law of rigid dynamics.; Axes system and relevant transforms.; Angular motion equations. Angular motion equations.; Revision.

**Week 7:** Aerodynamic forces.; Gravitational and thrust forces.; Linearized equations of motion.; Linearized equations of motion: contd.; Revision.

**Week 8:** Force and moment derivatives.; Force and moment derivatives.; Contribution of aircraft components to aerodynamic derivatives.; Linear model.; Revision

**Week 9:** Short period approximation.; Long period approximation.; Pure pitching motion.; Flying and handling qualities.; Revision

**Week 10:** Linearized lateral dynamics.; Lateral motion : Linearized coupled motion.; Roll approximation.; Spiral approximation.; Revision

**Week 11:** Dutch roll approximation.; Pure rolling.; Pure yawing.; Inertia coupling.; Revision

**Week 12:** Stability augmentation system: Longitudinal.; Stability augmentation system: Longitudinal.; Stability augmentation system: Lateral.; Stability augmentation system: Lateral.; Revision



# **AGRICULTURE AND FOOD ENGINEERING**



# AGRICULTURAL ENGINEERING

## 8 weeks

01. Organic Farming for Sustainable Agricultural Production

## 12 weeks

1. Farm Machinery
2. Fundamentals of Food Process Engineering
3. Irrigation and Drainage
4. Dairy and Food Process and Products Technology
5. Thermal Operations in Food Process Engineering: Theory and Applications
6. Thermal Processing of Foods



# ORGANIC FARMING FOR SUSTAINABLE AGRICULTURAL PRODUCTION

**PROF. DILIP KUMAR SWAIN**

Department of Agricultural and Food Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.Sc

## COURSE OUTLINE :

Organic farming is an integrated system of agricultural production based on ecological principles, promotion of biodiversity, biological cycles and organic matter recycling to maintain and improve soil fertility and environmental sustainability. The regulations for organic crop cultivation prohibit the use of chemo-synthetic pesticides, mineral fertilizers, growth promoters and Genetically Modified Organism. Indiscriminate use of these chemicals in conventional farming poses a serious threat to the quality of produce as well as the environment. Concern about food safety and security and environmental sustainability is increasing among scientist, administrator and environmentalist. In view of this, the course is designed to train students on organic farming practices, quality analysis of the products, environmental impact assessment, health benefit of the organic food etc. After successful completion of the course, the students should be able to design resource efficient farming system for small and marginal farmers for improving their economy while meeting the quality food demand in a sustainable environment.

## ABOUT INSTRUCTOR :

Dr. Dillip Kumar Swain completed his Doctoral Degree from Indian Institute of Technology Kharagpur, India, which received the Fertilizer Association of India Silver Jubilee Award in 2003 for the outstanding doctoral research in Fertilizer Usage. Before joining this Institute, Dr. Swain worked as Post-Doctoral Fellow at the United Nations University, Tokyo, Japan, availing Japan Society for the Promotion Science Fellowship. Dr. Swain teaches the subjects: Systems Approach in Agriculture, Soil-Plant-Water Relationships, Crop Production Systems, and Organic Food Chain Management for undergraduate and postgraduate students in Agricultural and Food Engineering. The research areas of Dr. Swain are Climate Change Adaptations/Mitigations for Crop Production, Organic Farming and Sustainable Agricultural Production, and Crop Modeling and Simulation. He is working on assessment of climate change impacts on food grain production of India and evaluation of adaptations through environmental controlled experiment and simulation analysis. Dr. Swain is also involved in outreach activities through demonstration of food production technologies in farmers' field. Dr. Swain is actively involved in guiding M.Tech. and PhD research projects.

## COURSE PLAN :

- Week 01** : Organic Farming: Concepts and principles of organic farming.
- Week 02** : Key indicators of sustainable agriculture, organic farming and climate change
- Week 03** : Input management; compost production, vermicomposting, Compost quality, Compost utilization and marketing.
- Week 04** : Organic crop management: field crops, horticulture and plantation crops.
- Week 05** : Plant protection measures, biopesticides, natural predators, cultural practice.
- Week 06** : Rotation design for organic system, Transition to organic agriculture, farming system.
- Week 07** : Quality analysis of organic foods, Antioxidants and their natural source, organic food and human health.
- Week 08** : Standards of organic food and marketing.



# FARM MACHINERY

**PROF. V.K. TEWARI**

Department of Agricultural and Food Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : B.E/B.Tech, B.Sc

**INTENDED AUDIENCE** : Students of 3rd yrs B.Tech./BE (Agricultural Engineering) or 4th yrs. B.Sc, Agricultural courses of Agricultural Universities.

**INDUSTRIES APPLICABLE TO** : Tractor companies like, M&M Ltd. TAFE Ltd., Escorts Ltd., Eicher Ltd., Punjab Tractors Ltd. and several Farm Machinery Manufacturers in the country.

**COURSE OUTLINE :**

The course on Farm Machinery is designed for undergraduate students of Agricultural Engineering, Practicing Engineers, Machinery Manufacturers and Research Scientists. The contents comprises of basic principles and the use of modern technology, viz, Image Processing, Microcontrollers, Sensors and Embedded Systems. Design of horticultural machines and equipment are specially included considering the need of the hour. Suitable examples in the form of problems and their solutions are included for the students to get clarity about the various concepts discussed on each topic. Use of machines Custom hiring and mechanization of small farms are also discussed under each level of mechanization for the readership to appreciate the importance of the machines used.

**ABOUT INSTRUCTOR :**

Prof. V.K. Tewari, B.Tech.(Hons.), M.Tech. (FMP) and Ph.D(Engg.) has been in the IIT system as a student and faculty. He has been teaching Farm Machinery Design, Farm Power, Engineering Ergonomics, Precision Agriculture at UG/PG levels in IIT, Kharagpur for the last 35 yrs. He was IIT JEE Chairman (2003-2006) He has served as Head of the Agricultural & Food Engineering Department and Rural Development Centre IIT, Kharagpur. He is a long standing member of American Society of Agricultural and Biological Engineers, USA.

**COURSE PLAN :**

- Week 01** : Importance of farm machines in the contest of enhance production, multiple cropping, labour scarcity etc.
- Week 02** : Ploughing and first opening of the soil, the design and component details.
- Week 03** : Machinery of seedbed preparation operation.
- Week 04** : Equipment for sowing and planting and inter cultivation.
- Week 05** : Variable Rate Fertilizer Applicator, Microprocessor Based Herbicide Applicator, Spraying etc.
- Week 06** : Equipment for irrigation
- Week 07** : Machinery for crop harvesting design and operation
- Week 08** : Root crop harvesting machinery
- Week 09** : Machinery for horticultural crops
- Week 10** : Equipment for crop protection and disease control
- Week 11** : Machinery for transport and material handling
- Week 12** : Machinery for land drainage, reclamation and estate maintenance





# FUNDAMENTALS OF FOOD PROCESS ENGINEERING

**PROF. JAYEETA MITRA**

Department of Agricultural and Food Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**INDUSTRIES APPLICABLE TO** : Any Industry deals with food processing such as Hindustan Lever, ITC, Britannia, PepsiCo, Amul etc.

## COURSE OUTLINE :

Food Process engineering has become an important branch of applied engineering. Since post harvest processing is gaining impetus in our country, concepts of basic food structures and their processing are essential. Enormity of foods with their diverse as well as specific unique characteristics demands special processing treatments. At the same time being biological commodities, their processing needs to meet the safety requirements as well. This course has been designed to impart the fundamental concepts of Food rheology, as well as thermal/non-thermal processing of foods. Drying being the most common technique followed for food preservation, a detailed discussion on drying has been incorporated. Food freezing has been covered and finally few important unit operations of food engineering are discussed. A glimpse of non-thermal processing (High pressure processing, Pulsed electric field etc.) has also been included in the courses.

## ABOUT INSTRUCTOR :

Dr. Jayeeta Mitra is working as Assistant Professor in AGFE Dept., IIT Kharagpur Since 2014. Prior to this, she has worked as Assistant Professor in Centre of Food Science and Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi and Food Process Engineering Department, National Institute of Technology Rourkela. She has studied B Tech in Agril. Engg from BCKV, Mohanpur; Masters in Process and Food Engineering Pantnagar, Uttarakhand and obtained her Ph.D from IIT Kharagpur. She has worked in drying for few years. She is currently working on Food Processing, Packaging and storage. She is member of AFST (I), ISAE and ASABE. She is the Associate Editor of the Journal JPTR, Springer.

## COURSE PLAN :

- Week 01** : Concept of Food Rheology and its Measurements
- Week 02** : Viscoelastic foods
- Week 03** : Thermal processing and microbial death kinetics
- Week 04** : Evaporation and concentration
- Week 05** : Heat Exchangers
- Week 06** : Drying Technology
- Week 07** : Freezing and Freeze Drying
- Week 08** : Size Reduction
- Week 09** : Separation Techniques
- Week 10** : Mixing and agitation
- Week 11** : Leaching and Extraction
- Week 12** : Non Thermal Processing



# IRRIGATION AND DRAINAGE

**PROF. DAMODHARA RAO MAILAPALLI**  
Department of Agricultural and Food Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**PRE-REQUISITES** : An introductory background in chemistry, physics and Maths (calculus) will be needed.

**INDUSTRIES APPLICABLE TO** : All irrigation based companies.

## COURSE OUTLINE :

Agricultural engineers have been applying scientific principles for the optimal use of natural resources in agricultural production for the benefit of humankind. This particular course deals with application of both irrigation and drainage principles in agriculture for achieving profitable crop production with minimal environmental implications. This is one of the core courses of Agricultural Engineering program recommended for under graduate and graduate students. In this course we will focus on soilwater- plant-atmosphere relationship, crop water requirement, irrigation scheduling, irrigation water conveyance, measurement of irrigation water, water application methods, irrigation systems design and their performance evaluation, drainage of agricultural lands, management of salt affected soils, performance evaluation of drainage systems, ground water hydrology, irrigation wells and water-lifting devices-pumps. It involves weekly quizzes, in-class numerical problem solving, assignments and class tests.

## ABOUT INSTRUCTOR :

Dr. D.R. Mailapalli graduated from the Indian Institute of Technology (IIT)- Kharagpur with a Ph.D degree in 2007. After having 6 years of postdoctoral research experience from the U.S. universities (UC-Davis and UW-Madison), Dr. Mailapalli joined as a faculty at IIT-Kharagpur in 2013. Since then he has been teaching On-farm water management (theory and lab), Tube wells and pumps, Surface water hydrology and Non-point source pollution control and management at UG and PG level. His research interests are in agricultural water management, irrigation hydraulics, sediment and nutrients transport and non-point source pollution. He has published more than 30 research articles and 20 conference papers, volunteered as a reviewer for more than 30 research papers.

## COURSE PLAN :

- Week 01** : Soil-Water-Plant-Atmosphere Relationship
- Week 02** : Crop Water Requirement and Irrigation Scheduling
- Week 03** : Irrigation Water Conveyance and Measurement of Irrigation Water
- Week 04** : Water Application Methods
- Week 05** : Irrigation Systems Design-1
- Week 06** : Irrigation Systems Design-2
- Week 07** : Performance Evaluation of Irrigation System
- Week 08** : Drainage of Agricultural Lands
- Week 09** : Management of Salt affected soils
- Week 10** : Performance Evaluation of Drainage Systems
- Week 11** : Ground Water Hydrology
- Week 12** : Irrigation wells and Water-lifting devices-pumps



# DAIRY AND FOOD PROCESS AND PRODUCTS TECHNOLOGY

**PROF. TRIDIB KUMAR GOSWAMI**

Department of Agricultural and Food Engineering  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: Rerun   Core&Elective   UG/PG
<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 16 Nov 2019

**INTENDED AUDIENCE :** B.E/B.Tech, M.E/M.Tech, M.S, Ph.D

**INDUSTRIES APPLICABLE TO :** Any Processing Industry such as Britannia, ITC, Hindustan Lever, Mother Dairy, Amul, etc.

## COURSE OUTLINE :

This course will cover basics of dairy (liquid food) food processing and preservation technologies required in any dairy and food processing industries. The basic knowledge on dairy food processing is intermingled with most of the unit operations at some or other stage of processing. Since, this basic aspect of food processing and preservations not taught in most of the Agricultural engineering institutions elaborately, a comprehension of these aspects of processing and preservation will enrich the knowledge base of the students in general.

## ABOUT INSTRUCTOR :

Prof. Tridib Kumar Goswami, a NAAS, ISAE, IE, AABS Fellow, did his B.Sc. in Chemistry (Hons) from University of Calcutta, B.Tech. in Food Technology and Biochemical Engineering from Jadavpur University, Ph.D. from IIT Kharagpur. After serving Kwality Ice Cream, Bombay for 1½ years, he joined IIT Kharagpur in 1989 and is still continuing as a Professor. He has earned 5 Indian Patents, published 104 papers in peer reviewed reputed journals, 55 conference proceedings. He has written 4 books and 14 book chapters published by International publishers. He has travelled around the world for presenting papers and was specially invited by Jeonbuk National University, Korea with full sponsorship in 2009. He has guided 14 Ph.D., out of which 3 theses have been awarded the prestigious Jawaharlal Nehru Award offered by ICAR. One of his papers was awarded the prestigious N.N. Mohan Memorial Award for 2009 conferred by AIFPA, New Delhi for Best Paper of the year.

## COURSE PLAN :

- Week 01 :** Basic principles and methods of food processing and preservation. Emerging Technologies in food processing. Food additives and preservatives.
- Week 02 :** Food laws and standards. Effect of processing on acceptability and nutritive value of food.
- Week 03 :** Physico-chemical properties and structure of milk and milk constituents.
- Week 04 :** Chemical and microbial spoilage of milk and milk products; Fluid milk Processing, packaging and distribution.
- Week 05 :** Common dairy processes – cream separation (standardization), pasteurization, sterilization and Homogenization.
- Week 06 :** Process technology for manufacture of evaporated milk, condensed milk, dried milk, malted milk, infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products.
- Week 07 :** Methods and procedures for sampling and testing of milk and milk products. Laws and standards for milk and milk products.
- Week 08 :** Technological processes for industrially manufactured foods of commercial importance, from plant and animal origin.
- Week 09 :** Cereals, vegetables, fruits, meats, poultry and egg products; Bakery, pasta and confectionary products, ready to eat foods, fermented foods, alcoholic and non- alcoholic Beverages, tea, coffee and cocoa, fabricated foods.
- Week 10 :** Packaging materials; Characteristics, properties and their design. Packaging requirement for different processed and unprocessed foods.
- Week 11 :** Working Principles of various types of fillers : form-fill- seal machine.
- Week 12 :** Gas packaging and modified atmosphere Package design. Shelf life prediction of foods in packages. Quality control in Food packaging. Product safety and packaging regulations.



# THERMAL OPERATIONS IN FOOD PROCESS ENGINEERING: THEORY AND APPLICATIONS

**PROF. TRIDIB KUMAR GOSWAMI**

Department of Agricultural Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core&Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Agricultural Engineering, Food Technology, Food Engineering, Chemical Engineering, Biotechnological Engineering, Thermal Engineering, Biotechnology

**INDUSTRIES APPLICABLE TO** : Any Processing Industry such as ITC, Hindustan Lever, Britannia etc.

**COURSE OUTLINE :**

This course will cover basics of processing and preservation technologies required in any processing industries. The basic knowledge on thermal processing is intermingled with most of the unit operations at some or other stage of processing. Since, these basic aspects of thermal operations is not taught in most of the engineering institutions elaborately, a comprehension of these aspects of thermal processing will enrich the knowledge base of the students in general.

**ABOUT INSTRUCTOR :**

Prof. Tridib Kumar Goswami, a NAAS, ISAE, IE, AABS Fellow, did his B.Sc. in Chemistry (Hons) from University of Calcutta, B.Tech. in Food Technology and Biochemical Engineering from Jadavpur University, Ph.D. from IIT Kharagpur. He has earned 5 Indian Patents, published 104 papers in peer reviewed reputed journals, 55 conference proceedings. He has written 4 books and 14 book chapters published by International publishers. One of his papers was awarded the prestigious N.N. Mohan Memorial Award for 2009 conferred by AIFPA, New Delhi for Best Paper of the year.

**COURSE PLAN :**

**Week 1:** Fundamentals of food processing and preservation

**Week 2:** One dimensional conduction heat transfer in Cartesian coordinate

**Week 3:** One dimensional conduction heat transfer in cylindrical coordinate

**Week 4:** Transient heat transfer by conduction

**Week 5:** Drying technology

**Week 6:** Preservation by high temperature processing

**Week 7:** Multiple effect evaporators

**Week 8:** Process time calculations

**Week 9:** Boiling and condensation

**Week 10:** Heat Exchangers

**Week 11:** Convective heat transfer

**Week 12:** Distillation used in food process industries



# THERMAL PROCESSING OF FOODS

**PROF. R. ANANDALAKSHMI**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core&Elective | Both

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Chemical food engineer or biotechnologist designing thermal processing technologies for food processing or working with thermal processing of foods R&D laboratories working in the area of thermal food processing

**INDUSTRIES APPLICABLE TO** : Food Corporation of India, Department of food and public Distribution. India Central Food Technological Research Institute, Institute of Food Security and Central Warehousing Corporation. Some of the private sectors such as Amul, Perfetti Van Melle India Pvt. Ltd., Parle Products Ltd., PepsiCo India Ltd. etc.

## **COURSE OUTLINE :**

The Food and Agriculture Organization (FAO) of the United Nations (UN) issued a report on the importance and complexities associated with feeding the projected 9.1 billion world population in 2050. Sustainable production of safe and nutritious foods, development of foods that have a long shelf life and foods that are either ready-to-eat or easy to prepare are of greater importance towards meeting this goal. Understanding “Food Engineering” and “Thermal Processing of Foods” serves as basic requirement means of meeting this goal.

## **ABOUT INSTRUCTOR :**

Dr. R. Anandalakshmi is an Associate Professor in the Department of Chemical Engineering, Indian Institute of Technology, Guwahati. Her research interests are in the area of Computational Heat Transfer and Fluid Flow, Process Modeling and Simulation, Solar Thermal Energy Conversion, Energy Efficient Design of Thermal Systems, Microwave Assisted Food and Material Processing, Food Packaging and Preservation, Refrigeration and Air-conditioning Systems.

## **COURSE PLAN :**

**Week 1:** Food microbiology: microbial growth and concerns in various foods, Blanching, Pasteurization, Ultra-pasteurization, Hot fill and UHT

**Week 2:** Thermal processing equipment, Milk pasteurization, Canning operations

**Week 3:** Temperature distribution and heat penetration, Kinetics of reactions, F value and process requirements

**Week 4:** Quality considerations and process optimization, Shelf life studies, Validation of heat processes

**Week 5:** Fundamentals of aseptic processing, Aseptic equipment design, Aseptic process design

**Week 6:** Microwave and radio frequency heating, Ohmic heating, Overview of non-thermal processing technologies

**Week 7:** Advanced separation processes High pressure, dialysis ultrafiltration and reverse osmosis Nanofiltration, electro dialysis and membrane separation

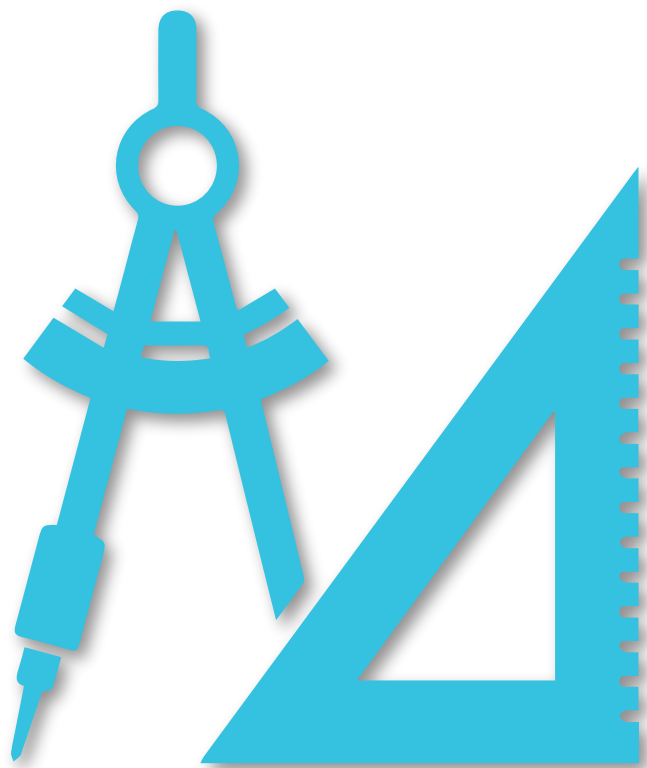
**Week 8:** Various types of heat exchangers for food process engineering Various types of driers for food process engineering

**Week 9:** Importance and applications of extrusion technology in food processing Changes of properties and functional components of extruded foods

**Week 10:** Food biosensors Types of functional foods: Probiotics and nutraceuticals

**Week 11:** Packaging considerations: Barrier and mechanical properties of different food packaging materials Biocomposite/bionanocomposite materials for food packaging applications

**Week 12:** Sanitary components and requirements, Regulatory considerations



# ARCHITECTURE





# ARCHITECTURE

## 08 weeks

- 01. Architectural Acoustics
- 02. Disaster Recovery And Build Back Better
- 03. Culturally Responsive Built Environments
- 04. Contemporary Architecture and Design
- 05. Role of Craft and Technology in Interior - Architecture



# ARCHITECTURAL ACOUSTICS

**PROF. SANKHA PRATIM BHATTACHARYA**

Department of Architecture and Regional Planning  
IIT Kharagpur

**PROF. SUMANA GUPTA**

Department of Architecture and Regional Planning  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**INTENDED AUDIENCE** : B.Arch

**EXAM DATE** : 16 Nov 2019

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**PRE-REQUISITES** : Basic knowledge of Mathematics, Physics and Architecture.

**INDUSTRIES APPLICABLE TO** : Architectural Design Firms, Acoustical consultancy companies. The design and consultancy firms can use these lecture modules as a part of the induction programme for their newly recruited graduates.

## COURSE OUTLINE :

The lectures will be oriented towards the students of architecture and will highlight on the evolution of acoustical science and its application in design and planning until today. The fundamentals of acoustics are an essential component while designing specific spaces small and big like recording studios, class rooms, lecture halls, auditoriums. The Architectural Acoustics course is broadly classified into three sub sections and comprises of 8 modules: After introduction to the course the lectures will be on sound physics. Lectures will include various characteristics of sound, its origin, propagation and auditory sensation and the measurement techniques.

## ABOUT INSTRUCTOR :

Dr. Shankha Pratim Bhattacharya is presently an Assistant Professor in Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur. He is an Architectural Engineer by profession and having more than fifteen years of teaching experience. He did his Ph.D on Modeling on Building Structure under Seismic Excitation in 2011. He has Worked as Principal Developer for 'Structural System' course under National Mission on Education through Information and Communication Technology (NMEICT) of MHRD, Govt. of India. His area of academic and research interest includes earthquake resistant building, building physics and structural systems. Presently he is offering a course on "Building Acoustics" for the undergraduate students of Indian Institute of Technology, Kharagpur. He has published more than ten technical papers in different reputed journals and international seminars.

Dr. Sumana Gupta is currently working as Assistant Professor in the Department of Architecture and Regional Planning at IIT Kharagpur since 2013. She completed her Master's degree and Doctoral Degree from the same Institute in 2008 and 2012 with a special interest in transportation planning and service quality evaluation of transport related facilities. Prior to this she worked for fourteen years as a professional architect and as a Lecturer in a Government Polytechnic College in India. She completed her Bachelor degree in Architecture in 1992 from Calcutta University. During her professional exposure as an architect she was involved in Science city auditorium design and presently offers the Building Acoustics course to the fourth year architecture students for the last four years.

## COURSE PLAN :

**Week 01** : Introduction to Architectural Acoustics and Building Physics

**Week 02** : Room Acoustics and Reverberation

**Week 03** : Sound Absorption

**Week 04** : Acoustical Criteria of Space Design

**Week 05** : Design Principles of Auditorium

**Week 06** : Electro- Acoustics & Open-Air Auditorium

**Week 07** : Air & Structure Borne Sound Propagation

**Week 08** : Environmental Acoustics



# DISASTER RECOVERY AND BUILD BACK BETTER

**PROF. RAM SATEESH PASUPULETI**

Department of Architecture  
IIT Roorkee

**PROF. SUBHOJYOTHI SAMADDAR**

Disaster Prevention Research Institute  
Kyoto University

**TYPE OF COURSE** : New | Elective | PG/UG

**Course Duration** : 8 Weeks (26 Aug`19 - 18 Oct`19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.Arch, Masters in disciplines of Architecture planning and Built Environment studies, PhD

**INDUSTRIES APPLICABLE TO** : National and International NGO's, Humanitarian agencies, Municipalities, Corporations, Village councils, Disaster Management Agencies, Research Organizations

**COURSE OUTLINE :**

Disaster recovery and build back better.

**ABOUT INSTRUCTOR :**

Prof. Ram Sateesh Pasupuleti is an Assistant Professor in the department of Architecture and Planning IIT Roorkee. He will look over the responsibility for running of the total duration of course.

Prof. Subhojyothi Samaddar is an Associate professor in the Disaster Prevention Research institute, Kyoto university. Japan.

**COURSE PLAN :**

**Week 1:** Introduction: Understanding Risk and Vulnerability; The road map of BBB.

**Week 2:** The Role of Built Environment professions in Disaster Risk Reduction

**Week 3:** Development of Building Codes and Regulatory framework (National and international)

**Week 4:** Build Back Better Approaches –Case studies (Spatial and Cultural Dimension)

**Week 5:** Build Back Better Approaches –Case studies (Governance and Management Dimension)

**Week 6:** Build Back Better Approaches –Case studies (Political and Institutional Dimension)

**Week 7:** Communication for Build Back Better (The people's dimension)

**Week 8:** The Pedagogic dimension for Build Back better



# CULTURALLY RESPONSIVE BUILT ENVIRONMENTS

**PROF. RAM SATEESH PASUPULETI**

Department of Architecture and Planning  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : M.A, M.Arch, M.U.R.P, M.E.P, M.L.A,

**PRE-REQUISITES** : M.Arch Conservation, Housing B.Arch /B.Plan 2nd year (pursuing)

**INDUSTRIES APPLICABLE TO** : Humanitarian and Non-Government Organizations Indian Heritage Cities Network, INTACH, UNESCO

## COURSE OUTLINE :

The objective of this course is to introduce Cultural Discourse in Built Environment Theory, Research, Practice and Education. To build the foundation and re-orient the students to use systems thinking and through interdisciplinary methods for bringing under one umbrella together the scientific, ecological, technological, and political dimensions of the subject of culturally responsive Built Environments.

## ABOUT INSTRUCTOR :

Dr. Ram Sateesh Pasupuleti is a registered architect in Sweden and India. He has attained his educational qualifications from most prestigious institutions- Doctorate from SABE University of Westminster, London, UK, M.A. in International Studies in Vernacular Architecture, Oxford Brookes University, Oxford UK, and a Bachelor of Architecture from Jawaharlal Nehru Technological University, Hyderabad, India. He has gained interesting working experiences from UK, Cyprus, Sweden and India. Such experiences across different working environments and geographies have endorsed his professional skills in trans-national education and research challenges and activities. His original quest of knowledge has contributed for designing culturally responsive environments in post disaster recovery in South Asian context. His research contributions have opened up interdisciplinary and trans-disciplinary research ideas involving vernacular architecture, urban design, sociology and cultural anthropology. He has been a lead person for thematic research group 'Adaptability' in Attractive Built Environments' at LTU Sweden. He was also (as deputy coordinator) coordinating Masters Course in Climate Sensitive urban planning and building at LTU. He has been a coordinator and also as organizing committee member for various National and international level symposiums, competitions, workshops and other intercultural activities.

## COURSE PLAN :

- Week 01** : Defining Theory and Concepts: Place and Space; Introduction to Vernacular Architecture: What is a Dwelling?
- Week 02** : Dimensions of culturally responsive built environment; Winter Urbanism.
- Week 03** : Power in Built Form
- Week 04** : Culture Disasters and Risk
- Week 05** : Conservation: Principles and practices
- Week 06** : Vernacular resources, materials and technology
- Week 07** : Planning for culture; Cultural economies; Safeguarding intangible heritage
- Week 08** : Social change in India; Culturally responsive built environment: Architectural education; Summarizing culturally responsive built environment



# CONTEMPORARY ARCHITECTURE AND DESIGN

**PROF. SAPTARSHI KOLAY**

Department of Architecture and Planning  
IIT Roorkee

**TYPE OF COURSE**

: Rerun | Elective | UG/PG

**COURSE DURATION**

: 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE**

: 16 Nov 2019

**INTENDED AUDIENCE** : B.Arch, M.Arch, B.Des, M.Des.

**INDUSTRIES APPLICABLE TO** : Architecture Companies and Design Studios

**COURSE OUTLINE :**

The course will impart knowledge on the historical backdrop and trends of contemporary architecture. Discussion will happen on the major phases of contemporary architecture - modernism and post-modernism. The salient features of both the phases of contemporary architecture will be detailed out with reference of relevant examples. These phases of architectural school of thoughts will also be extrapolated into the domain of visual design and fine arts, for a holistic understanding. The course will help the students in genesis of critical thinking on architectural appreciation and formulating design vocabulary.

**ABOUT INSTRUCTOR :**

Prof. Saptarshi Kolay is presently an Assistant Professor at Architecture and Planning department of Indian Institute of Technology Roorkee. After completing his under graduation in Architecture from Jadavpur University, he went on to explore User Centric design at Design Programme of Indian Institute of Technology Kanpur. Along with teaching he is pursuing his Ph.D from the Department of Architecture and Planning, IIT-Roorkee. He was selected in student-exchange programme for Aalto University, Finland and Escola De Arte and Desino, Spain. He has received Rafiq Azam Travel Bursary, Yuva-Ratna award and has participated in Design workshop by MIT, Media lab. His current research interest includes gerontology, way-finding design, visual communication design and contemporary art and design, etc. He has conducted one NPTEL course, titled "Visual Communication Design for Digital Media".

**COURSE PLAN :**

- Week 01 :** Preamble of Contemporary Architecture during Post Industrial Revolution  
Characteristics of Modern Architecture.
- Week 02 :** Phases of Modern Architecture.
- Week 03 :** Phases of Modern Architecture Characteristics of Post-Modern Architecture Phases of Post-Modern Architecture.
- Week 04 :** Phases of Post-Modern Architecture Works of master architects from contemporary era.
- Week 05 :** Phases of Modern Architecture - Brutalism Phases of Modern Architecture - Metabolism Phases of Modern Architecture - Late Modern Architecture Modernism in Visual Design Modernism in Industrial Design.
- Week 06 :** Genesis of Post - Modern Design Language Characteristics of Post-Modern Architecture and Design Phases of Post - Modern Architecture - Historicism Phases of Post- Modern Architecture - High-tech architecture Phases of Post - Modern Architecture - Neo-modern.
- Week 07 :** Phases of Post- Modern Architecture - Critical regionalism Phases of Post- Modern Architecture - Critical regionalism Phases of Post - Modern Architecture - Deconstructivism Phases of Post- Modern Architecture - Deconstructivism Postmodernism in Visual Design.
- Week 08 :** Post-modernism in Industrial Design Works of master architects - Modern era Works of master architects - Modern era Works of master architects -Post- Modern era Works of master architects - Post-Modern era.



# ROLE OF CRAFT AND TECHNOLOGY IN INTERIOR - ARCHITECTURE

**PROF. SMRITI SARASWAT**

Department of Architecture and Planning  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.Arch, M.Arch, B.Des, M.Des, B.Fine Arts, M.Fine Arts

**INDUSTRIES APPLICABLE TO** : All the relevant Industries related to Interior- Architecture; Design; Art; Craft and the Creative Industries (Specific Examples – Asian Paints; District Industries Centres; Alaya Design Studio)

**COURSE OUTLINE :**

This course is very crucial as it focuses on a trans-disciplinary research, emphasizing on the role of Craft & Technology in the discipline of Interior-Architecture. In the current decade which focuses on trans-disciplinarity and innovation, a course like this shall be very useful for a wide audience hailing from different disciplines such as art; craft; architecture; design; and, creative industries. Moreover, such a course is very much in line with the MHRD's initiatives like – SANDHI and Design Hub, where the focus is on amalgamation of Art, Science and Technology. It has multifold objectives: a) To understand the definition and scope of 'Interior-Architecture' and 'Craft & Technology'. b) To document and disseminate the role of Craft & Technology in Interior-Architecture through state-of-the-art literature; best studies and case studies. c) To create awareness and exposure for skill based knowledge systems. d) To establish link between tradition and continuity. e) To develop new paradigms of pedagogy and practice in the field of Interior-Architecture and Craft & Technology

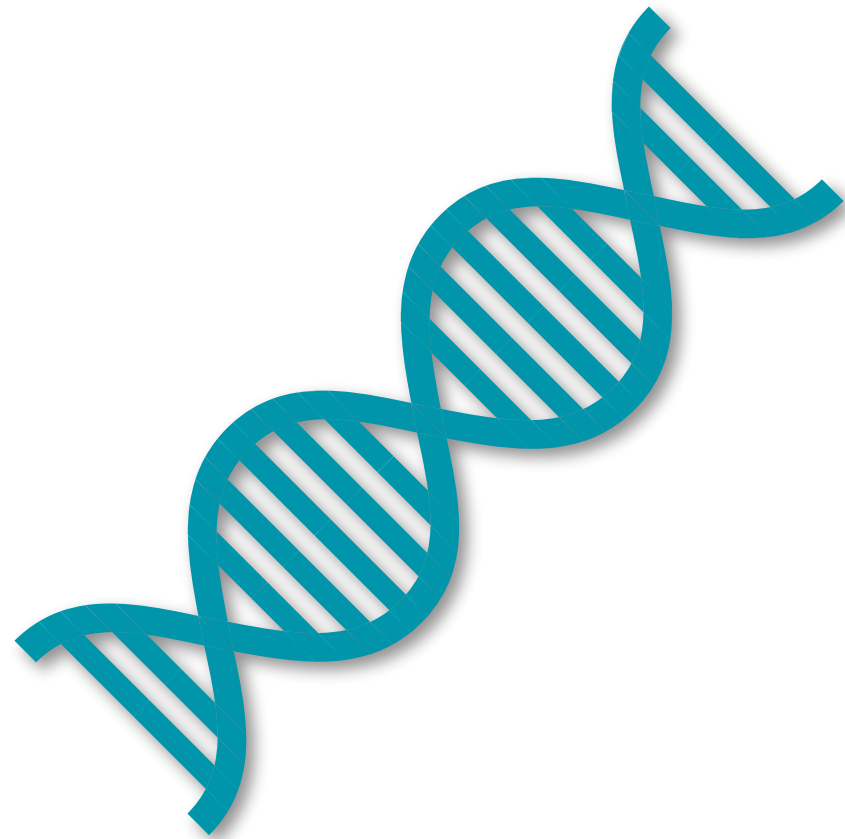
**ABOUT INSTRUCTOR :**

Prof. Smriti Saraswat is trained as an Architect & Interior-Designer, and specializes in Craft and Technology (with a Letter of Merit) from CEPT University, Ahmedabad. She is currently an Assistant Professor at Department of Architecture and Planning at IIT Roorkee (Uttarakhand). She is passionate about Interior-Architecture; Craft and Technology; Cultural Heritage; Visual Narratives; Design Research and Writing; and Pedagogy. She has been doing research and documentation on cultural heritage and visual narratives (especially, art-craft-interior-architecture traditions of India) for almost five years now. She has written several papers and monographs based on these topics.

**COURSE PLAN :**

- Week 01** : Interior- Architecture: Definition and Understanding, Craft: Definition and Understanding (Varied Perspectives on Art and Craft), Interior- Architecture and Craft & Technology: Establishing Inter- Relationships and Exploring Applications. Discourse.
- Week 02** : Interior- Architecture: Documenting Knowledge and Skills, Traditional Knowledge Systems and the Ingenious skills of the communities, Interior- Architecture: Documenting Materials; Tools and Techniques, Traditional Knowledge Systems and the Indigenous materials; tools and techniques, Discourse.
- Week 03** : Creative and Cultural Industries: Understanding Definition; Significance and Scope, Building Crafts: Definitions; perspectives and frameworks, Building Crafts: Craft and Technology and its Role in creating/enhancing Interior- Architecture, Discourse.
- Week 04** : Best Studies related to the Subject, Case Studies From Gujarat, Rajasthan, Uttarakhand, Miscellaneous Case Studies.
- Week 05** : Craft and Technology in Interior Architecture: Decoding Systems and Transformation through Time, Discourse.
- Week 06** : Overview of the Craft Sector Today, Issues and Challenges, Policies and Reforms, Gaps, Opportunities
- Week 07** : Continuity and Revival: Research and Documentation Perspective, Education and Training Perspective, Innovation and Development Perspective, Resource Building and Dissemination Perspective, Application and Collaboration Perspective.
- Week 08** : Interventions: Process Based, Product/Design Based, Technology Based, Marketing/Management Based, Summary & Discourse.





# **BIOTECHNOLOGY & BIOENGINEERING**



# BIOTECHNOLOGY AND BIOENGINEERING

## 04 weeks

- 01. Plant Developmental Biology
- 02. Functional Genomics
- 03. Biomicrofluidics
- 04. Biomedical nanotechnology

## 08 weeks

- 01. Bioenergy
- 02. Plant Cell Bioprocessing
- 03. Introduction to Biostatistics
- 04. Nanotechnology in Agriculture
- 05. Computer Aided Drug Design
- 06. Introduction To Proteomics
- 07. Introduction to Mechanobiology
- 08. WildLife Conservation
- 09. Tissue Engineering

## 12 weeks

- 01. Genetic Engineering: Theory and Application
- 02. Industrial Biotechnology
- 03. Drug Delivery: Principles and Engineering
- 04. Introduction to Proteogenomics
- 05. Fundamentals of micro and nanofabrication
- 06. Principles Of Downstream Techniques In Bioprocess



# PLANT DEVELOPMENTAL BIOLOGY

**PROF. SHRI RAM YADAV**

Department of Biotechnology  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic knowledge of biology

**INTENDED AUDIENCE** : UG/PG PhD student's of Plant science/ Botany/ Biotechnology/ Agriculture

**INDUSTRIES APPLICABLE TO** : Food based industries

**COURSE OUTLINE :**

Plant Developmental Biology encompasses the study of how complex multicellular plants are developed from a single zygotic cell. This course will provide an overview of mechanisms underlying the Meristem function during growth and development, Cell specification, Differentiation and Organogenesis in the flowering plants. It also describes the approaches used to study plant development. This course will be highly useful for students to enhance their knowledge and develop their research interest in the field of developmental biology.

**ABOUT INSTRUCTOR :**

Dr. Shri Ram Yadav is an Assistant Professor at Department of Biotechnology, Indian Institute of Technology, Roorkee. Dr. Yadav has fifteen years of research experience in the field of plant development biology. He completed his M.Sc. in Biotechnology from University of Jammu, India and later he earned his PhD at Indian Institute of Science (IISc), Bangalore, India and worked on flower development in rice. He did his postdoctoral research at University of Helsinki, Finland to study cell-cell communication during vascular development in Arabidopsis root. Currently his research group is working on adventitious root development and stem cell maintenance using rice and Arabidopsis as model plants. He has contributed significantly in the field of plant development biology and published several research articles in top-tier international journals.

**COURSE PLAN :**

**Week 1:** Introduction

**Week 2:** Molecular Genetics of Plant Development

**Week 3:** Root development

**Week 4:** Shoot development



# FUNCTIONAL GENOMICS

**PROF. S. GANESH**

Department of Biological Science and Bioengineering  
IIT Kanpur

**TYPE OF COURSE**

: Rerun | Elective | UG/PG

**COURSE DURATION**

: 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE**

: 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, B.Sc/M.Sc

**PRE-REQUISITES** : Basic level of understanding in cell and molecular biology is expected

**INDUSTRIES APPLICABLE TO** : Biotechnology, medical and pharma companies, paramedic clinical centers, and educational institutes.

**COURSE OUTLINE :**

With the emergence of high throughput DNA sequencing technologies, the complete genome sequences of many organisms are deciphered and are being analyzed. Despite the progress, understanding the cellular functions of most the genes thus identified remains a challenge. The emerging field of "Functional Genomics" aims at providing comprehensive approaches to understand the genome functions, to develop and promote high throughput and large scale approaches to investigate the function of the genomes, their products and the interactions between the two. This course thus will provide an overview of the concept of Functional Genomics and contemporary approaches used to understand the genome function.

**ABOUT INSTRUCTOR :**

Prof. S. Ganesh teaches biology, genetics and genomics at IIT Kanpur. His research interests include human molecular genetics and neuroscience. He works on genetic forms of neurodegenerative disorders in humans to understand their genetics and disease mechanisms, and to develop therapeutics.

**COURSE PLAN :**

**Week 01** : Introduction to Functional Genomics: Pre- and post-genomic era; major advancements in genomic approaches; epigenetics and metagenomics; forward versus reverse genetics

**Week 02** : Genome Analyses - Part 1 : Genome editing approaches and their applications; gene expression analyses and applications

**Week 03** : Genome Analyses - Part 2 : Methods for DNA/RNA sequencing, sequence analysis and their applications

**Week 04** : Comparative Genomics : Genomic insight into evolution; power of comparative genomic analysis



# BIOMICROFLUIDICS

**PROF. TAPAS KUMAR MAITI**

Department of Biotechnology  
IIT Kharagpur

**PROF. SUMAN CHAKRABORTY**

Department of Mechanical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, PhD

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**COURSE OUTLINE :**

This course will be unique to the discipline of Biotechnology as it deals with cutting-edge research and development in the interfacial areas of Biology and Mechanical engineering. The understanding of any subject in its entirety is often incomplete without language and tools derived from other disciplines. Microfluidics is an avenue of Mechanical Engineering which today, is not only helping in the understanding of diseases from an engineering perspective, but also aiding in the development of cheap, portable, diagnostic platforms that can predict whether a person is carrying a disease, even from a small drop of body fluid, at the remotest of locations. This amalgamated discipline, called Biomicrofluidics, which is presently revolutionizing the field of medical diagnostics and mechanobiology, needs to be exposed to the fertile minds of the future generations to draw them towards research in this field and contribute to the society.

**ABOUT INSTRUCTOR :**

Prof. Tapas Kumar Maiti is an Biochemist working for more than two decades on natural anti-cancer lectins, immunomodulatory mushroom glucans, tissue engineering, biomicrofluidics-based understanding of cancer progression, as well as development of microfluidic chip-based cancer-screening devices and drug-testing models.

Prof. Suman Chakraborty is an expert in fluid mechanics with specialization in microfluidics, presently working towards exploiting microscale transport phenomena for the development of inexpensive chip-based extreme point-of-care diagnostic kits.

**COURSE PLAN :**

**Week 01** : Introduction to Microfluidics & relevance in biology, Microfluidic Device Fabrication.

**Week 02** : Microfluidic device based- science explorations, Dielectrophoresis for particle and cell manipulations.

**Week 03** : Electrowetting and Droplet –based microfluidics, Optical microfluidics for Molecular diagnostics, Microfluidic arrays and microchannel enzyme reactors.

**Week 04** : Biosensors and Biocantilevers, Recent microfluidic replacements of age-old biological techniques, BioMEMS: Commercialization, potential and market.



# BIOMEDICAL NANOTECHNOLOGY

**PROF. P. GOPINATH**

Department of Biotechnology  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc/M.Sc, Ph.D

**PRE-REQUISITES** : Basic knowledge in biology

## COURSE OUTLINE :

Biomedical nanotechnology is a rapidly developing field, which includes a diverse collection of disciplines. The applications of nanotechnology are gaining overwhelming response in almost all the fields. Especially in healthcare sector, tremendous developments have been achieved. For example, cancer diagnosis and therapy, medical implants, tissue engineering etc. In the coming years, the developments in this field are expected to flourish and lead to several life saving medical technologies and treatment methods. Thus, the main objective of this course is to impart knowledge on biomedical applications of nanotechnology.

## ABOUT INSTRUCTOR :

Prof. P. Gopinath is an Associate Professor in the Department of Biotechnology at Indian Institute of Technology (IIT) Roorkee, India. He received his B.Sc. degree in Microbiology and M.Sc. degree in Biotechnology from Bharathidasan University, India. He earned his Ph.D. in Biotechnology at Indian Institute of Technology Guwahati, India. He did his postdoctoral research at University of Rochester Medical Center, New York, USA. Currently his research group in nanobiotechnology laboratory is working on the development of various polymer based nanocarriers for the delivery of various anticancer agents including anticancer drugs, siRNA, genes etc. This group is also exploring the possibilities of various biocompatible imaging agents for cancer diagnosis. In order to realize the efficacy of such therapeutic and imaging agents, they are validating these systems in an artificial scaffold which mimics the in vivo condition to the closest extent. He has published more than 60 research articles, 5 books and 6 book chapters.

## COURSE PLAN :

**Week 01** : Introduction to nano, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterisation of nanomaterials

**Week 02** : DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications.

**Week 03** : Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.

**Week 04** : Nanotechnology in point-of-care diagnostics, Nanopharmacology & drug targeting, Cellular uptake mechanisms of nanomaterials, In vitro methods to study antibacterial and anticancer properties of nanomaterials, Nanotoxicology





# BIOENERGY

**PROF. MAINAK DAS**

Department of Biotechnology & Bioengineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.A, M.Arch, M.U.R.P, M.E.P, M.L.A,

**PRE-REQUISITES** : Has cleared 10+2 with science

**INDUSTRIES APPLICABLE TO** : Green energy industries, Agro-waste processing industries, Renewable energy materials industry, Bio-fuel and fossil fuel companies.

## COURSE OUTLINE

This course aims to provide an overview of the basic process, by which solar energy is collected and converted to biomass, which is essentially, what we call 'bioenergy'. During the discourse, emphasis will be given on different strategies to convert biomass to biofuels, the review of the available technologies and how these could meet the growing demand for energy in the future.

## ABOUT INSTRUCTOR

Prof. Mainak Das, Department of BSBE & Design Indian Institute of Technology, Kanpur. is an agriculture graduate (1989-1994) from College of Agriculture Indore, India. He did his master's in animal physiology (1994-1997) from National Dairy Research Institute, Karnal, India. Later, he did his doctoral studies (2004-2008) in biomedical sciences from University of Central Florida, USA. Since April 2010, he is a tenured faculty in bioengineering and design at Indian Institute of Technology, Kanpur, India. His area of research is green energy, bio-electricity, physiology and sensors.

## COURSE PLAN

**Week 1** : Introduction to bioenergy

**Week 2** : Basics of biomass technology & biomass resources

**Week 3** : Biofuels I

**Week 4** : Biofuels II

**Week 5** : Biofuels III

**Week 6** : Bio-power I

**Week 7** : Bio-power II

**Week 8** : Bioenergy distribution & end use for a sustainable future



# PLANT CELL BIOPROCESSING

**PROF. SMITA SRIVASTAVA**

Department of Biotechnology  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic knowledge of Fermentation Technology, Basics in plant cell and tissue culture, plant biotechnology

**INTENDED AUDIENCE** : Researchers and students in the area of Plant Biotechnology, Biochemical/ Bioprocess Engineering and Biotechnology.

**INDUSTRIES APPLICABLE TO** : Himalaya Pvt. Ltd., Reliance life sciences, Dabur

**COURSE OUTLINE :**

This is a course designed primarily for students in the undergraduate or master's programs interested in bioprocess development for production of high value products from plant cells and tissue cultures. This course is expected to introduce the student to identify the industrial applications of Plant Cell/Tissue Culture Technology. The student will be able to develop plant cell/tissue culture based bioprocesses for large scale in vitro production of high value phytochemicals. Strategies that can be utilized to improve yield and productivity of phytochemicals from plant cell/tissue cultures with case studies will be discussed.

**ABOUT INSTRUCTOR :**

Dr. Smita has experience in the application of Chemical and Biochemical Engineering principles to facilitate the development of sustainable bioprocesses for commercial production of high-value low-volume phytochemicals.

As faculty at IIT Madras, Dr. Smita and her research group have set up a plant cell cultivation facility up to reactor level in the Department of Biotechnology at IIT Madras, to facilitate research on mass cultivation of plant cells/tissues for in vitro production of high-value phytochemicals. Her research experience in the area of bioprocessing for phytochemicals is demonstrated by 19 peer reviewed international journal publications, 4 book chapters, 4 Indian patent applications and 27 different international/national conference presentations (as first/corresponding author) in the area of bioprocessing for phytochemicals.

**COURSE PLAN :**

**Week 1:** Introduction to plant cells and the in vitro forms of plant tissue cultures for commercial applications

**Week 2:** Culture initiation and preservation

**Week 3:** Secondary metabolism in plant cells: Its role and commercial applications

**Week 4:** Strategies to enhance yield and productivity of plant secondary metabolites in in vitro cell/tissue cultures

**Week 5:** Biotransformation

**Week 6:** Genetic transformations in plant cells

**Week 7:** Scale-up considerations in plant cell/tissue cultures

**Week 8:** Case studies on in vitro production of high-value plant secondary metabolites for commercial applications: A Combinatorial/Integrated approach for synergistic effect on production rates.



# INTRODUCTION TO BIOSTATISTICS

**PROF. SHAMIK SEN**

Department of Biosciences & Bioengineering  
IIT Bombay

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.Sc, Ph.D

**PRE-REQUISITES** : Basic knowledge of 12th standard mathematics is sufficient.

**INDUSTRIES APPLICABLE TO** : Biotech companies, pharma companies and omics companies may be interested in this course.

## COURSE OUTLINE :

Observations from biological laboratory experiments, clinical trials, and health surveys always carry some amount of uncertainty. In many cases, especially for the laboratory experiments, it is inevitable to just ignore this uncertainty due to large variation in observations. Tools from statistics are very useful in analyzing this uncertainty and filtering noise from data. Also, due to advancement of microscopy and molecular tools, a rich data can be generated from experiments. To make sense of this data, we need to integrate this data a model using tools from statistics. In this course, we will discuss about different statistical tools required to

(i) analyze our observations, (ii) design new experiments, and (iii) integrate large number of observations in single unified model.

## ABOUT INSTRUCTOR :

Dr. Shamik Sen joined IIT Bombay in July 2010 as an Assistant Professor in the Department of Biosciences and Bioengineering. Dr. Sen earned a B.E. in Mechanical Engineering from Jadavpur University, Kolkata, and a M. Tech in Mechanical Engineering from IIT Kanpur. He then completed his PhD in Mechanical Engineering from University of Pennsylvania, where he worked in the area of mechanobiology.

## COURSE PLAN :

**Week 01** : Introduction to the course, Data representation and plotting, Arithmetic mean, Geometric mean, Measure of Variability, Standard deviation.

**Week 02** : SME, Z-Score, Box plot, Kurtosis, R programming, Correlation.

**Week 03** : Correlation and Regression, Interpolation and extrapolation, Nonlinear data fitting, Concept of Probability: introduction and basics.

**Week 04** : Counting principle, Permutations, and Combinations, Conditional probability, Conditional probability and Random variables, Random variables, Probability mass function, and Probability density function, Expectation, Variance and Covariance.

**Week 05** : Expectation, Variance and Covariance, Binomial random variables and Moment generating function, Probability distribution: Poisson distribution and Uniform distribution, Uniform distribution Part-II and Normal distribution Part-I, Normal distribution Part-II and Exponential distribution.

**Week 06** : Sampling distributions and Central limit theorem Part-II, Central limit theorem Part-III and Sampling distributions of sample mean, Central limit theorem - IV and Confidence intervals, Confidence intervals Part- II.

**Week 07** : Test of Hypothesis - 1, Test of Hypothesis - 2 (1 tailed and 2 tailed Test of Hypothesis, p-value) - (Type -1 and Type -2 error), T-test.

**Week 08** : 1 tailed and 2 tailed T-distribution, Chi-square test, ANOVA, ANOVA for linear regression, Block Design



# NANOTECHNOLOGY IN AGRICULTURE

**PROF. MAINAK DAS**

Dept. of Biological Sciences and Bioengineering & Design  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : 10+2 in science

**INDUSTRIES APPLICABLE TO** : Agriculture industry, Seed industry, Fertilizer industry, Food technology industry

**COURSE OUTLINE :**

Modern agriculture is a chemical intensive process starting from fertilizer, pesticide to food preservation. Modern nanotechnology tools if used judiciously in future, have the ability to offer sustainable development along with the optimal, precision and more effective use of chemicals. In this course, I will be sharing my journey from basic agriculture to modern day nanoparticle based agriculture practices.

**ABOUT INSTRUCTOR :**

Prof. Mainak Das is a faculty at Biological Sciences and Bio-engineering & Design program. He works in the areas of bio-electricity, green energy, physiology, and sensor. He has a BS training in agriculture, MS training in animal physiology and a doctoral training in biomedical sciences. He has been working in the area of nanotechnology application in animals and plants for the past 18 years.

**COURSE PLAN :**

**Week 01** : History of agriculture and the role of chemicals in modern agriculture

**Week 02** : Overview of nanotechnology

**Week 03** : Application of nanotechnology in modern day agriculture practices I

**Week 04** : Application of nanotechnology in modern day agriculture practices II

**Week 05** : Application of nanotechnologies in animal production

**Week 06** : Nanotechnology and shelf life of agricultural and food products

**Week 07** : Nanotechnologies for water quality and availability

**Week 08** : Green nanotechnology and the role of good governance and policies for effective nanotechnology development



# COMPUTER AIDED DRUG DESIGN

**PROF. MUKESH DOBLE**

Department of Biotechnology & Bioengineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : Prior knowledge of biochemistry, bioinformatics

**INDUSTRIES APPLICABLE TO** : Pharmaceutical industries/Biopharma/biotech

## COURSE OUTLINE :

Drug discovery and development is a time consuming and expensive process, taking about 10 years and costing about US 1.0 B dollars. Several candidates that enter clinical trials fail because of several reasons. Computer assisted drug design can speed up the process, reduce surprises and predict the properties, thereby reduce the cost of R&D. The course will cover structure and target based design, molecular modeling, quantum mechanics, drug likeness properties, QSAR and pharmacokinetic and dynamics using several softwares that are freely available.

## ABOUT INSTRUCTOR :

Prof. Mukesh Doble is a Professor at the Department of Biotechnology at IIT Madras. He Has previously worked in Imperial chemical Industries (ICI) and General Electric (GE) for 20 years. Areas of research are Biomaterials, Biopolymers, and Drug design. He has Published 280 papers and 10 books and filed 10 patents (including two US). He has delivered online video courses in Downstream processes, Medical Biomaterials and Biostatistics and Design of Experiments

## COURSE PLAN :

**Week 01** : Introduction to drug discovery

**Week 02** : Structure and property

**Week 03** : ADME-rules

**Week 04** : Force field/MM/QM

**Week 05** : Boundary conditions/Conformation

**Week 06** : QSAR/Pharmacophore

**Week 07** : Enzymes/proteins structures/docking

**Week 08** : PK/PD



# INTRODUCTION TO PROTEOMICS

**PROF. SANJEEVA SRIVASTAVA**

Department of Biosciences & Bioengineering  
IIT Bombay

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.Sc., M.Sc. and MS

**PRE-REQUISITES** : Any B.Sc. or M.Sc. The target audiences of this course are required to have a basic introduction to biology.

## COURSE OUTLINE :

This course introduces to the basic biology of proteins and the new advanced science called as proteomics which aims to look into the protein properties from a global perspective, i.e., not undertaking one protein at a time, but an entire set of proteins in the milieu. The course will cover in detail the two major aspects of proteomics i.e., Gel-based proteomics and Mass spectrometry-based proteomics. The gel-based module will cover different techniques like SDS-PAGE, 2-DE, 2D-DIGE etc. These techniques had a major contribution in transition from protein chemistry to proteomics. Mass spectrometry, on the other hand, is an advanced analytical technique for accurate mass measurement. In this module, we will discuss the basics of mass spectrometry, sample preparations, liquid chromatography, hybrid mass spectrometers and quantitative proteomics techniques such as iTRAQ, SILAC and TMT using mass spectrometry. The course will also provide the basic knowledge about sample preparation, mass spectrometry workflow, different chromatography technologies and quantitative proteomics.

## ABOUT INSTRUCTOR :

Dr. Sanjeeva Srivastava is the Group Leader for the Proteomics Laboratory at the Indian Institute of Technology Bombay India (IITB). He obtained his Ph.D. from the University of Alberta and post-doc from the Harvard Medical School in the area of proteomics, stress physiology and has specialized expertise in applications of data enabled sciences in global health, developing country and resource limited settings.

## COURSE PLAN :

**Week 01** : Basics of Proteins and Proteomics

**Week 02** : Gel-based proteomics

**Week 03** : Two-dimensional gel electrophoresis (2-DE)

**Week 04** : Difference in gel electrophoresis (DIGE) & Systems Biology

**Week 05** : Basics of mass spectrometry

**Week 06** : Basics of mass spectrometry and sample preparation

**Week 07** : Quantitative proteomics

**Week 08** : Advancement in Proteomics





# INTRODUCTION TO MECHANOBIOLOGY

**PROF. SHAMIK SEN**

Department of Biosciences & Bioengineering  
IIT Bombay

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Biotech/Biosciences/Bioengineering

**INDUSTRIES APPLICABLE TO** : Academic Institutes, Startups working in the area of tissue engineering

**COURSE OUTLINE :**

Mechanobiology is an upcoming interdisciplinary field of science where concepts of mechanics, biology and engineering are combined to understand the basics of different cellular processes ranging from cell division to cell differentiation and death.

**ABOUT INSTRUCTOR :**

Dr. Shamik Sen joined IIT Bombay in July 2010 as an Assistant Professor in the Department of Biosciences and Bioengineering. Dr. Sen earned a B.E. in Mechanical Engineering from Jadavpur University, Kolkata, and a M. Tech in Mechanical Engineering from IIT Kanpur. He then completed his PhD in Mechanical Engineering from University of Pennsylvania, where he worked in the area of mechanobiology.

He is currently working in the area of mechanobiology where he is integrating mechanics and biology for probing stem cell biology and cancer cell biology. He is combining experiments with simulations for addressing his research questions.

**COURSE PLAN :**

- Week 01** : Need to study Mechanobiology, Cell as a Tent, individual components, Cell-ECM crosstalk, ECM proteins: Collagen, Measuring properties of collagen networks.
- Week 02** : Properties of collagen networks, Rheology, Rheology of biopolymer networks, Atomic Force Microscopy (AFM), Design of protein constructs for AFM.
- Week 03** : Protein unfolding using AFM, Focal adhesions: focal adhesion proteins, Focal adhesion organization, Focal adhesions: role of forces.
- Week 04** : Cytoskeleton: Actin, Force-velocity relationships of actin networks, Mesenchymal cell migration, Actin dynamics during mesenchymal migration.
- Week 05** : Adhesion Independent Migration, Adhesion Independent & Collective Cell Migration, Collective Cell Migration, Mechanobiology of Stem Cell Fate.
- Week 06** : Mechanobiology of Stem Cell Fate, Mechanobiology of Diseases: Cancer, Mechanobiology of Diseases: Atherosclerosis & Hypertension.
- Week 07** : Mechanobiology of Diseases: Muscular Dystrophy, Nuclear Mechanotransduction: LINC complex, Nuclear Mechanotransduction: LINC complex in cell migration, Nuclear Mechanotransduction: Gene regulation, Mechanical Forces & DNA damage.
- Week 08** : Techniques in Mechanobiology: Hydrogels, AFM, Traction Force Microscopy, Trypsin Deadhesion & Laser Ablation, Microfabrication, FRET.



# WILD LIFE CONSERVATION

**PROF. ANKUR AWADHIYA**

Department of Biotechnology  
IIT Kanpur

<b>TYPE OF COURSE</b>	: Rerun   Core   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**PRE-REQUISITES** : Has cleared 10+2 with science

**INDUSTRIES APPLICABLE TO** : Tourism industries, Education industries, Green energy industries, Renewable energy / materials industry

## COURSE OUTLINE

Conservation of wild life is important, not only because animals like pandas are cute, or animals like tiger or elephant are majestic, and we want to have them with us it is also important for the provisioning of several ecosystem services and the proper working of the ecosystem itself, of which wetoo are a part. In this course, we shall discuss the several facets of wildlife conservation, including its importance and the threats being faced, and also how they are being managed in the field. Weshall explore how to capture wild animals, how to treat them when needed, how to manage their habitats and their populations, and so on. We Will use the case study approach with real-life examples from the field to get a better understanding of this field and its applications.

## ABOUT INSTRUCTOR

Prof. Ankur Awadhiya (B. Tech IIT Kanpur 2009, Ph. D IIT Kanpur 2015, AIGNFA IGNFA Dehradun 2016) isan IFS officer borne on the Madhya Pradesh cadre. His interests include photography, tourism, research, instrumentation and creative literary pursuits

## COURSE PLAN

- Week 1** : Introduction, Importance, Threats
- Week 2** : Monitoring wild animals
- Week 3** : Monitoring & managing habitats
- Week 4** : Management of wildlife diseases
- Week 5** : Capturing and restraining wild animals
- Week 6** : Conservation genetics
- Week 7** : Ex-situ conservation
- Week 8** : Management of changes



# TISSUE ENGINEERING

**PROF. VIGNESH MUTHUVIJAYAN**

Department of Biotechnology  
IIT Madras

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Understanding of basic cell biology would be helpful

**INDUSTRIES APPLICABLE TO** : Companies that are involved in regenerative medicine and related technologies

## COURSE OUTLINE

The course will introduce principles and applications of tissue engineering. The course will provide an understanding of the applications of engineering and life science principles in the field of tissue engineering. As an up and coming interdisciplinary domain of research, the course will be designed based on current literature.

## ABOUT INSTRUCTOR

Prof. Vignesh Muthuvijayan is a Chemical Engineer by training. He received his B.Tech in Chemical Engineering from A. C. Tech, Anna University, India. He went on to pursue his Master's degree in Chemical and Biochemical Engineering at University of Maryland, Baltimore County and his PhD in Chemical Engineering at Oklahoma State University. He also worked as a post-doc at Johns Hopkins University. After spending about 8 years in the United States, he moved back to India to join the Department of Biotechnology at IIT Madras in 2011. His research interests are in the area of biomaterials and their applications.

## COURSE PLAN

**Week 1** : Introduction to tissue engineering

**Week 2** : Biomaterials: natural materials, polymers

**Week 3** : Biomaterials: hydrogels, ceramics, scaffold fabrication

**Week 4** : Immune response to biomaterials

**Week 5** : Cells: source, culture, and tissue dynamics

**Week 6** : Cells: differentiation, adhesion, and migration

**Week 7** : Cells and signals

**Week 8** : Applications



# GENETIC ENGINEERING: THEORY AND APPLICATION

**PROF. VISHAL TRIVEDI**

Department of Biotechnology  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : General Biology 10+2

**INTENDED AUDIENCE** : UG/PG/PhD/Scientist in industry

**INDUSTRIES APPLICABLE TO** : Companies related to biotechnology

## **COURSE OUTLINE :**

In this we discuss about biotechnology, its scope and impact on human life with several customized products. The Development of technology and generation of product has multiple steps and understanding these steps are being covered in this course with a discussion of biotechnology application at the end. By the end of this course, student will be able to understand following aspects of biotechnology:

1. Basic metabolic pathways and their regulation.
2. Microbial growth kinetics with an emphasis on fermentation
3. Basic molecular biology tools used in biotechnology.
4. Basic methodology for product recovery and analysis.

## **ABOUT INSTRUCTOR :**

Prof. Trivedi did his Ph.D. from Central Drug Research Institute, Lucknow in the field of Structural Biology. From his postdoctoral research at the Department of Molecular and Cellular Biology, Harvard University and Molecular Oncology Research Institute, Tufts University, Boston, USA, he gained extensive research experience in the field of cell biology, intracellular signal transduction, and immunology. Currently, his laboratory at Department of Biosciences and Bioengineering has an active group working and exploring questions related to malaria parasite biochemistry, the role of novel proteins, development of anti-malarial agents, and lastly understanding factors playing a crucial role in immunomodulation and host pathology in different organs.

## **COURSE PLAN :**

**Week 1:** Introduction and Basics of Biological System.

**Week 2:** Basics of Biological System

**Week 3:** Basics of Cloning (Part I)

**Week 4:** Basics of Cloning (Part II)

**Week 5:** Recombinant DNA Technology (Part I)

**Week 6:** Recombinant DNA Technology (Part II)

**Week 7:** Product Recovery and Characterization

**Week 8:** Biotechnology in Social Welfare

**Week 9:** Lab Demo related to the molecular biology protocols

**Week 10:** Lectures by industry people- Bio pharma industry, real life experience

**Week 11:** Latest cutting edge technology for Genome editing.

**Week 12:** Conclusion



# INDUSTRIAL BIOTECHNOLOGY

**PROF. DEBABRATA DAS**

Department of Biotechnology  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : Knowledge in microbiology, Biochemistry and mathematics in 10+2 level

**INDUSTRIES APPLICABLE TO** : DuPont India, IFB Agra Industry, IOC; ONGC, Dr. Reddy's Laboratories, Biocon United beverages.

## COURSE OUTLINE :

The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance. It uniquely blends the science and engineering with various biochemical processes to obtain products of diverse fields such as chemicals, food, bioenergy etc. The course introduces bioreactors, its types, operation methods and provides an experimental demonstration of the same. Strategies to obtain higher yields, design of the reactors and production of biofuels from microbes are thoroughly explained. Students of various disciplines such as biotechnology, chemical engineering, food engineering, and pharmaceutical industries can be benefitted from the course as it discusses the existing bioprocess applications such as wine and cheese making, antibiotics and vaccines etc. The course majorly focusses on the applications and allows students to gain practical knowledge rather than mere theory. Major bottlenecks for the operation of biochemical industries will be discussed.

## ABOUT INSTRUCTOR :

Dr. Debabrata Das pursued his doctoral studies from Indian Institute of Technology (IIT) Delhi. He is a Senior Professor at IIT Kharagpur. He was also associated as MNRE Renewable Energy Chair Professor. He has pioneered the promising R&D of Bioenergy production processes by applying fermentation technology. Prof. Das is involved in three different area of research: Gaseous energy recovery from organic wastes; algal biorefinery and CO<sub>2</sub> sequestration; and microbial fuel cell. He is presently involved in teaching both undergraduate and post-graduate courses on Biochemical Reaction Engineering; Aspects of Biochemical Engineering; Bioprocess Plant and Equipment Design; and Bioprocess Technology for the students of Department of Biotechnology; Department of Chemical Engineering; Department of Chemistry and School Energy Science and Engineering.

## COURSE PLAN :

**Week 01** : Introduction, Microbes and enzymes of industrial importance

**Week 02** : Different types of bioreactors and bioreactor design

**Week 03** : Microbial growth, substrate degradation and product formation kinetics, Tutorial 1

**Week 04** : Instrumentation, Sterilization of air, media and reactor

**Week 05** : Upstream and Downstream processing

**Week 06** : Production of Oxychemicals I

**Week 07** : Production of Oxychemicals II

**Week 08** : Production of Oxychemicals III

**Week 09** : High fructose corn syrup, Cheese making, and Single cell production

**Week 10** : Vaccines production and Metal leaching

**Week 11** : Bioenergy- Gaseous fuels: Biohydrogen, Biomethane and Microbial fuel cell; Liquid fuels: Bioethanol, Biodiesel and Biobutanol

**Week 12** : Aerobic and Anaerobic wastewater treatment processes



# DRUG DELIVERY: PRINCIPLES AND ENGINEERING

**PROF. RACHIT AGARWAL**

Department of BioSystems Science and Engineering  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : A course in biochemistry, Molecular biology, Anatomy is recommended

**INTENDED AUDIENCE** : Anyone in bachelors having completed two years

**INDUSTRIES APPLICABLE TO** : All pharmaceuticals, Hospitals and biotechnology industries

**COURSE OUTLINE :**

This course introduces concepts of drug delivery to meet medical challenges. The course is designed to be modular, with each module focusing on the various aspects of drug delivery

**ABOUT INSTRUCTOR :**

Prof. Rachit Agarwal is working as an Assistant Professor in IISc Bangalore. He completed post- doctoral fellow from Georgia Institute of Technology, Atlanta, Georgia, USA. He had done his PhD in Biomedical Engineering May 2013 University of Texas at Austin, Texas, USA Dissertation title: Effect of shape on cell internalization of polymeric hydrogel nanoparticles.

**COURSE PLAN :**

**Week 1:** Pharmacokinetics: Bioavailability, Elimination, Therapeutic index

**Week 2:** Prodrugs, Controlled release

**Week 3:** Polymers: Synthesis, Properties, Characterization, Crystallinity and amorphousness

**Week 4 :** Biopolymers: Natural and Synthetic, Biocoatibility, Biodegradation commonly used biopolymers

**Week 5:** Polymer-Drug conjugates, PEGylation

**Week 6:** Diffusion controlled systems, Ficks laws, Reservoir systems, Non-erodible matrix systems, Bio-erodible Systems

**Week 7:** Hydrogels: Physical or chemical, Pore-size calculation, In-situ crosslinking

**Week 8:** Nano and Micro-particles: Dendrimers, Liposomes, Micelles

**Week 9:** Metal and polymeric particles, Effect of particle shape, Charge and elasticity

**Week 10:** Protein Adsorption and tissue engineering, Drug delivery in tissue engineering

**Week 11:** Implant associated infections, Route specific delivery: Oral, Subcutaneous, Intramuscular, Transdermal, Inhalation, Intravenous

**Week 12:** Vaccines, Cancer vaccines, Cell and gene delivery, Smart responsive drug delivery, Targeted drug delivery, Nanotoxicology and market translation





# INTRODUCTION TO PROTEOGENOMICS

**PROF. SANJEEVA SRIVASTAVA**

Department of Biotechnology

IIT Bombay

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Students with science or engineering background but course is open to all.

**INDUSTRIES APPLICABLE TO** : Thermofisher Scientific, Illumina

## COURSE OUTLINE :

This course is a part of a workshop by experts in the fields of proteomics and proteogenomics in cancer research from the Broad Institute of MIT and Harvard and Indian Institute of Technology Bombay. The course will comprise interactive lectures with case studies, hands-on sessions and demonstrations on proteogenomics aimed at accelerated understanding of cancer. This course will cover the principles of proteogenomics followed by experimental sessions, where proteomics data using LC-MS/MS will be processed and analyzed.

## ABOUT INSTRUCTOR :

Prof. Sanjeeva Srivastava completed Ph.D in University of Alberta, Canada (2006). He has his Post-doc, at Harvard Institute of Proteomics, Harvard Medical School, USA (2007-2009). He worked as an Assistant Professor, Department of Biosciences and Bioengineering, IIT Bombay (2009-2014) and currently is an Associate Professor in the Department.

## COURSE PLAN :

**Week 1:** Proteogenomics overview- Part I and II, Introduction to Genomics- Part I, II and III ; SL1 and SL2

**Week 2:** Introduction to Genomics IV, Gene expression & Phenotype - Part I and II, An overview of NGS technology, SH1 and SH2

**Week 3:** Introduction to Proteomics, Introduction to MS-based Proteomics- Part I and II, Applications of NGS – Ion Torrent SL 3 and SL4

**Week 4:** Introduction to MS-based Proteomics- Part I and II (Hands-on), Data analysis: Normalization Batch Correction and Missing values, Statistical Tests, SH3 and SH4 NGS- Ion Torrent

**Week 5:** Machine learning and Clustering, Hypothesis testing, ProTIGY- Part I and II, Proteogenomics approach to unravel proteoforms, SL5 and SL6: Genomic Analysis using Droplet PCR

**Week 6:** Workflow to Automated Data Processing, Introduction to Fire Cloud and Data Model, Bioinformatics solutions for 'Big Data' Analysis- Part I and II, SH5 and SH6: Genomic Analysis using Droplet PCR

**Week 7:** Data Science infrastructure management- Part I, II and III, DIA-SWATH Atlas-Part I and II, SL7: Introduction to Targeted Proteomics, SH7: Data Analysis using Skyline

**Week 8:** Human Protein Atlas-Part I and II, Affinity based proteomics & HPA, Clinical Considerations for OMICS-Part I and II, SL8: Proteomics: PTMs, SL9: Clinical Proteomics

**Week 9:** Introduction to Proteogenomics-Part I and II, Sequence centric proteogenomics, Gene Variant Analysis, Proteomics in Clinical studies, SH8: ProTIGY

**Week 10:** Supervised Machine learning- Predictive Analysis Part I and II, Supervised Machine learning- Marker Selection, Gene Set Analysis using WebGestalt- Part I and II, SH9: Supervised Machine Learning

**Week 11:** Biological Network Analysis- Part I and II, Mutation and Signaling - Part I and II Pathway Enrichment, SH10: Pathway Enrichment and Network Analysis

**Week 12:** Gene Set Enrichment Analysis (GSEA), Pathway enrichment: GSEA, Linked Omics, (Hands-on), Proteogenomics Conclusions, SL10: Topics in Proteogenomics- Malaria and Cancer case study



# FUNDAMENTALS OF MICRO AND NANOFABRICATION

**PROF. SUSHOBHAN AVASTI**  
**PROF. SHANKAR SELVARAJA**  
IISC BANGALORE

**TYPE OF COURSE** : New | Core | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : General background in Physics, Chemistry, Materials, Chemical engineering, Mechanical engineering, or Electronic engineering should be enough.

**INTENDED AUDIENCE** : Masters students interested in fundamentals of top-down micro and nanodevice fabrication

**INDUSTRIES APPLICABLE TO** : Electronic Device Manufacturing

## **COURSE OUTLINE:**

The course provides an in-depth understanding of top-down device fabrication. Focus is the unit processes typically used in micro & nanofabrication of devices. Both concepts and practical aspects are covered. Topics include crystal growth, doping, chemical vapor deposition, physical vapor deposition, photolithography, wet etching, dry etching, and packaging. The course is accessible to students from diverse backgrounds, such as materials, physics, chemistry, mechanical engineering, and electrical engineering.

## **ABOUT INSTRUCTOR :**

Prof. Sushobhan has worked in the field of semiconductor device fabrication technology for more than 10 years, specializing on photovoltaics. His PhD thesis was on organic, Si heterojunction silicon solar cells. He then worked as a post-doctoral research associate in the Princeton Institute of Science and Technology of Materials (PRISM), where he worked on oxide, Si heterojunction solar cells.

Prof. Shankar Kumar Selvaraja obtained B.E. Electronics and Communication Engineering from Dr. MCET, Pollachi, Bharathiar University, M.E. Optical Communication from College of Engineering, Anna University, Chennai, M. S. Microelectronics and Microsystems from University of Twente, The Netherlands and Ph.D. in Photonics Engineering from Ghent University, Belgium in 2011. His doctoral thesis was carried out at imec (inter-university microelectronics center), Leuven, Belgium on wafer-scale fabrication technology for Silicon photonic integrated circuits.

## **COURSE PLAN :**

**Week 1:** Introduction to micro-fabrication

**Week 2:** Substrate

**Week 3:** Cleaning

**Week 4:** Additive processing: Doping

**Week 5:** Additive processing: Native Films

**Week 6:** Additive processing: CVD

**Week 7:** Additive processing: PVD

**Week 8:** Lithography 1

**Week 9:** Lithography 2

**Week 10:** Subtractive Process: Wet Etching

**Week 11:** Subtractive Process: Dry Etching

**Week 12:** CMP and Packaging



# PRINCIPLES OF DOWNSTREAM TECHNIQUES IN BIOPROCESS

**PROF. MUKESH DOBLE**

Department of Biotechnology  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Basics of physics/chemistry/Maths, Mass and heat balance, and thermodynamics

## COURSE OUTLINE

A product that is manufactured in a bioreactor or a fermentor, is recovered and purified in several subsequent unit operations. The economy of a manufacturing process is determined by the cost effectiveness of these downstream operations. This course discusses these operations and the basic underlying principles with worked out problems.

## ABOUT INSTRUCTOR

Prof. Mukesh Doble is a Professor at the Department of Biotechnology at IIT Madras. He has previously worked in Imperial chemical Industries (ICI) and General Electric (GE) for 20 years. Areas of research are Biomaterials, Biopolymers, and Drug design. He has Published 250 papers and 8 books and filed 6 patents.

## COURSE PLAN

**Week 1** : Introduction; Mass balance, Heat Balance, flow sheet; Costing

**Week 2** : Costing (continued), Physical and chemical principles in Downstream; Problems in Mass balance, flow sheet; Cell Breakage

**Week 3** : Cell Breakage (continued); Solid Liquid Separation; Solid Liquid Separation (continued)

**Week 4** : Solid Liquid separation-problems; Pre-treatment and Filters; Adsorption

**Week 5** : Adsorption (continued); Adsorption (continued); Adsorption (continued)

**Week 6** : Liquid-Liquid Extraction; Liquid-Liquid extraction (continued); Liquid-Liquid extraction (continued)

**Week 7** : Liquid-Liquid extraction (continued); Reversed micellar and aqueous two phase extraction Membranes

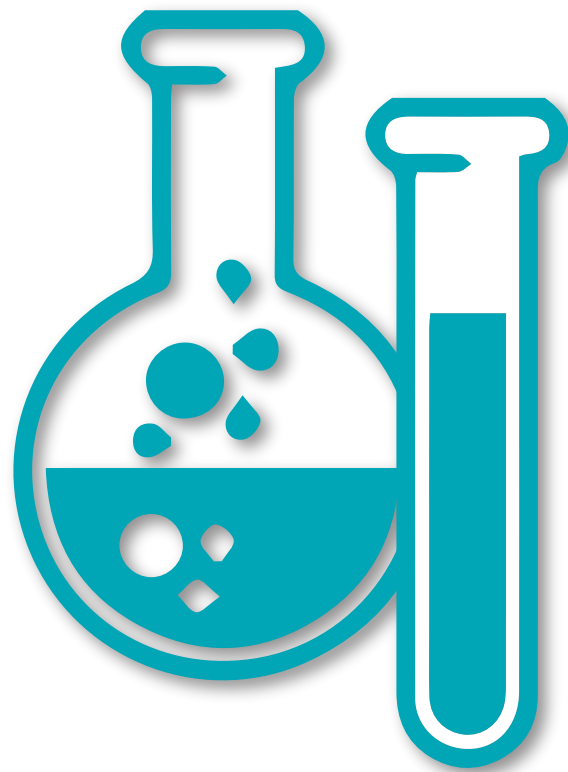
**Week 8** : Membranes (continued); Membranes (continued); Membranes (continued)

**Week 9** : Precipitation; Chromatography; Chromatography (continued)

**Week 10** : Chromatography (continued); Chromatography (continued); Chromatography (continued)

**Week 11** : Chromatography (continued); Chromatography (continued); Crystallisation

**Week 12** : Drying; Drying and Distillation; Future trends, Summary of the course



# **CHEMICAL ENGINEERING**



# CHEMICAL ENGINEERING

## 04 weeks

- 01. Unit operations of particulate matter
- 02. Infrared spectroscopy for pollution monitoring.

## 08 weeks

- 01. Natural Gas Engineering
- 02. Phase Equilibrium Thermodynamics
- 03. Technologies For Clean And Renewable Energy Production

## 12 weeks

- 01. Chemical Engineering Thermodynamics
- 02. Chemical Process Intensification
- 03. Chemical Process Safety
- 04. Chemical Reaction Engineering-I
- 05. Flow through porous media
- 06. Fluid and Particle Mechanics
- 07. Heat Transfer
- 08. Continuum Mechanics and Transport Phenomena
- 09. Introduction to Polymer Physics
- 10. Fundamentals of Particle and Fluid Solid Processing
- 11. Mass Transfer Operations - II
- 12. Mechanical Unit Operations



# UNIT OPERATIONS OF PARTICULATE MATTER

**PROF. SHABINA KHANAM**

Department of Chemical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Core | UG  
**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**INDUSTRIES APPLICABLE TO** : Any chemical industry which deals with particulate matter

**COURSE OUTLINE :**

Around 75% of chemical manufacturing processes involve small solid particles at some point. Proper design and handling of these fine particles often makes the difference between success and failure of the product. Many products such as catalysts, pigments, fertilizers, cements, ceramics and pharmaceuticals are currently manufactured in particulate forms. Unit Operations of Particulate Matter deal with Science and Technology of solid material, which is a multidisciplinary field including Materials Science, Environmental, Biomedical, Aerospace, Agricultural, Chemistry, Microbiology and Cell Science, Pharmacy and Medicine. The primary objective of this course is to

- Identify the important physical mechanisms occurring in processes involving particles
- Formulate and solve mathematical descriptions of such processes
- Apply this knowledge to the design of particulate systems such as Sedimentation tank, Filtration unit, Fluidization unit, Flotation cell, etc.

**ABOUT INSTRUCTOR :**

Dr. Shabina Khanam is working as Associate Professor in Chemical Engineering Department of IIT Roorkee. She has completed B.Tech degree from AMU Aligarh, Aligarh in 2000 and M.Tech and Ph.D. degree from IIT Roorkee in 2002 and 2007, respectively. Her major field of study is Process Integration, Energy and Mass Conservation and Modeling and Simulation of Chemical Processes. She has almost 10 years experience in teaching and research. During this period she has supervised 2 Ph.D. and 19 M.Tech. theses. At present 6 Ph.D and 3 M.Tech theses are in pipe line. She has published 29 and 26 research papers in different refereed journals and conferences, respectively. She has taught the proposed course six times in her 10 years teaching career.

**COURSE PLAN :**

**Week 01** : Introduction, Sedimentation and Design of Thickener, Centrifugal Sedimentation, Industrial Equipment

**Week 02** : Filtration , Batch Filtration , Continuous Filtration , Filtration Equipment

**Week 03** : Fluidization, Liquid Fluidization, Gas Fluidization

**Week 04** : Flotation, Transportation of Solids, Hydraulic Transport and Pneumatic Transport





# INFRARED SPECTROSCOPY FOR POLLUTION MONITORING

**PROF. J R MUDAKAVI**

Dept. of Chemical Engineering  
IISc Bangalore

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (2 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Chemists and Chemical Engineers, Environmental Engineers, Environmental Scientists, Civil Engineers, Pollution Control Administrators.

: 10+2 +3years of BE/BSC Basic knowledge of differential calculus and integration

**INDUSTRIES APPLICABLE TO** : Chemical industries, pollution control

**COURSE OUTLINE :**

Nowadays, Infra Red Spectroscopy is the most preferred technique for synthesis and monitoring almost all organic compounds. The course consists of : Introduction to pollution control monitoring, Atomic structure, Introduction to Infra Red Spectroscopy, Interaction of electromagnetic radiation with matter, Instrumentation for Infra Red Spectroscopy, Applications of Infra Red Spectroscopy for air pollution, organic compounds in the Industrial Effluents, Continuous Monitoring etc.

**ABOUT INSTRUCTOR :**

Prof. J R Mudakavi is a former faculty of Chemical engineering Dept, Indian Institute of Science, Bangalore. He has taught "Modern Instrumental Methods of analysis and Pollution Control" for 36 years. He is an authority on analytical instrumentation. He is the author of 2 books on Air Pollution and Hazardous Waste management. He has published more than 100 papers in National and International Journals, conferences, symposia etc. He is a member of several expert committees such as CSIR, DST, MOEF, KSPCB etc. He has offered two courses on instrumentation in NPTEL. He is a popular science writer, lecturer and environmentalist.

**COURSE PLAN :**

**Week 1:** Introduction to pollution control monitoring and Atomic structure.

**Week 2:** Atomic structure and Interaction of electromagnetic radiation with matter

**Week 3:** Interaction of electromagnetic radiation with matter and Instrumentation for Infra-red Spectroscopy.

**Week 4:** Infrared Spectroscopy and Application of Infra-red Spectroscopy for chemical analysis and air pollution monitoring.



# NATURAL GAS ENGINEERING

**PROF. PANKAJ TIWARI**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : Rerun | Core&Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, Ph.D

**PRE-REQUISITES** : Bachelor Degree in any Engineering discipline

**INDUSTRIES APPLICABLE TO** : Petroleum Industries/companies: ONGC, OIL, GAIL, IOCL, etc.

## COURSE OUTLINE :

The field of natural gas engineering is very much important for petroleum engineers specializing in gas processing technology. The course outlines an optimal balance between natural gas production, natural gas processing and gas transportation. An extensive treatise on natural gas engineering, both upstream and gas refining processes with key equipment and facility design will be covered. This course will also highlight the current status of production of natural gas through unconventional sources/technics and the applications of natural gas.

## ABOUT INSTRUCTOR :

Dr. Pankaj Tiwari is serving as Assistant Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati since Aug 2012. He has received doctoral degree from University of Utah, USA (2012) and Master of Technology from Indian Institute of Technology Kanpur, India (2006). He also worked at General Electric, Plastic division at JFWTC Bangalore (2007) on developing the monomer for high performance polymer (HPP). He has taught Natural Gas Engineering as an elective course to UG, PG and PHD students at IIT Guwahati for three consecutive years (2013, 2014 and 2015).

## COURSE PLAN :

- Week 01** : Introduction, Gas Production, Upstream, Reservoir- Well Completion, Properties of Natural Gas: Phase Behavior, etc.
- Week 02** : Properties of Natural Gas: Formation Volume Factor, etc., Gas Reservoir Deliverability, Wellbore Performance, Choke Performance.
- Week 03** : Well inflow performance relationship (IPR), Skin factor, Productivity Index, Wellbore Performance: TPR Curve, Single Phase & Multi Phase flow, Choke Performance: CPR Curve, Sonic and Subsonic Flow.
- Week 04** : Well Deliverability : Nodal Analysis.
- Week 05** : Natural Gas Production: Downstream, Surface Facilities, Principle of Separator, Design of Separator: Vertical, Horizontal; Two Phase Separation, Three Phase Separation.
- Week 06** : Dehydration of Natural Gas, Design of Dehydration, Sweeting Processes.
- Week 07** : Compressor design and energy calculation, Transportation and Measurement, Pipeline Design.
- Week 08** : Flow through pipeline, issues and solutions, Unconventional Production of Natural Gas: Shale Gas, Gas Hydrates, Coal bed Methane, Oil Shale, Pyrolysis of Carbonaceous Materials etc..



# PHASE EQUILIBRIUM THERMODYNAMICS

**PROF. GARGI DAS**

Department of Chemical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Basic knowledge of Engineering Thermodynamics desirable

**INDUSTRIES APPLICABLE TO** : Refining and Petrochemical Industry (IOC, HPCL, BPCL etc.), G.A.I.L., O.N.G.C, Shell

## COURSE OUTLINE :

This is an introductory course in Thermodynamics and is one of the basic subjects to understand interfacial mass transfer and separation processes like distillation, solvent extraction, etc. The course introduces the concepts of chemical potential and fugacity and emphasizes the principles governing equilibrium for single and multicomponent systems. It discusses ideal as well as non-ideal solutions and deals with the entire range of phase miscibility (completely miscible to totally immiscible). There is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will be able to apply the basic principles of thermodynamics, the laws, and the pertinent equations to engineering design of mass transfer equipment.

## ABOUT INSTRUCTOR :

Prof. Gargi Das is Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur, West Bengal. She has been teaching thermodynamics for the past 16 years to the students of Chemical Engg and Biotechnology as a core course. Students from Mechanical Engineering, Agricultural Engineering and Chemistry have opted it as a breadth course. She has contributed to NPTEL through her video based and web based courses on Multiphase Flow and Thermodynamics. Her areas of expertise are Multiphase Flow, Transport phenomena, CFD and Process Intensification. She has over 50 refereed research papers, two books and three book chapters.

## COURSE PLAN :

**Week 01** : Chemical Potential

**Week 02** : Chemical Equilibrium

**Week 03** : Fugacity

**Week 04** : Ideal solution

**Week 05** : Properties of solutions

**Week 06** : Non ideal solution –activity coefficient – Part 1

**Week 07** : Non ideal solution –activity coefficient – Part 2

**Week 08** : Partially and completely immiscible systems, Hydrocarbon Thermodynamics



# TECHNOLOGIES FOR CLEAN AND RENEWABLE ENERGY PRODUCTION

**PROF.P. MONDAL**

Department of Chemical Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**COURSE OUTLINE :**

The course deals with the production of energy from different fossil fuels through cleaner routes as well as from renewable resources. It is intended to help the young scientific professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of energy resources for cleaner energy production.

**ABOUT INSTRUCTOR :**

Dr. Prasenjit Mondal, is presently working as Associate Professor in the Department of Chemical Engineering, Indian Institute of Technology Roorkee, India. He joined the institute in 2009 as Assistant Professor. He has also worked as Process Engineer in industry for two years and as scientist in Centre for Scientific and Industrial Research, India for three years before joining IIT Roorkee. His area of research is Energy and Environmental Engineering. He has handled number of R & D projects sponsored by Industry, Govt. of India and International Agencies. He has published two books and more than 150 papers in international journals and conference proceedings. He is the recipient of NTSE scholarship, MHRD fellowship, Govt. of India .

**COURSE PLAN :**

**Week 1:** Introduction, Characterization of coal and conventional routes for energy production from coal

**Week 2:** Cleaner routes for energy production from coal

**Week 3:** Characterization of crude oil and conventional routes for crude oil utilization

**Week 4:** Cleaner routes for energy production from petroleum crude

**Week 5:** Cleaner energy production from gaseous fuels

**Week 6:** Solar and wind energy production

**Week 7:** Production of hydro and geothermal energy

**Week 8:** Energy production from biomass and wastes and energy conservation



# CHEMICAL ENGINEERING THERMODYNAMICS

**PROF. JAYANT K. SINGH**

Department of Chemical Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Engineering Thermodynamics.

**INTENDED AUDIENCE** : B.Tech in Chemical Engineering

**INDUSTRIES APPLICABLE TO** : Industries - Bechtel, UOP, EIL, Reliance,  
Indian Oil, ONGC, Unilever

## **COURSE OUTLINE :**

This course covers the foundation of classical thermodynamics in the form of postulates, and later their applications to open and close systems, criteria of stability and equilibria, the equation of states, properties of pure fluids and mixtures, theories and model of phase equilibrium, and chemical reaction equilibrium.

## **ABOUT INSTRUCTOR :**

Prof. Jayant K. Singh received his B.Tech from IIT Kanpur in Chemical Engineering in 1997. He subsequently completed his Masters degree in Computer Science and Engineering and Ph.D. in Chemical Engineering in the area of molecular simulation from SUNY Buffalo, USA in 2004. Dr. Singh is currently a professor in the department of Chemical Engineering at IIT Kanpur. This research interest is in thermodynamics and statistical mechanics, material modeling, confined fluids and development of molecular simulation tools. Dr Singh has co-authored more than 100 peer reviewed articles in international journals of repute.

## **COURSE PLAN :**

**Week 1:** : The postulates of thermodynamics, Condition of Equilibrium

**Week 2:** The maximum Work Theorem, Carnot Cycle and other cycles

**Week 3:** Generalized Thermodynamic Potential, Maxwell relation, Stability of

**Week 4:** Properties of pure fluids

**Week 5:** Intermolecular forces, Equation of States

**Week 6:** Properties of mixtures-I

**Week 7:** Properties of mixtures-II

**Week 8:** Vapor-liquid equilibrium

**Week 9:** Theories and models of VLE of mixtures-I

**Week 10:** Theories and models of VLE of mixtures-II

**Week 11:** LLE and SLE

**Week 12:** Chemical Reaction Equilibria



# CHEMICAL PROCESS INTENSIFICATION

**PROF. SUBRATA KUMAR MAJUMDER**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : BE/MSc in Chemical Engineering

**INTENDED AUDIENCE** : UG/PG students of Chemical/ Mechanical Engineering

**INDUSTRIES APPLICABLE TO** : Industrial Research and Development Section of Chemical and Mechanical Engineering.

## **COURSE OUTLINE :**

This course covers the developments in a number of intensified technologies, with particular emphasis on their application in chemical processes. The course is intended to be a useful resource for practising engineers and chemists alike who are interested in applying intensified reactor and/or separator systems in chemical industries. It will provide a basic knowledge of chemical engineering principles and process intensification for chemists and engineers who may be unfamiliar with these concepts. It will be a valuable tool for chemical engineers who wish to fully apply their background in reaction and separation engineering to the design and implementation of green processing technologies based on process intensification principles. Students in undergraduate and postgraduate degree programmes, will gain a better understanding of the practical applications in different areas.

## **ABOUT INSTRUCTOR :**

Dr. S. K. Majumder is a Professor in the Chemical Engineering Department, IIT Guwahati, India. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. He is a Fellow of the International Society for Research and Development, London, UK. He is also a recipient of various honours and awards. He has authored four books, five book chapters, and has more than 80 publications in several reputed international journals. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

## **COURSE PLAN :**

**Week 1:** Introduction on Process Intensification

**Week 2:** Mechanism involved in the process intensification

**Week 3:** Role of Process intensification in sustainable development

**Week 4:** Design Techniques for Process Intensifications

**Week 5:** Stochastic Optimization for Process Intensification

**Week 6:** Process intensification by cavitation

**Week 7:** Process Intensification by monolith reactor

**Week 8:** Process Intensification by interface modification and residence time

**Week 9:** Process intensification in distillation

**Week 10:** Process intensification in extraction

**Week 11:** Process intensification by membrane

**Week 12:** Micro Process Technology in process intensification



# CHEMICAL PROCESS SAFETY

**PROF. SHISHIR SINHA**

Department of Chemical Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Chemical Engineering Thermodynamics, Chemical Technology

**INTENDED AUDIENCE** : All Chemical Engineering students

**INDUSTRIES APPLICABLE TO** : Useful for all Process industries, Refineries, Fertilizer plants, Petrochemical plants specially for managers and decision makers

**COURSE OUTLINE :**

As chemical process technology becomes more complex, chemical engineers will need a more detailed and fundamental understanding of safety. The course focuses on understanding the important technical fundamentals of chemical process safety. The emphasis on the fundamentals will help the student understand the concepts and apply them accordingly. This application requires a significant quantity of fundamental knowledge and technology.

**ABOUT INSTRUCTOR :**

Prof. Shishir Sinha is presently working as Professor and Head in the Department of Chemical Engineering at IIT Roorkee. He has been teaching the courses related to Process Utilities and Safety, Chemical Engineering Thermodynamics and safe operation in Petroleum industries to undergraduate and postgraduate students for more than 12 years.

**COURSE PLAN :**

**Week 1:** Introduction to Process safety, Accidents and Loss statistics

**Week 2:** Toxicological Studies

**Week 3:** Fire and Explosion

**Week 4:** Prevention of Fire and Explosion

**Week 5:** Source model and dispersion

**Week 6:** Relief and relief sizing

**Week 7:** Hazard Identification, HAZOP analysis

**Week 8:** Risk Assessment

**Week 9:** QRA and LOPA

**Week 10:** Process of Accident Investigation

**Week 11:** Reliability Engineering

**Week 12:** Economics of loss prevention





# CHEMICAL REACTION ENGINEERING - I

**PROF. BISHNUPADA MANDAL**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.Tech in Chemical Engineering and allied disciplines

**INDUSTRIES APPLICABLE TO** : Almost all chemical industries including IOCL, OIL, ONGC, etc.

## **COURSE OUTLINE :**

This course will provide an overview of chemical kinetics and reactor design at basic to an intermediate level. This course applies the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical and biological reacting systems such as derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions and design of chemical and biochemical reactors via synthesis of chemical kinetics, and mass and energy balances. The goal is to provide students with the theoretical/analytical background to understand chemical kinetics and reactor design and to tackle complex problems.

## **ABOUT INSTRUCTOR :**

Prof. Bishnupada Mandal is currently a Professor and Head in the Department of Chemical Engineering at the Indian Institute of Technology, Guwahati. Prof. Mandal has over 15 years of teaching and research experience at IIT Guwahati. He has received B.Sc in Chemistry (Honours) and B.Tech. in Chemical Engineering from University of Calcutta, Kolkata, M.Tech. in Chemical Engineering from Jadavpur University, Kolkata and Ph.D in Engineering from Indian Institute of Technology, Kharagpur, India. He was visiting Research Professor in the department of Chemical and Biomolecular Engineering at The Ohio State Engineering, Columbus, Ohio, USA during May-July 2017. He has served as Vice Chairman, IIT-JEE 2011 as well as Chairman, IIT-JEE 2012 for IIT Guwahati Zone. He had been a recipient of the prestigious BOYSCAST fellow award of Department of Science and Technology (DST) Govt. of India and spent one year (2006-2007) as a visiting scientist at the Ohio State University, Columbus, USA.

## **COURSE PLAN :**

**Week 1:** Kinetics of Homogeneous Reactions

**Week 2:** Stoichiometry

**Week 3:** Interpretation of Batch Reactor Data

**Week 4:** Ideal Reactor Design

**Week 5:** Design for single reactions

**Week 6:** Design for parallel reactions

**Week 7:** Design for parallel reactions (contd)

**Week 8:** Temperature and Pressure Effects

**Week 9:** Temperature and Pressure Effects (contd)

**Week 10:** Residence Time Distribution

**Week 11:** Reactor modeling with RTD

**Week 12:** Reactor modeling with RTD (contd)



# FLOW THROUGH POROUS MEDIA

**PROF.SOMENATH GANGULY**

Department of Chemical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core\_Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Background in Fluid Mechanics or equivalent is preferred

**INTENDED AUDIENCE** : Chemical / Mechanical / Civil / Petroleum / Environmental / Biomedical Engineering Water Resources, Soil Science, Hydrogeology, Agriculture

**INDUSTRIES APPLICABLE TO** : Chemical Process Industries, Oil & Gas Companies, Environmental Consultants

## **COURSE OUTLINE :**

A general overview of porous media flow, and introduction to various theoretical tools to characterize and predict the flow is provided in this course. The course is meant for undergraduate students, pursuing degrees in various engineering disciplines, listed above. The course will serve as a refresher course for PG students, who are engaged in research related to porous media flow.

## **ABOUT INSTRUCTOR :**

Prof. Somenath Ganguly teaches at IIT Kharagpur and supervises a research laboratory on Microstructured Porous Media. He performed research work in the area resulting in several sole-author publications in Transport in Porous Media (Springer), Journal of Porous Media, Chemical Engineering Research and Design. Also, he stays abreast with new knowledge in this field by regularly reviewing manuscripts.

## **COURSE PLAN :**

**Week 1:** Introduction, Permeability, Porosity, Various forms of characterizations

**Week 2:** Darcy's Law, Mass Continuity in Cartesian and Cylindrical Coordinates, Pressure Equations

**Week 3:** Reynold's Number for Porous media, Kozeny Carman, and Ergun Equation

**Week 4:** Transport mechanisms: Bulk and Surface Diffusion, Knudsen Transport, Klinkenberg effect, slip flow

**Week 5:** Immiscible displacement, two phase mass continuity, capillary pressure

**Week 6:** Conceptual models of relative permeability and saturation

**Week 7:** Progression of saturation front in two phase flow, Buckley Leverett theory

**Week 8:** Miscible displacement, Diffusion in porous media, Tracer Test

**Week 9:** Introduction to Taylor Aris Dispersion, Dispersion Regimes

**Week 10:** Migration and interception of fine particles

**Week 11:** Introduction to flow through deformable porous media

**Week 12:** Applications, Summary



# FLUID AND PARTICLE MECHANICS

**PROF. BASAVARAJ MADIVALA**  
**PROF. SUMESH P. THAMPI**  
Department of Chemical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Core | UG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**INDUSTRIES APPLICABLE TO** : Chemical process industries

## **COURSE OUTLINE :**

This course introduces the concepts of fluid and particle mechanics and demonstrates their applications.

## **ABOUT INSTRUCTOR :**

Prof. Madivala G. Basavaraj Before joining IIT-Madras in February 2011, he spent 3 months as visiting fellow at KULeuven (Belgium) in Prof. Jan Vermant's group. he was a postdoctoral researcher with Prof. Norman J. Wagner at the University of Delaware (USA). he studied chemical engineering at SIT, Tumkur (Bangalore University), and received my M.S (Research) from IISc, Bangalore, by working on - the determination of local dispersion coefficient and local holdup in a packed bed using X-rays. his PhD in chemical engineering is from KULeuven, Belgium (Prof. Jan Vermant). his PhD thesis was on - Tailoring colloidal gel rheology in bulk and at interfaces: Exploiting shape and surface chemistry effects.

Prof. Sumesh is an Assistant Professor at IIT Madras. His research areas are Interfacial Fluid Mechanics, Hydrodynamics of complex fluids, Active Matter. He did his Post-doctoral research at Oxford University. He is interested in understanding soft and living (or active) fluids.

## **COURSE PLAN :**

**Week 1:** Introduction to Navier Stokes (NS) equations and their exact solutions, Poiseuille flow

**Week 2:** Taylor Couette flow, Rheology

**Week 3:** Dimensional analysis

**Week 4:** Turbulent Flow

**Week 5:** Friction losses, Moody's chart

**Week 6:** Boundary layer theory

**Week 7:** Introduction to Particles, their characterization

**Week 8:** Particulate Phenomena – Brownian motion and phoresis

**Week 9:** Motion of particles in a fluid, terminal velocity, particle separation

**Week 10:** Sedimentation of dilute, concentrated and flocculated dispersions

**Week 11:** Packed and Fluidized Beds

**Week 12:** Filtration



# HEAT TRANSFER

**PROF. SUNANDO DASGUPTA**

Department of Chemical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Chemical and Mechanical Engg

**PRE-REQUISITES** : Process engineers, Linear algebra, Fluid Mechanics

**INDUSTRIES APPLICABLE TO** : Reliance, HPCL, BPCL, RCF, Other chemical and petrochemical industries

**COURSE OUTLINE :**

Heat transfer occurs in many unit operations in variety of processes in chemical, petrochemical, power and pharmaceutical industries. Understanding the fundamentals governing heat transfer is key to designing equipment that involves heat exchange. This course for undergraduate students covers the fundamental aspects and quantitation of different modes of heat transport. The course can also serve as a refresher for graduate students.

**ABOUT INSTRUCTOR :**

Prof. Sunando DasGupta is a professor of Chemical Engineering and was the Dean of Sponsored Research at the Indian Institute of Technology Kharagpur. He obtained his Bachelor's degree from the Jadavpur university, Masters from IIT Kanpur and PhD from the Rensselaer Polytechnic Institute, USA in 1992. His research interests are in the fields of microscale transport processes and microfluidics and he has over 140 publications in peer reviewed journals. Prof. DasGupta is a Fellow of the National Academy of Engineering, has received the Herdillia Award by the Indian Institute of Chemical Engineers for excellence in Basic Research in Chemical Engineering and is a Senior Associate of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.

**COURSE PLAN :**

**Week 1:** Introduction; Introduction to Conduction; Energy Balance; 1D Steadystate Conduction - Resistance Concept; Resistances in Composite Wall Case

**Week 2:** Resistances in Radial systems; Heat Generation I : Plane and Cylindrical Wall; Introduction to Extended Surfaces; Extended Surfaces I : General formulation; Extended Surfaces II - Uniform Cross-sectional Area

**Week 3:** Extended Surfaces III – Varying Cross-section area; 2D Plane wall; Transient Analyses I : Lumped Capacitance Method; Transient Analyses II : Full Method; Transient Analyses : Semi-infinite Case

**Week 4:** Introduction to Convective Heat Transfer; Heat and Mass Transport Coefficients; Boundary Layer : Momentum, Thermal and Concentration; Laminar and Turbulent Flows ; Momentum Balance; Energy and Mass Balances ; Boundary Layer Approximations

**Week 5:** Order of Magnitude Analysis; Transport Coefficients; Relationship between Momentum, Thermal and Concentration boundary Layer; Reynolds and Chilton-Colburn Analogies; Forced Convection : Introduction

**Week 6:** Flow Past Flat Plate I – Method of Blasius; Flow Past Flat Plate II - Correlations for Heat and Mass Transport; Flow Past Cylinders; Flow through Pipes I; Flow through Pipes II

**Week 7:** Flow through Pipes III; Flow through Pipes IV – Mixing-cup Temperature; Flow through Pipes V – Log mean Temperature difference; Flow through Pipes VI – Correlations for Laminar and Turbulent Conditions; Example problems : Forced Convection

**Week 8:** Introduction to Free/Natural Convection; Heated plate in a quiescent fluid- I; Heated plate in a quiescent fluid- II; Boiling I; Boiling II

**Week 9:** Condensation : I; Condensation : II; Radiation : Introduction; Spectral Intensity; Radiation : Spectral properties, Blackbody

**Week 10:** Properties of a Blackbody; Surface Adsorption; Kirchoff's Law; Radiation Exchange - View Factor; View Factor Examples

**Week 11:** View factor - Inside Sphere Method, Blackbody Radiation Exchange; Diffuse, Gray Surfaces in an Enclosure; Resistances - Oppenheim matrix method; Resistances - Examples; More Examples : Volumetric Radiation

**Week 12:** Introduction and Examples; Parallel Flow Heat Exchangers; LMTD I; Shell and Tube Heat Exchangers; Epsilon-NTU Method



# CONTINUUM MECHANICS AND TRANSPORT PHENOMENA

**PROF. T. RENGANATHAN**

Department of Chemical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Engineering Physics, Engineering Mathematics, Chemical Process Principles, Engineering Thermodynamics

**INTENDED AUDIENCE** : Undergraduate students in Chemical Engineering, Mechanical Engineering, Biotechnology

**INDUSTRIES APPLICABLE TO** : Any process industry

## **COURSE OUTLINE :**

This course relates the laws of Physics to the conservation equations of transport phenomena. Continuum mechanics brings out the analogy between solid and fluid mechanics. Transport phenomena brings out the analogy between the transport of momentum, energy and mass.

## **ABOUT INSTRUCTOR :**

Prof. T. Renganathan is a faculty in the Department of Chemical Engineering at IIT Madras. Prior to joining IIT Madras, he worked as a faculty at Anna University, Chennai. He has taught many of the core courses in Chemical Engineering and established two undergraduate laboratories. His areas of research includes multiphase flows, microfluidics, gasification and capture of CO<sub>2</sub>. He has carried out many sponsored and consultancy projects mainly in the area of energy and environment.

## **COURSE PLAN :**

- Week 1:** Fluid kinematics : Eulerian vs. Lagrangian; Material Derivative; Flow visualization; System vs. Control volume; Reynolds Transport Theorem
- Week 2:** Total mass balance : integral balance and applications; differential balance and applications
- Week 3:** Linear Momentum balance : Integral balance; Calculation of force
- Week 4:** Stress : Traction Vector, Stress at a point, Stress element, stress tensor; Cauchy's formula; Equality of cross shears; Fluids at rest; Stress in fluids
- Week 5:** Strain : Types and measures of deformation; Displacement Field, Displacement Gradient – 1D, 3D; relationship between strain and Displacement Field; displacement Gradient Tensor, Strain tensor, Rotation tensor; Fluids vs. Solids; Strain rate tensor
- Week 6:** Hooke's Law; Lamé's equation; Relationship between material properties; Newton's law of viscosity; Navier-Stokes equation
- Week 7:** Pascals's law and applications; Bernoulli equation and applications; Applications of Navier-Stokes equation - Couette flow and Poiseuille flow
- Week 8:** Momentum transport : Shear stress as momentum flux; Navier Stokes equation; Integral energy balance and applications
- Week 9:** Differential balance for total energy, Potential energy, Kinetic energy, Internal energy, Enthalpy, Temperature; Fourier's law; Applications of differential energy balance - Composite walls, Couette Flow
- Week 10:** Integral component mass balance and applications (batch reactor and CSTR); Fick's law; total flux, diffusion flux, convection flux, different average velocities; differential component mass balance
- Week 11:** Applications of differential component mass balance : Diffusion through stagnant film; diffusion with homogeneous reaction
- Week 12:** Shell balance in Cylindrical and Spherical Coordinates : Liquid flow through pipe; Current Flow through wire; Sublimation of solid; Concluding remarks



# INTRODUCTION TO POLYMER PHYSICS

**PROF. PRATEEK KUMAR JHA**  
Department of Chemical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Core/Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, Ph.D

**PRE-REQUISITES** : Following courses are desired but not mandatory: Undergraduate courses in computer programming, thermodynamics, fluid mechanics/solid mechanics/continuum mechanics, and engineering mathematics/calculus.

**INDUSTRIES APPLICABLE TO** : Polymer and plastic Industries.

## COURSE OUTLINE :

This course is an introduction to the physics of polymers, designed for senior undergraduate and postgraduate students. We will discuss statistical-mechanical, thermodynamic, and continuum theories for the structure, dynamics, and rheology of polymeric materials. Emphasis will be on developing a conceptual understanding of the theoretical and simulation methods employed in the study of polymers, and their application to specific systems. This course can be of potential interest to students studying in various disciplines including polymer science, chemical engineering, physics, chemistry, and materials science.

## ABOUT INSTRUCTOR :

Dr. Prateek Kumar Jha is an Assistant Professor in the Department of Chemical Engineering at IIT Roorkee. He did his PhD in Chemical Engineering at Northwestern University, USA, followed by postdoctoral research at University of Michigan, Ann Arbor, USA. His current areas of research interest are molecular simulations, polymer physics, drug delivery, and charged systems.

## COURSE PLAN :

- Week 01** : Macromolecules and Life, Molecular flexibility, Classification of polymers, Types of polymerization, Average molecular weights and polydispersity, Concept of universality
- Week 02** : Random walk models in polymer physics: 1-D random walk (drunkard walk), 2-D random walk on a lattice, freely jointed chain, modified freely jointed chain, freely rotating chain
- Week 03** : Elastic energy of polymer chain, bead-spring model, ideal polymer chain and finite extension models, radius of gyration, pair correlation function, scattering experiments
- Week 04** : Review of programming concepts, Monte Carlo simulations of a polymer chain, Importance Sampling, Metropolis criteria, Practical aspects of Monte Carlo simulation
- Week 05** : Excluded volume interaction. Flory theory in good solvent, bad solvent, and theta solvent. Monte Carlo simulations in good solvent and bad solvent regime.
- Week 06** : Concentrated polymer solutions. Review of Solution thermodynamics: Mixing and phase separation, osmotic pressure, chemical potential, thermodynamic origin of diffusion.
- Week 07** : Lattice model of solutions, Flory-Huggins theory of polymer solutions, Definition of partition function and free energy, binodal and spinodal curve, critical point, extension to polymer blends and melt
- Week 08** : Brownian motion, Correlation functions, Time translational invariance and time reversal symmetry, Brownian motion of a free particle, Einstein relation
- Week 09** : Brownian motion in a potential field, Introduction to Molecular Dynamics and Brownian Dynamics
- Week 10** : Rouse model of polymer chain, normalized coordinates and basis functions, Rouse modes, problems with Rouse model
- Week 11** : Review of continuum mechanics: equations of motion, stress tensor, deformation tensor, deformation gradient tensor, constitutive relations of solids, liquids, and rubber. Microscopic definition of stress tensor.
- Week 12** : Experimental rheology: rheometers, linear viscoelasticity, superposition principle, relaxation modulus, storage modulus, loss modulus.





# FUNDAMENTALS OF PARTICLE AND FLUID–SOLID PROCESSING

**PROF. ARNAB ATTA**

Department of Chemical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Fluid Mechanics

**INTENDED AUDIENCE** : Chemical Engineering

**INDUSTRIES APPLICABLE TO** : GAIL, ONGC, IOCL, Reliance Industries, Tata Steel, Haldia, Petrochem

**COURSE OUTLINE :**

The objective of this course is to familiarize students with various industrial operations involving particulate solids and its handling in various unit operations, where fluid-particle interactions are of paramount importance. This course will describe and explain the fundamentals of fluid-particle mechanics, which are essential for the understanding of numerous industrial fluid-solid processes like packed bed operation, fluidization, sedimentation, filtration, separation of solids from fluids, etc.

**ABOUT INSTRUCTOR :**

Prof. Arnab Atta is presently an Assistant Professor of Chemical Engineering at IIT Kharagpur. He obtained his Ph.D. in Chemical Engineering from IIT Delhi, as a National Doctoral Fellow. During his Ph.D., he was granted the Canadian Commonwealth Fellowship to visit and pursue a collaborative research in the Department of Chemical Engineering, Laval University, Quebec, Canada. His research interests are inclined towards developing CFD models for a range of applications in multiphase flow and systems at different length scales. He also actively works on droplet based microfluidic flows.

**COURSE PLAN :**

**Week 1:** Introduction to relevance of fluid-particle mechanics and processing operations in chemical engineering. Solid particle characterization Size distribution, determinations of mean particle size, methods of particle size measurement

**Week 2:** Fluid-particle mechanics: Flow around immersed bodies, concept of drag, boundary layer separation

**Week 3:** Fluid-particle mechanics: Motion of particles in a fluid, effect of particle shape, influence of boundaries on terminal velocity

**Week 4:** Fluid flow through granular and packed beds of particles: Ergun equation, Kozeny- Carman equation, Darcy's law, permeability

**Week 5:** Fluidization: Minimum fluidization velocity, relevant particle properties, types of fluidization, liquid- solid and gas-solid systems

**Week 6:** Introduction to separation of solids from fluids. Sedimentation - Free and hindered settling, fine and coarse particles, Richardson-Zaki equation

**Week 7:** Filtration: Principles of flow through filter cakes and medium, filtration practice, selection of filtration equipment

**Week 8:** Centrifugal separations: Gas cyclone and hydrocyclone, efficiency of separation, sedimentation in a centrifugal field

**Week 9:** Particle size reduction: Particle fracture mechanisms, energy requirement for size machine types and characteristics of comminution equipment, selection of appropriate machine

**Week 10:** Particle size enlargement: Interparticle forces, comparison and interaction between forces, nucleation and growth of particles, granulation equipment

**Week 11:** Transport of fluid-solid systems: Hydraulic and pneumatic transport, flow regimes, rheological models, dilute and dense phase

**Week 12:** Colloids and nanoparticles: Introduction, surface forces, suspension rheology, and application





# MASS TRANSFER OPERATIONS - II

**PROF. CHANDAN DAS**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Mass Transfer Operations I

**INTENDED AUDIENCE** : Under graduate students/Candidates from professional fields

**INDUSTRIES APPLICABLE TO** : All chemical and design industries like TATA STEEL, Worley Parsons Oman Engineering LLC, Hindalco Industries Limited, Indian Oil Corporation Ltd., Engineers India Ltd, etc.

**COURSE OUTLINE :**

This course will provide an overview on mass transfer at basic to an intermediate level. This course applies the concepts of diffusion and interphase mass transfer to the analysis of different unit operations such as humidification, drying, adsorption, extraction, leaching, crystallization and membrane processes.

**ABOUT INSTRUCTOR :**

Prof. Chandan Das is a Professor in Department of Chemical Engineering at IIT Guwahati. His Key research areas are Membrane Separation Technology, Food Science & Technology, Sustainable Material for Corrosion Protection, Heavy metal remediation using *Spirulina platensis*, blue-green micro algae. He has authored 3 books and published articles in reputed journals.

**COURSE PLAN :**

**Week 1:** Humidification and air conditioning - I

**Week 2:** Humidification and air conditioning - II

**Week 3:** Drying Operations - I

**Week 4:** Drying Operations - II

**Week 5:** Liquid Extraction

**Week 6:** Liquid Extraction

**Week 7:** Leaching

**Week 8:** Membrane Separation Technology

**Week 9:** Membrane Separation Technology

**Week 10:** Adsorption and Ion-exchange

**Week 11:** Adsorption and Ion-exchange

**Week 12:** Crystallization



# MECHANICAL UNIT OPERATIONS

**PROF. NANDA KISHORE**

Department of Chemical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Chemical Engineering, Biotechnology and Food Engineering

**COURSE OUTLINE :**

Chemical engineering consists of several unit operations and unit processes. Before the reaction step, the raw materials should be processed through various unit operations and similarly after the reaction step as well either for product separation or for purity. Thus unit operations are essentially part of chemical engineering and hence, basic knowledge about the principles and equipment of solid-solid unit operations and solid-liquid unit operations is mandatory for any professional chemical engineer.

**ABOUT INSTRUCTOR :**

Dr Nanda Kishore completed PhD from Indian Institute of Technology Kanpur in 2008 and presently is a Professor in the Department of Chemical Engineering of IIT Guwahati. He has been working in the area of computational fluid flow past solid and fluid spheres in variety of non-Newtonian fluids for last 15 years. He has published over 70 research articles in various international level reputed journals, published more than 35 papers in national/international conference proceedings and published 08 book chapters. He was a visiting researcher in Department of Chemical and Processing Engineering, University of Surrey, Guildford, United Kingdom in July 2016. He received Young Scientist Research Award in 2016 from DAE-BRNS; IEI Young Engineers Award for the year 2015-2016; Young Scientist Research Grant Award from Science and Engineering Research Board of Department of Science and Technology, Government of India, 2013.

**COURSE PLAN :**

**Week 1:** Introduction of Particulate Solids

**Week 2:** Screening

**Week 3:** Size Reduction

**Week 4:** Storage and Conveying of Bulk Solids

**Week 5:** Size Enlargement

**Week 6:** Flow past Bluff Bodies

**Week 7:** Flow Through Packed and Fluidized Beds

**Week 8:** Filtration

**Week 9:** Cross Flow Filtration and Membrane Separations

**Week 10:** Gravity Sedimentation

**Week 11:** Centrifugal Separations

**Week 12:** Flootation



# **CHEMISTRY AND BIOCHEMISTRY**



# CHEMISTRY AND BIOCHEMISTRY

## 04 weeks

- 01. Bioinorganic Chemistry
- 02. Introductory Non-Linear Dynamics

## 08 weeks

- 01. Stereochemistry
- 02. Mechanisms in Organic Chemistry
- 03. Metals In Biology

## 12 weeks

- 01. Chemical Crystallography
- 02. Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries
- 03. Introductory Organic Chemistry I
- 04. Principles Of Organic Synthesis
- 05. Reagents In Organic Synthesis
- 06. Thermodynamics: classical to statistical
- 07. Ultrafast Optics and Spectroscopy
- 08. Analytical Chemistry
- 09. Coordination Chemistry
- 10. Quantum Computing
- 11. NMR spectroscopy for Chemists and Biologists
- 12. Biophysical chemistry
- 13. Organic Chemistry in Biology and Drug Development



# BIOINORGANIC CHEMISTRY

**PROF. S. P. RATH**

Department of Chemistry and Biochemistry  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Should have good knowledge of Coordination Chemistry

**INTENDED AUDIENCE** : UG and PG students of Chemistry

**COURSE OUTLINE :**

The field of Bioinorganic Chemistry has grown significantly in recent years and lies at a natural juncture between Chemistry, Biology, and Medicine. This rapidly expanding field probes fascinating questions about the uses of metal ions in nature. This short course will give a brief overview on some selected topics from this highly interdisciplinary subject and will provide some insights into various applications of inorganic molecules on the life-related processes.

**ABOUT INSTRUCTOR :**

Prof S. P. Rath received his PhD in Inorganic Chemistry from Indian Association for the Cultivation of Science (IACS), Kolkata and carried out post-doctoral research at the University of California, Davis. He then joined the Department of Chemistry at the Indian Institute of Technology, Kanpur in 2004. He is the recipient of several awards and honours including P. K. Kelkar Research Fellowship for young faculty (2009-12), Alexander von Humboldt Fellowship for Experienced Researcher (2012), Chemical Research Society of India (CRSI) Bronze medal (2015) and C.N.R. Rao National Prize in Chemical Sciences (2018). He is presently J. N. Gupta & M. Gupta Chair Professor of Chemistry at IIT Kanpur and also Elected Fellows of West Bengal Academy of Science and Technology (2017) and National Academy of Sciences, India (2017). He has taught a variety of UG and PG courses at IIT Kanpur and also has received commendations multiple times from the Director, IIT Kanpur for excellence in teaching as Outstanding Instructor. His research is in the fields of Physical-Inorganic and Bioinorganic Chemistry with special emphasis on the structure-function correlation utilizing a wide variety of synthetic and spectroscopic methods combined with DFT calculations. He has guided 15 PhD students and has over 100 publications in peer reviewed high-impact journals.

**COURSE PLAN :**

**Week 1:** Bioinorganic Chemistry: General introduction and prospects

Metals in Biology: Nature's selection

**Week 2:** Design principles used in chemical biology; some noteworthy examples

**Week 3:** Life with oxygen

**Week 4:** Metals in medicine



# INTRODUCTORY NON-LINEAR DYNAMICS

**PROF. RAMAKRISHNA RAMASWAMY**

Department of Chemistry and Biochemistry  
IIT Delhi

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic mathematics

**COURSE OUTLINE :**

This course is designed to introduce students to the basic ideas of Dynamical systems, Stability, and chaos, largely using Iterative mappings as the model. The course will focus on qualitative ideas and will require students to explore dynamics through simulations (MATLAB will be adequate).

**ABOUT INSTRUCTOR :**

Prof. Ram Ramaswamy is currently Visiting Professor in the Department of Chemistry at IIT Delhi. He earlier taught in the School of Physical Sciences at the Jawaharlal Nehru University. His areas of research include chemical dynamics, nonlinear dynamics, and systems and computational biology.

**COURSE PLAN :**

**Week 1:** Introduction, Stability, Phase space and invariant sets.

**Week 2:** Maps and flows. Simple examples of dynamical systems

**Week 3:** The Tent map and the Logistic map. Symbolic dynamics

**Week 4:** Chaotic dynamics, Lyapunov exponents, invariant measures.



# STEREOCHEMISTRY

**PROF. AMIT BASAK**

Department of Chemistry  
IIT Kharagpur

**TYPE OF COURSE** : Rerun| Elective | UG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : BE/B.Tech

**PRE-REQUISITES** : 12th Chemistry

**INDUSTRIES APPLICABLE TO** : Pharmaceutical industries, Perfumery Industries

## COURSE OUTLINE :

Stereochemistry of molecules dictates isomerism, chemical and biochemical reactivity. Reactivity. These days, chiral drugs have become an integral part of pharmaceutical industry. A basic concept on 3D structures and conformations of molecules and asymmetric synthesis and other stereochemical principles and attributes are essential. This course will lay the foundation on to which further advanced topics can be built up.

## ABOUT INSTRUCTOR :

Prof. Amit Basak offering this course at the first year level at IIT Kharagpur for many years. Before that, I had taught UG students of Presidency University for more than 10 years. Due to my interaction with Sir Prof J. Baldwin (my PhD supervisor at Oxford) and Prof Talapatra ( PhD supervisor, both of whom are renowned stereochemists, my interest in teaching stereochemistry at UG and PG level grew up immensely.

## COURSE PLAN :

- Week 01** : Constitution and Configuration; Chemistry in 3D space Chirality and its origin, symmetry criterion;
- Week 02** : Stereogenicity and topicity; Enantiomers, Diastereomers, Epimers, Anomers, Atropisomers
- Week 03** : Nomenclature: Absolute (R/S and D,L) and relative configurations (Threo/erythro , syn/anti and like/unlike)
- Week 04** : Prochirality, pro-R and pro-S designations; related problems
- Week 05** : Conformations of acyclic systems: X-CH<sub>2</sub>-CH<sub>2</sub>-X and of cyclic systems: cyclopropane, cyclobutane, cyclopentane
- Week 06** : Conformations of cyclohexane (including mono and disubstituted), cis and trans-decalins
- Week 07** : Stereoelectronic and steric principles in reactions: Substitution, elimination and addition; selectivity and specificity
- Week 08** : Stereoelectronic and steric principles in reactions: Substitution, elimination and addition; selectivity and specificity (contd); Importance of stereochemistry in real life: some examples





# MECHANISMS IN ORGANIC CHEMISTRY

**PROF. NANDITA MADHAVAN**

Department of Chemistry  
IIT Bombay

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic Organic Chemistry

**INTENDED AUDIENCE** : Chemistry

**COURSE OUTLINE :**

The course can be broadly classified as a Physical Organic Chemistry course. Understanding organic reaction mechanisms are extremely useful in predicting the products and improving the reaction efficiency.

**ABOUT INSTRUCTOR :**

Nandita Madhavan got her bachelor's degree in Chemistry from S.I.E.S. College (Mumbai University) and her master's degree from IIT Bombay, and her Ph.D. research from the University of Illinois at Urbana-Champaign focused on developing light activated molecular switches. After completing her post-doctoral research at Georgia Institute of Technology, she joined IIT Madras as an Assistant Professor. She moved to IIT Bombay in 2016 and currently designs peptide-based ion transporters and molecular switches. Nandita is also associated with the Centre of Teaching and Learning at IIT Bombay and is interested in understanding and exploring novel methods of teaching and learning.

**COURSE PLAN :**

**Week 1:** Basic concepts Basics of Arrow pushing I to IV

**Week 2:** Polar reactions I to III; Radical reactions I and II

**Week 3:** Reaction coordinate diagrams I to IV; Kinetics of organic reactions I and II; Kinetic versus thermodynamic control Thermodynamics I

**Week 4:** Thermodynamics II; Kinetics I to III; Hammond's postulate

**Week 5:** Kinetic versus Thermodynamic control II; Steric effects; Curtin-Hammett Equation; Solvent effects pH effects

**Week 6:** Determining nature of intermediate LFER I to IV; Applications of LFER

**Week 7:** Kinetic Isotope Effects I to IV; Equilibrium Kinetic Isotope Effects

**Week 8:** Mass balance, designing substrate Checking for common intermediate Isotope Labelling and trapping Cross-over experiments Summary



# METALS IN BIOLOGY

**PROF. D. MAITI**

Department of Chemistry and Biochemistry  
IIT Bombay

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Chemistry, Biochemistry students

**COURSE OUTLINE :**

Metals are the vital component of any biosystem. Starting from transporting biochemicals to catalyzing biochemical transformations, almost every process requires presence of a metal center. In order to understand these processes, knowledge of specific functions carried out by these metals are necessary. This course will be helpful to understand the fundamental properties of the metals present in biosystems and mechanism of their action.

**ABOUT INSTRUCTOR :**

Prof. Debabrata Maiti, an Associate Professor at IIT Bombay has completed his PhD from John Hopkins University with Prof. Kenneth D. Karlin in Bioinorganic Chemistry. He started his independent career at IIT Bombay in 2011 and since then has been involving actively in teaching bio-inorganic chemistry and organometallic chemistry.

**COURSE PLAN :**

**Week 1** : Introduction Lecture; Distribution of Metals in Biology; Metal storage in body

**Week 2** : Regulation of metal concentration; Metal folding of biopolymers; Electron Transfer

Proteins

**Week 3** : Electron Transfer proteins; Molecular oxygen carriers; Hydrolytic and related enzymes

**Week 4** : Hydrolytic and related enzymes; Hydroxylases ; Hydrogenases and bioorganometallic chemistry;

**Week 5** : Active site model systems; Nitrogenase; Photosynthesis; Co-enzymes

**Week 6** : Co-enzymes; Effect of metal concentration; Signaling

**Week 7** : Metal Toxicity Lecture; Metals in medicine; Metalloneurochemistry: zinc, others

**Week 8** : Metalloneurochemistry: Zinc, Metals, Microbes, and the Immune system; Metalloprotein Engineering: convert protein function



# CHEMICAL CRYSTALLOGRAPHY

**PROF. ANGSHUMAN ROY CHOUDHURY**

Department of Chemistry  
IISER Mohali

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Ph.D and 2nd year M.Sc

**PRE-REQUISITES** : Basic knowledge about molecular symmetry

**INDUSTRIES APPLICABLE TO** : Pharmaceutical industry

## COURSE OUTLINE :

This course would highlight the concepts and applications of widely used experimental technique of X-ray crystallography. The course would take the students through the lane of crystallographic symmetry to the structure determination and refinement of crystal structures using x-ray diffraction. Any experimental organic or inorganic chemist would be benefited from this course.

## ABOUT INSTRUCTOR :

The instructor has obtained his Ph. D. in 2005 from Indian Institute of Science, Bangalore working in the area of small molecule X-ray crystallography. Following that he has worked in the University of Liverpool as a post-doctoral fellow from October, 2004 to September, 2007. Then he moved to BITS, Pilani as Assistant Professor in Chemistry. From there, he moved to IISER Mohali in December, 2009 as Assistant Professor in chemistry. He has more than 70 publications in various international journals, guided two PhD students and a few masters students at IISER Mohali. He offers the same course at IISER Mohali in the August Semester.

## COURSE PLAN :

- Week 01** : Introduction, 1D symmetry, Concept of 2D symmetry and lattices, notations of symmetry elements, space groups in 2D, 3D lattices, 32 point groups and their notations, crystal systems and Bravais lattices.
- Week 02** : Stereographic projections, Laue symmetry; glide planes, screw axes and their notations, space groups, equivalent points, space group symmetry diagrams etc.
- Week 03** : Miller Indices, crystallographic planes and directions, close pack structures, linear density, planar density, Miller-Bravais indices for hexagonal systems, various ceramic structures (NaCl, ZnS, CaF<sub>2</sub>, CsCl etc.), octahedral and tetrahedral sites etc.
- Week 04** : What are X-rays, generation and classification of X-ray, X-ray sources, diffraction of X-rays, Bragg's law. The reciprocal lattice, reciprocal relationship, Bragg's law in reciprocal space, Ewald's sphere and sphere of reflection
- Week 05** : Methods of crystal growth, identification of phases and morphologies, in-situ cryo crystallization, crystal growth under external stimuli etc.
- Week 06** : Data collection strategies, Laue Method, Oscillation, rotation and precession methods. L-P corrections, structure factor, scaling, interpretation of intensity data, temperature factor, symmetry from intensity statistics
- Week 07** : Structure factor and Fourier synthesis, Friedel's law; exponential, vector and general forms of structure factor, determination of systematic absences for various symmetry or lattice centering, FFT, Anomalous scattering and absolute configuration.
- Week 08** : Phase problem, Direct Methods, structure invariants and semi invariants, probability methods, Phase determination in practice, Patterson Methods, Patterson Symmetry, completion of structure solution, Del-F synthesis.
- Week 09** : Refinement by Fourier synthesis, refinement by Del-F synthesis, Refinement by least squares method, weighting functions, Goodness-of-Fit (GOF) parameter, treatment of non-hydrogen atoms, and treatment of hydrogen atoms, treatment of disordered structures.
- Week 10** : Crystal selection, indexing of crystals, data collection, data reduction, space group determination, structure solution and refinement using SHELXS97 and SHELXL97, introduction to crystallographic packages (APEX II suite, OLEX2, WinGx, PLATON) and IUCr validation of the data
- Week 11** : Methodology, geometrical basis of powder X-ray diffraction, applications of PXRD: determination of accurate lattice parameters, identification of new/unknown phases, applications in pharmaceutical industry.
- Week 12** : Applications of powder X-ray diffraction: Structure determination from PXRD and Reitveld method for structure refinement, indexing of PXRD, handling of PXRD using DASH.



# SPECTROSCOPIC TECHNIQUES FOR PHARMACEUTICAL AND BIOPHARMACEUTICAL INDUSTRIES

**PROF. SHASHANK DEEP**

Department of Chemistry and Biochemistry  
IIT Delhi

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : BSc Chemistry

**COURSE OUTLINE :**

A variety of Spectroscopic techniques will be discussed along with their application in chemical, Pharmaceutical and Bio-pharmaceutical Industries.

**ABOUT INSTRUCTOR :**

Dr. Shashank Deep is a Professor in Department of Chemistry, Indian Institute of Technology, Delhi. He obtained his Ph.D. degree from Indian Institute of Technology Delhi. He then moved to Prof. Hinck laboratory at Department of Biochemistry, University of Texas health science center at San Antonio, Texas, USA on a post-doctoral assignment. His second postdoctoral work was with Prof. Erik Zuiderweg at Department of Biophysics, University of Michigan, Ann Arbor, MI, USA where he used NMR to study the protein-protein interaction, protein dynamics and protein structure. He joined the department as an Assistant Professor in 2005. Dr. Deep is a member of American Chemical society, Protein Society, and Indian Biophysical Society. He is joint secretary of Protein Society (India). He has taught physical chemistry. He is involved in web course development for various programmes(IITPAL,UGC-EDUSAT,NPTEL & e- PATHSHALA).

**COURSE PLAN :**

**Week 1:** Summary of Spectroscopic techniques, Electromagnetic radiation and its interaction with matter, Resolution, Signal to Noise Ratio.

**Week 2:** UV-Visible/Fluorescence spectroscopy and its application

**Week 3:** Fluorescence spectroscopy/ Microscopy and its application

**Week 4:** Electron Microscopy/ Scanning Microscopy

**Week 5:** Rotational/ Vibrational Spectroscopy and its application

**Week 6:** Raman spectroscopy/Rotational-Raman/Vibrational-Raman

**Week 7:** NMR spectroscopy

**Week 8:** Mass spectroscopy

**Week 9:** Application of FTIR, NMR and Mass in Pharmaceutical Industry

**Week 10:** Application of FTIR, NMR, Mass in Bio-Pharmaceutical Industry

**Week 11:** Surface Plasmon Resonance Spectroscopy and its application

**Week 12:** Elemental Analysis (Flame photometry, AAS, ICP) and its application



# INTRODUCTORY ORGANIC CHEMISTRY I

**Prof. HARINATH CHAKRAPANI**  
**Prof. NEERAJA DASHAPUTRE**  
**IISER PUNE**

**TYPE OF COURSE** : New | Core | UG  
**COURSE DURATION** : 8 Week (26 Aug'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Any student who has done basic physical/ general chemistry courses

**INTENDED AUDIENCE** : Third year undergraduates of B.Sc. Chemistry; M.Sc. Chemistry students and doctoral students

**INDUSTRIES APPLICABLE TO** : Companies in the pharmaceutical sector may recognize and value this course

## **COURSE OUTLINE :**

This course focuses on organic chemistry, the chemistry of carbon. Carbon based compounds; the organic compounds are the building blocks of life on earth. From biological molecules such as nucleic acids to polymers in plastic, they are omnipresent. Synthetically made compounds such as pharmaceutical drugs, paints and oils find wide use in our day-to-day life. This course highlights the fundamentals of organic chemistry. Topics such as structure, physical properties, and chemical reactivity of various organic compounds will be discussed in detail. This course also builds fundamentals of organic chemistry such as resonance, conformational analysis and stereochemistry. Study of various functional groups such as carboxylic acid derivatives, aldehydes, ketones, etc. will be conducted in detail. In short, welcome to a course explaining the molecular basis of chemistry around you.

## **ABOUT INSTRUCTOR :**

Prof. Neeraja Dashaputre completed her undergraduate studies in chemical technology from Institute of Chemical Technology, Mumbai. After which, she obtained a doctoral degree in organic chemistry at University of Maryland, USA. She worked as a faculty at Claremont University post her doctoral studies. She joined IISER Pune in July 2016 and is currently Assistant Professor. Her research interests are in pedagogy development for teaching chemistry. She has over five years of teaching experience in India, and USA.

Prof. Harinath Chakrapani completed his undergraduate and post-graduate studies in Chemistry from Loyola College and Indian Institute of Technology Madras, respectively. He moved to Duke University, USA to pursue his doctoral studies and after post-doctoral research stints at Wake Forest University and the National Cancer Institute, USA, he joined IISER Pune in July 2009 and is currently Associate Professor. His research interests are in organic chemistry and chemical biology. His laboratory works on developing new tools to study effects of oxidative stress responses in cells and antibiotic resistance. He has over eight years of teaching experience at IISER Pune.

## **COURSE PLAN :**

**Week 1:** Electronic Structure and Bonding

**Week 2:** Acids and Bases

**Week 3:** Stereochemistry

**Week 4:** Alkanes and Alkyl Halides

**Week 5:** Alkenes and Alkynes

**Week 6:** Alcohols, Amines, Ethers and Epoxides

**Week 7:** Carbonyl Compounds : Aldehydes and ketones

**Week 8:** Carboxylic acid derivatives



# PRINCIPLES OF ORGANIC SYNTHESIS

**PROF. T PUNNIYAMURTHY**

Department of Chemistry and Biochemistry  
IIT Guwahati

**TYPE OF COURSE** : New | Core | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : BSc (Chemistry)

**INTENDED AUDIENCE** : M.Sc

**COURSE OUTLINE :**

The course covers formation of acid-catalyzed carbon-carbon bond formation to application of the modern transition metal catalysis. Students preparing for NET and GATE examination will find this course extremely useful.

**ABOUT INSTRUCTOR :**

Professor T Punniyamurthy is Head of the Department of Chemistry at IIT Guwahati and obtained PhD in Chemistry from IIT Kanpur in 1995. He subsequently held postdoctoral positions at North Dakota State University, Kyushu University and Ecole Nationale Supérieure de Chimie de Montpellier prior to joining at Indian Institute of Technology, Guwahati in 2001. He is also visiting Professor at Oxford University, Kyushu University and the Scripps Research Institute San Diego. His research interests include C-H activation, stereoselective synthesis and heterocyclic chemistry. He has produced 21 PhD scholars and 30 M.Sc students with 130 publications having citations around 6300 and h-index 42. He is a recipient of UKIERI Research Fellowship, JSPS Bridge Fellowship, JSPS Invitation Fellowship, Fulbright Fellowship and CRSI Bronze medal. He is also an elected Fellow of the Indian Academy of Sciences, National Academy of Sciences and Royal Society of Chemistry.

**COURSE PLAN :**

**Week 1:** Formation of Aliphatic Carbon-Carbon Bonds: Base Catalyzed Reactions

**Week 2:** Formation of Aliphatic Carbon-Carbon Bonds: Acid Catalyzed Reactions

**Week 3:** Organometallic Reagents

**Week 4:** Formation of Aliphatic Carbon-Nitrogen Bonds

**Week 5:** Electrophilic Aromatic Substitution

**Week 6:** Nucleophilic Aromatic Substitution

**Week 7:** Aromatic Diazonium Salts

**Week 8:** Molecular Rearrangements

**Week 9:** Reagents Containing Phosphorus, Sulfur, Silicon, Boron or Tin

**Week 10:** Free-Radical Reactions

**Week 11:** Reagents Containing Phosphorus, Sulfur, Silicon, Boron or Tin (contd)

**Week 12:** Free-Radical Reactions (contd)





# REAGENTS IN ORGANIC SYNTHESIS

**PROF. SUBHAS CHANDRA**

Department of Chemistry  
IIT Guwahati

**TYPE OF COURSE** : New | Core | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : BSc (Chemistry)

**INTENDED AUDIENCE** : M.Sc., Ph.D

**INDUSTRIES APPLICABLE TO** : Dr. Reddy's Laboratory, Lupin, Syngenta etc.

**COURSE OUTLINE :**

This course will deal with the various synthetic strategies using organic reagents. Both classical and modern reagents shall be discussed emphasizing on the mechanistic details. This course will be useful for preparing for NET and GATE examination

**ABOUT INSTRUCTOR :**

Prof. Subhas Chandra Pan obtained his B.Sc. degree in Chemistry Honours in 2001 from Calcutta University and M.S. degree in 2004 from Indian Institute of Science, Bangalore. During his MS thesis he worked in Prof. Goverdhan Mehta's laboratory on the total synthesis of epoxyquinone natural products. He obtained his PhD degree in 2008 under the guidance of Prof. Benjamin List at the Max-Planck-Institut für Kohlenforschung, Mülheim an der Ruhr, Germany. After doing postdoctoral studies at Harvard University with Prof. E J Corey and at the Scripps Research Institute, Florida with Prof. Glenn C. Micalizio, he joined IIT Guwahati as Assistant Professor in 2011 and was promoted to Associate Professor in 2015. So far he has published 56 research publications in peer reviewed journals and wrote a book chapter with Prof Benjamin List. He has over 1000+ citations with "h" index 15 and "i10" index of 24. So far he has guided 5 Ph.D and 10 master students for their dissertation. He is a recipient of DAE Young Scientist Research Award (2012) and Thieme Chemistry Journal Award (2018).

**COURSE PLAN :**

**Week 1:** Oxidizing Agents in Organic Transformations-Part-I

**Week 2:** Oxidizing Agents in Organic Transformations-Part-II

**Week 3:** Reducing Agents in Organic Transformations-Part-I

**Week 4:** Reducing Agents in Organic Transformations-Part-II

**Week 5:** Organic Transformations-Using Non-Transition Metals Part-I

**Week 6:** Organic Transformations-Using Non-Transition Metals Part-II

**Week 7:** Organic Transformations-Using Non-Transition Metals Part-III

**Week 8:** Organic Transformations-Using Transition Metals Part-I

**Week 9:** Organic Transformations-Using Transition Metals Part-II

**Week 10:** Organic Transformations-Using Transition Metals Part-III

**Week 11:** Organic Transformations-Using Transition Metals Part-IV

**Week 12:** Organic Transformations-Using Lanthanides Reagents





# THERMODYNAMICS: CLASSICAL TO STATISTICAL

**PROF. SANDIP PAUL**

Department of Chemistry and Biochemistry  
IIT Guwahati

**TYPE OF COURSE** : New | Core\_Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**COURSE OUTLINE :**

This course is intended for final year BSc (in Chemistry) as well as for MSc (in Chemistry) and PhD (in Chemistry) students and it is assumed that no previous knowledge of the subject is required. Moreover, this course demonstrates the form physical and statistical basis of thermodynamics by showing how the properties of macroscopic systems are direct consequences of the behaviors of their elementary constituents. Thus this course will give the students a broader spectrum of skills as well as a better understanding of the physical bases.

**ABOUT INSTRUCTOR :**

The broad area of instructor's teaching and research interest is statistical mechanics and its applications to chemistry and biology. Prof. Paul completed his PhD in computational chemistry from Indian Institute of Technology, Kanpur. Later he worked with Prof. Gern Patey of University of British Columbia, Vancouver, Canada and with Prof. Max Berkowitz of University of North Carolina, Chapel Hill, USA for his postdoctoral research. Soon after, he joined in the Department of Chemistry, Indian Institute of Technology, Guwahati as a faculty member. Understanding the effect of osmolytes on the protein conformation, the use of hydrotrope molecules to enhance the aqueous solubility of sparingly soluble drug molecules etc. is the main interest of his research group. He has published 64 journal papers as of now.

**COURSE PLAN :**

**Week 1:** Properties of ideal gases and how they differ from real gases, first law of thermodynamics

**Week 2:** Concepts of state and path functions (with examples); Proof of work and heat as path functions and internal energy as state function

**Week 3:** Activity, activity coefficient, Debye-Hückel theory for activity coefficient of electrolytic solutions; determination of activity, activity coefficients and ionic strength.

**Week 4:** Phase diagram of two component systems (with examples).

**Week 5:** One dimensional random walk and its importance

**Week 6:** Canonical ensemble and calculation of different thermodynamical quantities such as average pressure, average energy.

**Week 7:** Translational partition function

**Week 8:** Rotational and vibrational partition function

**Week 9:** Quantum Statistics of ideal gases. Identical particles and symmetry requirements.

**Week 10:** Quantum distribution functions: Bose-Einstein Statistics

**Week 11:** Ideal Bose gas

**Week 12:** Ortho and para hydrogen



# ULTRAFast OPTICS AND SPECTROSCOPY

**PROF. ATANU BHATTACHARYA**  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | PG  
**COURSE DURATION** : 12 weeks 29 Jul'19 - 18 Oct'19  
**Exam Date** : 17 Nov 2019

**INTENDED AUDIENCE** : Senior UG, MSc and PhD

**INDUSTRIES APPLICABLE TO** : Optic Industries and Spectrometer

## **COURSE OUTLINE :**

Plane wave and phase velocity, Representation of short pulses in time and frequency domain, General construction of laser, Ultrafast Laser System: Oscillator and Amplifier, Gaussian Beam characteristics, Polarization and Birefringence in ultrafast optics, Pulse Measurements in frequency and time domains, Nonlinear Ultrafast Optics: second order, third order, higher order, Dispersion in Ultrafast Optics, Ultrafast Spectroscopy, Ultrafast Dynamics through Conical Intersections, Ultrafast Processes in gas, liquid, and solids

## **ABOUT INSTRUCTOR :**

Prof. Atanu Bhattacharya received the PhD degree in Physical Chemistry from Colorado State University (USA) in 2010. His doctoral research involved the time and frequency resolved spectroscopy of energetic molecules in molecular beam under supervision of Prof. Elliot R. Bernstein. In 2013, he joined Indian Institute of Science (Bangalore, India) as assistant professor at the Department of Inorganic and Physical Chemistry. Currently, he is specializing in Attosecond Chemistry, Femtosecond Chemistry of Catalysis and Explosives and Femtosecond X-ray Spectroscopy.

## **COURSE PLAN :**

**Week 1:** Introduction and Mathematical Representation of Ultrafast Pulse

**Week 2:** Propagation of Ultrafast Pulse, Part I: Nonlinear Optical Effects

**Week 3:** Propagation of Ultrafast Pulse, Part I: Nonlinear Optical Effects

**Week 4:** Propagation of Ultrafast Pulse, Part I: Nonlinear Optical Effects

**Week 5:** Propagation of Ultrafast Pulse, Part II: Dispersion Effects

**Week 6:** Propagation of Ultrafast Pulse, Part II: Dispersion Effects

**Week 7:** Construction of Ultrafast Laser

**Week 8:** Measurement of Ultrafast Pulses

**Week 9:** Ultrafast Spectroscopy, Part I: Measurement Techniques

**Week 10:** Ultrafast Spectroscopy, Part II: Kinetic and Quantum Model

**Week 11:** Ultrafast Processes, Part I: Molecular Photophysics and Photochemistry, Gas Phase Reaction Dynamics

**Week 12:** Ultrafast Processes, Part II: Metals, Semiconductors, Biomolecules and Transition Metal Complexes.



# ANALYTICAL CHEMISTRY

**PROF. DEBASHIS RAY**

Department of Chemistry  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: Rerun  Core  UG/PG
<b>COURSE DURATION</b>	: 12weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 17 Nov 2019

**INTENDED AUDIENCE** : BE/B.Tech, M.Sc

**PRE-REQUISITES** : H. S. +2 Level

**INDUSTRIES APPLICABLE TO** : Hindustan Lever Ltd, Ranbaxy, Shell, ONGC, NTPC, SAIL, CIL, Waters, PHE Dept.

## COURSE OUTLINE :

It will give the opportunity to study and use specialized instruments and specific methods to separate, identify, and quantify the unknown substance. Spectroscopic technique will consist of applications of atomic absorption spectroscopy, atomic emission spectroscopy, ultraviolet-visible spectroscopy, X-ray fluorescence spectroscopy, infrared spectroscopy, Raman spectroscopy and Mössbauer spectroscopy. In electrochemical methods cyclic voltammetry, coulometry and amperometry will be discussed. The course has applications that include forensic science, analysis of biological samples, clinical analysis, environmental analysis, and materials analysis.

## ABOUT INSTRUCTOR :

Prof. Debashis Ray is an M.Sc. (Gold Medalist) from Burdwan University in 1985 and did his Ph. D. from IACS (degree from Jadavpur University) in 1989 and in faculty roll of IIT Kharagpur from 1990. Specialization: Inorganic Chemistry, Coordination Chemistry, Bioinorganic Chemistry, Analytical Chemistry. Received INSA YS Medal in 1994 and CRSI Bronze Medal in 2007. Visited Indiana University during 1995 availing BOYSCAST fellowship of Govt of India, Oxford University in 2001 using INSA-RSC exchange program and was a Humboldt Fellow during 2002-2003 in MPI, Muelheim, Germany.

## COURSE PLAN :

- Week 01** : Chemicals and Materials Analysis Methods
- Week 02** : Role of Analytical Chemistry and Techniques
- Week 03** : Chemical Equilibria and Basis of Chemical Analysis
- Week 04** : Spectrochemical Methods - I
- Week 05** : Spectrochemical Methods - II
- Week 06** : Thermal Methods - I
- Week 07** : Thermal Methods - II
- Week 08** : Electroanalytical Methods - I
- Week 09** : Electroanalytical Methods - II
- Week 10** : Electrochemical Sensors
- Week 11** : Bioanalytical Chemistry
- Week 12** : Applications of Chemical Analysis



# COORDINATION CHEMISTRY

**PROF. DEBASHIS RAY**

Department of Chemistry  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks ( 29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.Sc, M.Sc, B.Pharm, M.Pharm

**PRE-REQUISITES** : Basic Inorganic Chemistry

**INDUSTRIES APPLICABLE TO** : Indian Rare Earths Ltd, NTPC, ONGC, SAIL, CIL, MECL, Hind Zinc, Hind Copper, BASF, Tata Chemicals

## COURSE OUTLINE :

It will give an excellent opportunity to study and use the century old Nobel prize winning knowledge of coordination chemistry. The study will also lead to understand the difference between a coordinated ligand and charge balancing ion in a coordination compound. Complexation reactions, stability constants, structures, geometrical and optical isomerism, bonding, reactions and reactivity will be discussed. Color and electronic, and magnetic properties will be delineated with respect to their application in analytical chemistry, industry and medicine. Use of coordination compounds of some precious metal ions will be explained in relation to homogeneous catalysis for the production of useful organic and pharmaceutically important substances.

## ABOUT INSTRUCTOR :

Prof. Debashis Ray is an M.Sc. (Gold Medalist) from Burdwan University in 1985 and did his Ph. D. from IACS (degree from Jadavpur University) in 1989 and in faculty roll of IIT Kharagpur from 1990. Specialization: Inorganic Chemistry, Coordination Chemistry, Bioinorganic Chemistry, Analytical Chemistry. Received INSA YS Medal in 1994 and CRSI Bronze Medal in 2007. Visited Indiana University during 1995 availing BOYSCAST fellowship of Govt of India, Oxford University in 2001 using INSA-RSC exchange program and was a Humboldt Fellow during 2002-2003 in MPI, Muelheim, Germany.

## COURSE PLAN :

**Week 01** : Introduction - Definitions and Classification of Ligands

**Week 02** : Nomenclature

**Week 03** : Coordination Number and Stereochemistry

**Week 04** : Structures, Symmetries Isomerism and Coordination Equilibria

**Week 05** : Bonding in Complexes

**Week 06** : Jahn-Teller Effect and Spin Crossover

**Week 07** : Colors and Optical Spectra

**Week 08** : Orgel and Tanabe Sugano Diagrams

**Week 09** : Applications of CFT and Spinels

**Week 10** : Magnetochemistry

**Week 11** : Ligand Field Theory – Sigma and Pi Orbitals

**Week 12** : Reactions, Reactivity and Biological Inorganic Chemistry



# QUANTUM COMPUTING

**PROF. DEBABRATA GOSWAMI**

Department of Chemistry  
IIT Kanpur

**TYPE OF COURSE** : Rerun| Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INDUSTRIES APPLICABLE TO** : Intel, Microsoft Research

## COURSE OUTLINE

Quantum computing exploits the quantum mechanical nature of matter to simultaneously exist in multiple possible states. Building up on the digital binary logic of bits, quantum computing is built on the basis of interacting two-level quantum systems or 'qubits' that follow the laws of quantum mechanics. Addressability of the quantum system and its fragility to fidelity are the major issues of concern, which if addressed appropriately, will enable this new approach to revolutionize the present form of computing. After developing the basics, this course delves on various implementation aspects of quantum computing and quantum information processing.

## ABOUT INSTRUCTOR

Prof. Debabrata Goswami, Department of Chemistry, Indian Institute of Technology, Kanpur works at the forefront of interdisciplinary research that embodies theoretical and experimental developments in the fundamental aspects of femtosecond laser-matter interactions for applications towards quantum computing. After receiving undergraduate degree from IIT Kanpur, Dr. Goswami went to US with multiple scholarships to receive his PhD from Princeton University and completed his one-year postdoctoral Fellowship at Harvard University in 1995. After several research jobs in US, he returned to India in 1998 as a Faculty in TIFR (Mumbai). He moved to IIT Kanpur in 2004, where he continues as the Professor of Chemistry. He is the recipient of several academic and research accolades, including the Wellcome Trust International Senior Research Fellowship (UK), the Swarnajayanti Fellowship and the Thathachary Science Award (India). He is Fellow of the Royal Society of Chemistry, as well as member of several academic and professional societies and councils. He has published well over hundred peer-reviewed research articles, several book chapters, edited conference proceedings and books. His popularizes Science Education and is a popular K12 teacher on Indian television. Over the past decade and half, he has taught several courses both at UG and PG courses at TIFR and IIT Kanpur. The course on Quantum Computing was conceived and developed by Prof. Goswami as an open elective at IIT Kanpur more than a decade back and he has taught it eight times since.

## COURSE PLAN

**Week 1:** Quantum Measurements Density Matrices; • Positive-Operator Valued Measure

**Week 2:** Fragility of quantum information: Decoherence; • Quantum Superposition and Entanglement

**Week 3 :**Quantum Gates and Circuits; • No cloning theorem & Quantum Teleportation

**Week 4:** Bell's inequality and its implications; • Quantum Algorithms & Circuits

**Week 5:** Deutsch and Deutsch-Jozsa algorithms; • Grover's Search Algorithm

**Week 6:** Quantum Fourier Transform; • Shore's Factorization Algorithm

**Week 7:** Quantum Error Correction: Fault tolerance; • Quantum Cryptography

**Week 8:** Implementing Quantum Computing: issues of fidelity; • Scalability in quantum computing

**Week 9:** NMR Quantum Computing; • Spintronics and QED approaches

**Week10:** Linear Optical Approaches; • Nonlinear Optical Approaches;

**Week 11:** Limits of all the discussed approaches

**Week 12:** How promising is the future?



# NMR SPECTROSCOPY FOR CHEMISTS AND BIOLOGISTS

**PROF. ASHUTOSH KUMAR**  
**PROF. R. V. HOSUR**  
IIT Bombay

**TYPE OF COURSE** : New | Elective | PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Under graduate level understanding of Physics and Mathematics

**INTENDED AUDIENCE** : M. Sc./ PhD and Scientists working in Pharma and Biopharma Industries

**INDUSTRIES APPLICABLE TO** : Biocon, Wockhardt, Aurobindo Biopharma etc

## **COURSE OUTLINE :**

This course starts with Basic principles of NMR, walks through the analysis of spectra and demonstrates the application of multidimensional NMR spectroscopy in Chemistry and structural Biology.

## **ABOUT INSTRUCTOR :**

Prof. Ashutosh Kumar is working as Associate Professor in the Department of Biosciences and Bioengineering, IIT Bombay. His research area in NMR based structural Biology.

Prof. Hosur is a distinguished Visiting Professor in the Department of Biosciences and Bioengineering, IIT Bombay. Prior to this, he worked as a senior Professor in Tata Institute of Fundamental Research, Mumbai.

## **COURSE PLAN :**

- Week 1:** Nuclear Spin and Magnetic Moments Nuclear Spins in a Magnetic Field Spin Lattice Relaxation Spin temperature Resonance Absorption of Energy and The NMR Experiment Kinetics of Resonance Absorption
- Week 2:** Selection Rules and Line widths Bloch equations
- Week 3:** Instruction to operator Algebra 1 Instruction to operator Algebra 2 Instruction to operator Algebra 3 Chemical Shift Anisotropy of chemical shifts Learning spectral simulation
- Week 4:** Factors Influencing Isotropic Chemical shifts: Spin Spin Coupling Analysis of NMR spectra of molecules 1 Analysis of NMR spectra of molecules 2 Analysis of NMR spectra of molecules 3 Learning spectral simulation
- Week 5:** Dynamic Effects in the NMR spectra : Two site exchange collapse of spin multiplets  
Conformational Averaging of J- values Analysis of NMR spectra of molecules with J Values 1 Analysis of NMR spectra of molecules with J Values 2 Analysis of NMR spectra of molecules
- Week 6:** Principles of Fourier transform NMR Theorems on Fourier transforms Practical aspects of recording FTNMR spectra Free Induction Decay (FID) and the spectrum Pulse repetition rate Folding of signals Acquisition time and the resolution Data processing in FT NMR Learning of Data processing
- Week 7:** Dynamic range in FTNMR and Solvent suppression The Nuclear Overhauser Effect Experimental Schemes Advanced Treatment Steady state NOE and Transient NOE Assignment based on 7th week lectures spectral simulation
- Week 8:** Spin Echo Uncoupled spins Spin Echo Coupled spins Spin-lattice relaxation Spin-spin relaxation Polarization transfer SPT and INEPT spectral simulation
- Week 9:** Density matrix, Elements of Density Matrix Time evolution of density operator, Time evolution of density operator, Product operator formalism Product operator formalism Assignment based on 9th week lectures
- Week 10:** Segmentation of the time axis Two dimensional NMR 2D Fourier Transformation in NMR Peak shapes in 2D spectrum Quadrature detection in two-dimensional NMR Assignment based on 10th week lectures
- Week 11:** 2D- resolution/ separation experiments 2D- resolution/ experiments Two-dimensional correlation experiments COSY Two-dimensional correlation experiments COSY2 DQ-COSY etc TOCSY separation
- Week 12:** 2D NOESY 2D ROESY Heteronuclear COSY The HETCOR pulse sequence HSQC Assignment based on 12th week lectures





# BIOPHYSICAL CHEMISTRY

**PROF. PRAMIT KUMAR CHOWDHURY**

Department of Chemistry  
IIT Delhi

<b>TYPE OF COURSE</b>	: Rerun  Elective   UG
<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 17 Nov 2019

**PRE - REQUISITES** : Basic Course in Physical Chemistry

**INDUSTRIES APPLICABLE TO** : Pharmaceutical Industry

## COURSE OUTLINE

This introductory course in biophysical chemistry touches on some of the fundamentals of this field. Starting from basic elements in protein structure, the course covers other aspects like forces involved in protein folding, protein folding energy landscape, mechanisms of protein folding, mixing and relaxation techniques commonly used to study fast protein folding, and finally winds up with discussion on some spectroscopic tools (Absorption, Fluorescence and IR) that are very popular in the field of proteins.

## ABOUT INSTRUCTOR

Prof. Pramit K Chowdhury works on protein folding and dynamics using a range of spectroscopic techniques.

## COURSE PLAN

**Week 1:** Introduction to Protein Structure Ribosome, Trigger Factor, Amino Acids, Ramachandran Plot

**Week 2:** Forces in Protein Folding 1 Local and Nonlocal interactions, Bjerrum Length, Poisson Boltzmann Equation, Debye length, Case studies

**Week 3 :** Forces in Protein Folding 2 Electrostatics, Ion-Dipole Interactions, Dipole-Dipole Interactions, Orientational Averaging, Dipole-Induced-Dipole Interactions, Dispersion Forces, Empirical Potentials (Hard sphere potential, Lennard-Jones Potential), Brief Insight into Force Fields

**Week 4:** Forces in Protein Folding 3 Hydrophobic Effect (Accessible Surface Area, Molecular Nature, Temperature Dependence, Importance of Heat Capacity, Important Thermodynamic Equations), Hydrogen Bonding in Proteins

**Week 5:** Protein Denaturation 1 Protein Stability Curve, Unfolding of Proteins (Two-State Protein Unfolding), Thermal Denaturation (Protein Unfolding Thermodynamics), Differentiate Between Two-State and Multi-State Protein Unfolding, Chemical Denaturation and Thermodynamics, Relationship Between Thermal and Chemical Denaturation Protein Denaturation 2 Chemical Denaturation and Thermodynamics, Relationship Between Thermal and Chemical Denaturation, Pressure Induced Protein Denaturation and Thermodynamics, Key Points of Protein Stability

**Week 6:** Protein Folding Pathways Folding Code, Levinthal Paradox, Old and New Views of Protein Folding, Folding Funnel, Mechanisms of Protein Folding Diffusion 1 Fick's Laws of Diffusion (First and Second Laws), Frictional Forces, Einstein-Smoluchowski Equation, Stokes-Einstein Equations, Diffusion Controlled Reaction, Langevin Equation, Velocity Correlation Function, Mean Square Displacement, Brownian Motion,

**Week 7:** Diffusion 2 Random Walk Electrochemical Potential Nernst Equation, Ion Flow through Membranes, Diffusion Potential,

**Week 8:** Nucleation Mechanism Chymotrypsin Inhibitor 2 (CI2), Transition State, Energy Diagrams in Protein Folding Mutational Analyses Phi-value Analysis, Chevron Plots, Chevron Rollover

**Week 9:** Protein Folding Kinetics 1 – Rapid Mixing Stopped Flow Technique, Continuous Flow Technique, Case study with the heme protein Cytochrome c, Hydrodynamic Focusing-Microfluidics Protein Folding Kinetics 2 – Relaxation Techniques Temperature-jump Technique, Temperature-jump Instrument Setup, Optical Triggering-Flash Photolysis

**Week 10:** Experimental Tools 1 Einstein's coefficients, Franck Condon Principle, Franck Condon Factor, Vibronic Coupling, Franck Condon Envelope, Absorption Spectroscopy, Components of an Absorption Spectrophotometer, Oscillator Strength

**Week 11:** Experimental Tools 2 Fluorescence, Jablonski Diagram, Internal Conversion (IC), Intersystem Crossing (ISC), Heavy-Atom Effect, Fluorescence Quantum Yield, Phosphorescence, Stokes Shift, Solvent Effects, Intrinsic Protein Fluorescence, Fluorescence Quenching

**Week 12:** Experimental Tools 3 Infrared (IR) Spectroscopy of Proteins, Transition Dipole, How to collect Protein IR Spectra, Amide (I – III) bands, FTIR Spectrometer Details, Interferometer, ATR-FTIR, Detectors





# ORGANIC CHEMISTRY IN BIOLOGY AND DRUG DEVELOPMENT

**PROF. AMIT BASAK**

Department of Chemistry/Bioscience  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Organic Chemistry

**INTENDED AUDIENCE** : Chemistry, Biochemistry, Chemical Biology, Pharmacy

**INDUSTRIES APPLICABLE TO** :

**COURSE OUTLINE :**

The present course is an attempt to bridge the gap in our understanding of biological systems and processes at the molecular and functional level. The course first introduces the various kinds of bio molecules, macro to medium size to small, their structures and functions followed by molecular engineering to manipulate their activity and biosynthesis. That creates a perfect platform for the next module on drug design and discovery.

**ABOUT INSTRUCTOR :**

Prof. Amit Basak offering this course at the first year PG level at IIT Kharagpur for many years. Before that, he had taught UG students of Presidency College (now University) for more than 10 years. Due to his interaction with Sir Prof J. E. Baldwin (his PhD supervisor at Oxford), an extraordinary chemical biologist and Prof S. K. Talapatra (PhD supervisor), renowned stereo chemists. His interests are in teaching subjects at the interface of chemistry and biology PG level grew immensely.

**COURSE PLAN :**

**Week 1:** Introduction

**Week 2:** Peptides and proteins

**Week 3:** Peptides and proteins (contd.)

**Week 4:** Proteins as biological catalyst

**Week 5:** Nucleic acids

**Week 6:** Metabolism:

**Week 7:** Chemistry of cofactors/coenzymes, Chemistry of TPP, PLP, Folic Acid and other vitamins

**Week 8:** Principle of drug design

**Week 9:** Chemistry of diseases and Drug development

**Week 10:** Chemistry of diseases and Drug development (contd.)

**Week 11:** Proton pump inhibitors

**Week 12:** REVISION OF TOPICS and Problem solving



# CIVIL ENGINEERING



# CIVIL ENGINEERING

## 04 weeks

- 01. Reinforced Concrete Road Bridges
- 02. Structural Dynamics for Civil Engineers – SDOF systems
- 03. Geosynthetics Testing Laboratory
- 04. Geotechnical Engineering Laboratory
- 05. GPS Surveying
- 06. Global Navigation Satellite Systems And Applications

## 08 weeks

- 01. Fluid Mechanics
- 02. Principles of Construction Management
- 03. Project Planning & Control
- 04. Matrix Method of Structural Analysis
- 05. Photogeology in Terrain Evaluation (Part-1 and 2)
- 06. Remote Sensing and Digital Image Processing of Satellite Data
- 07. Remote Sensing and GIS
- 08. Geomorphic Processes: Landforms and Landscapes

## 12 weeks

- 01. Strength of Materials
- 02. Foundation Engineering
- 03. Concrete Technology
- 04. Design of Masonry Structures
- 05. Design of Reinforced Concrete Structures
- 06. Design of steel structures
- 07. Structural analysis-I
- 08. Integrated Waste Management for a Smart City
- 09. Wastewater Treatment and Recycling
- 10. Environmental Geotechnics
- 11. Sustainable Materials and Green Buildings
- 12. Glass In Buildings : Design And Applications
- 13. Glass Processing Technology
- 14. Advanced Concrete Technology
- 15. Structural Geology



# REINFORCED CONCRETE ROAD BRIDGES

**PROF. NIRJHAR DHANG**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Teach

**INDUSTRIES APPLICABLE TO** : This course will be recognized by design consultancy firms and construction industries.

**COURSE OUTLINE :**

In this course, reinforced concrete road bridges are taken up as these bridges are mainly used in road transportation system. This course will mainly focus on reinforced concrete slab bridges spanning in the range of 8-12m. Reinforced concrete T beam bridges will also be covered spanning in the range of 15-25m. The course will be introduced with general design considerations, design limit states. Different loading conditions will be discussed introducing IRC codes. Behaviour of concrete will also be discussed. Design of slab bridges and RCT beam bridges will be carried out in a systematic manner.

**ABOUT INSTRUCTOR :**

Prof.Nirjhar Dhang (born 1962) is currently Professor of the Department of Civil Engineering, Indian Institute of Technology, Kharagpur, where he teaches Bridge Engineering, Structural Health Monitoring & Control, Design of Reinforced Concrete Structures. He works in the field of structural engineering particularly in the area of concrete, structural health monitoring & control and railway bridges applicable for high speed rail. He has done many consultancy and research project work. He has published 30 papers in International/National journals and conferences.

**COURSE PLAN :**

**Week 01** : Introduction, design considerations, loads and IRC codes

**Week 02** : Flexural and shear strength of reinforced concrete members

**Week 03** : Solid slab bridge design

**Week 04** : T-beam bridge design



# SCHEDULING TECHNIQUES IN PROJECTS

**PROF. J. UMA MAHESWARI**

Department of Civil Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BE/ME/BSc/MSc etc

**PRE-REQUISITES** : Basics of Physics and mathematics upto 12th standard and familiarity with use of computer.

**INDUSTRIES APPLICABLE TO** : <http://www.gpsinindia.com/directory/gps-surveycompanies-in-india>

## COURSE OUTLINE :

This course aims to make the students well-versed with the latest scheduling techniques in construction projects. Hence, the contents are planned in such a way that any student shall be able to do the scheduling at ease starting from simple network techniques to matrix-based methods. Sufficient tutorials will be held to enable hands-on experience to the students.

## ABOUT INSTRUCTOR :

Prof. J. Uma Maheswari is Associate Professor in the Department of Civil Engineering at Indian Institute of Technology Delhi. She is very active in teaching several undergraduate and postgraduate level courses in Construction Project Management at Indian Institute of Technology Delhi. She was instrumental in developing and structuring the PG Diploma program in "Metro Rail Transport: Technology & Management". She had graduated 60 MTech and 3 PhD students till date. Her passionate research topics are Design Management, Automation in Design and Construction. She was a recipient of Kusuma Outstanding Young faculty Fellowship offered at IIT Delhi for two years. Recognizing her academic contribution, Project Management Institute India has conferred on her the prestigious PMI India Young Research Scholar Award in 2015. She also received the CIDC Vishwakarma Award for Outstanding Academician category offered by Construction Industry Development Council in 2018.

## COURSE PLAN :

**Week 1:** Introduction to scheduling Network analysis in CPM (Critical Path Method)

**Week 2:** PDM (Precedence Diagramming Method) analysis for overlap in activities

**Week 3:** BDM (Beeline Diagramming Method) network analysis for interdependent activities DSM (Dependency Structure Matrix) modeling in projects

**Week 4:** Evaluating/Estimating interdependent activities Other scheduling techniques in projects



# STRUCTURAL DYNAMICS FOR CIVIL ENGINEERS – SDOF SYSTEMS

**PROF. RIYA CATHERINE GEORGE**

Department of Civil Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic programming skills to solve some assignment questions.

**INTENDED AUDIENCE** : Students of Civil or Mechanical Engineering

**INDUSTRIES APPLICABLE TO** : Civil or Mechanical Design companies like L&T, TCE, Atkins, General Electric, Rolls Royce, etc.

**COURSE OUTLINE :**

The theory of structural dynamics is introduced. The characteristics of Single Degree of Freedom Systems under dynamic loading are discussed in detail. Methods to evaluate the response of SDOF systems under various types of dynamic loading are taught. A brief introduction to Multi - DOF systems is also included.

**ABOUT INSTRUCTOR :**

Prof. Riya Catherine George, holds a PhD degree from IIT Kanpur, in Civil Engineering. She is presently working as Assistant Professor at Hiroshima University, Japan. She has four years of industry experience with General Electric, Aviation division as structural engineer.

**COURSE PLAN :**

**Week 1:** Introduction to structural dynamics,  
SDOF, Free vibration – Undamped and damped systems

**Week 2:** Forced Vibrations – Harmonic, Periodic,  
Arbitrary excitations

**Week 3:** Numerical evaluation of dynamic responses,  
Earthquake excitations

**Week 4:** Generalized SDOF systems,  
Introduction to Multi Degree of Freedom Systems



# GEOSYNTHETICS TESTING LABORATORY

**PROF. J.N. MANDAL**

Department of Civil Engineering  
IIT Bombay

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG
<b>COURSE DURATION</b>	: 4 weeks (29 Jul'19 - 23 Aug'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**INTENDED AUDIENCE** : B.E, M.E, B.Sc, M.Sc, Ph.D

**PRE-REQUISITES** : Basic Soil Mechanics and Foundation Engineering/ Geotechnical Engineering

**INDUSTRIES APPLICABLE TO** : Larsen & Toubro, Reliance Infrastructure Limited, HCC, TATA Projects, AFCON, RITES LTD, GAMMON INDIA LTD, Simplex Infrastructure, IVRCL

## COURSE OUTLINE :

This course will show how to conduct the various types of tests used for geosynthetic testing. Each experiment of geosynthetic testing is presented with brief introduction covering the important details of the experiment, the theory and the purpose for which it is to be performed, followed by the detailed explanation of apparatus required, procedure and specimen calculations. These should enable students to compute the results of experiments very easily.

## ABOUT INSTRUCTOR :

Dr. J.N. Mandal is professor of Civil engineering at Indian Institute of Technology Bombay in Powai, Mumbai, India. The primary area of research interests include geotechnical and geosynthetics engineering, centrifuge, physical and numerical modeling, ground improvement, waste and nano materials, transportation and environmental geotechnics. He founded geosynthetics research and testing laboratory, offered the undergraduate and postgraduate courses on geosynthetics in 1984. Since then the significance growth of world class research and development has focused completely in the fore front of activities in the emerging area of geosynthetics. He is the author/editor of six books and also founded the International Geosynthetics Society chapter for India in 1988. He organized the first Indian Geotextile Conference in 1988 and chairman for International Conference of Geosynthetics and Geoenvironmental Engineering in 2004.

## COURSE PLAN :

- Week 01** : Physical Properties: Introduction; Types of Geosynthetics; Functions; Mass per unit area, thickness, specific gravity, Module 2: Mechanical Properties, Tensile strength and trapezoidal tear strength; Tensile Modulus.
- Week 02** : Mechanical Properties : Drop cone test; Puncture resistance; Puncture resistance contd. and burst strength; burst strength contd. and Grab strength; Grab strength contd. and triaxial test.
- Week 03** : Mechanical Properties : Direct Shear and Pull-out test; Pull-out contd.; Sewn seam strength test, Hydraulic Properties Permittivity and transmittivity; transmittivity contd.; Apparent Opening size, Endurance Properties Abrasion test; Ultraviolet degradation and Gradient Ratio, Tests on Geofoam : geofoam introduction.
- Week 04** : Tests on Geofoam : Density of geofoam, Water absorption test, Compressive Properties; Compressive strength contd.; Compressive strength contd., Tensile properties; Tensile Properties contd., Flexural properties, and flammability





# GEOTECHNICAL ENGINEERING LABORATORY

**PROF. J.N. MANDAL**

Department of Civil Engineering  
IIT Bombay

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 4 weeks ((29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E, M.E, B.Sc, M.Sc, Ph.D

**PRE-REQUISITES** : Basic Soil Mechanics and Foundation Engineering/ Geotechnical Engineering

**INDUSTRIES APPLICABLE TO** : Larsen & Toubro, Reliance Infrastructure Limited, HCC, TATA Projects, AFCON, RITES Ltd, Gammon India Ltd, Simplex Infrastructure, IVRCL.

## COURSE OUTLINE :

This course will show how to conduct the various types of tests used for soil testing. Each experiment of soil testing is presented with brief introduction covering the important details of the experiment, the theory and the purpose for which it is to be performed, followed by the detailed explanation of apparatus required, procedure and specimen calculations. These should enable students to perform the experiment and compute the results of experiments very easily.

## ABOUT INSTRUCTOR :

Dr. J.N. Mandal is professor of Civil engineering at Indian Institute of Technology Bombay in Powai, Mumbai, India. The primary area of research interests include geotechnical and geosynthetics engineering, centrifuge, physical and numerical modeling, ground improvement, waste and nano materials, transportation and environmental geotechnics. He founded geosynthetics research and testing laboratory, offered the undergraduate and postgraduate courses on geosynthetics in 1984. Since then the significance growth of world class research and development has focused completely in the fore front of activities in the emerging area of geosynthetics. He is the author/editor of six books and also founded the International Geosynthetics Society chapter for India in 1988. He organized the first Indian Geotextile Conference in 1988 and chairman for International Conference of Geosynthetics and Geoenvironmental Engineering in 2004.

## COURSE PLAN :

**Week 01** : Soil Processing and Moisture Content Test, Specific Gravity Test, Field Density Test, Grain Size Analysis.

**Week 02** : Grain Size Analysis, Consistency limits, Laboratory Compaction test, Laboratory Permeability test

**Week 03** : Laboratory Permeability test, Shear Strength Test

**Week 04** : Shear Strength Test, Consolidation Test



# GPS SURVEYING

**PROF. JAYANTA KUMAR GHOSH**

Department of Civil Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : BE/ME/BSc/MSc etc

**PRE-REQUISITES** : Basics of Physics and mathematics upto 12th standard and familiarity with use of computer.

**INDUSTRIES APPLICABLE TO** : <http://www.gpsinindia.com/directory/gps-surveycompanies-in-india>

## COURSE OUTLINE :

The objective of the course is to provide optimal insights into land surveying using GPS (Global Positioning System). The course starts with an introduction to land surveying leading to GPS as the state-of-art for surveying of land. Then, different aspects of GPS systems such as GPS architecture, GPS signals, GPS receivers, GPS software has been discussed followed by GPS positioning & GPS observables. Next, it provides GPS processing fundamentals consisting of pre-processing and processing steps under different processing strategies followed by quality assessment and field procedure of GPS surveying. The course concludes with a detail demonstration of GPS field surveying followed by processing of collected data.

## ABOUT INSTRUCTOR :

Prof. Jayanta Kumar Ghosh is working as Associate Professor in the Civil Engineering Department (Geomatics Engineering Group) of Indian Institute of Technology Roorkee. He is engaged in teaching, research and consultancy works in Geomatics engineering for more than 30 years. He is pioneer in introducing courses on GPS surveying in the UG & PG curriculum of Civil Engineering in India, since 1999. He has conducted many short term courses on GPS Surveying for the building professionals as early as 2002. He has more than 85 publications in the International and National journals and conferences of repute. He is member of different National and International technical associations.

## COURSE PLAN :

**Week 1:** Introduction; GPS System

**Week 2:** GPS Positioning; GPS Observables

**Week 3:** GPS Data Processing

**Week 4:** GPS Field Surveying; GPS Field Data Processing



# GLOBAL NAVIGATION SATELLITE SYSTEMS AND APPLICATIONS

**PROF. ARUN K. SARAF**

Department of Environmental Science  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Geoinformatics companies, e.g. NIIT, ESRI India, MapmyIndia, ISRO, etc.

## **COURSE OUTLINE :**

The proposed course provides basic understanding about digital elevation models (DEMs) and their applications in Civil Engineering and Earth Sciences. Further, various DEMs, their source, generation techniques, derivatives, errors and limitations would be discussed extensively. Surface Hydrologic Modelling using DEMs, Modelling derivatives and their applications would also be discussed.

## **ABOUT INSTRUCTOR :**

Dr. Arun K. Saraf obtained PhD. (Remote Sensing) from University of Dundee, United Kingdom. Presently he is working as Professor in the Department of Earth Sciences, Indian Institute of Technology, Roorkee, and teaches courses on Geographic Information Systems (GIS), Advanced GIS, Remote Sensing, Geomorphology etc. to under- and post-graduate students. He was also Head of Department of Earth Sciences between Jan. 2012 & Feb. 2015. He was first in the country to introduce GIS course to post graduate students in the year 1990. In 1986, he was awarded "National Fellowship to Study Abroad" by Govt. of India for his doctoral degree. Further, in 1993 he was awarded Indo USST Fellowship and worked in Goddard Space Flight Centre, NASA, USA for Post Doctoral Research. He has been also awarded National Remote Sensing Award-2001 by Indian Society of Remote Sensing.

## **COURSE PLAN :**

**Week 1:** Concept of digital elevation model (DEM) and its implementation. Various techniques to generate digital elevation models-Part 1, Part 2 & 3, Importance of spatial resolution with DEMs

**Week 2:** Accessing the quality of DEM, Integration of DEMs with satellite data, Common derivatives and Crashing network

**Week 3:** DEMs derivatives - 1, DEMs derivatives - 2, DEMs derivatives - 3, DEMs derivatives - 4, DEM based Surface Hydrologic Modelling -1

**Week 4:** DEMs based Surface Hydrologic Modelling (contd.)  
DEMs and dam simulation and its application in groundwater hydrology  
Applications of DEMs in solar and wind energy potential estimations  
Applications of DEMs in Viewshed and Flood Hazard Mapping  
DEMs Sources  
Limitations and future of Digital Elevation Models



# FLUID MECHANICS

**PROF. SUBASHISA DUTTA**

Department of Civil Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Undergraduate Students of Civil/ Mechanical and Engineering

**COURSE OUTLINE :**

Fluid Mechanics is an inter-disciplinary course covering the basic principles and has applications in Civil Engineering, Mechanical Engineering and Chemical Engineering. The students will have new problem solving approaches like control volume concept and streamline patterns which are now a days required to solve the real-life complex problems. The visualization of the fluid-flow problems will be demonstrated to enhance student's interest on the subject.

**ABOUT INSTRUCTOR :**

Prof. Dutta has more than 15 years experience of teaching in IIT Guwahati for both undergraduate and postgraduate students the Fluid Mechanics course in undergraduate level was instructed five times by Prof. Dutta. Besides this, he has developed an NPTEL web course on Fluid Mechanics for undergraduate students. As a part of research and consultancies work Prof Dutta has done mathematical modeling of different rivers like the Brahmaputra. In this course, some of the real life problems will be discussed.

**COURSE PLAN :**

**Week 1:** Introduction and Basic Concepts

**Week 2:** Properties of Fluids and Fluid Statics

**Week 3:** Properties of Fluids and Fluid Statics (contd)

**Week 4:** Fluid Kinematics

**Week 5:** Mass, Bernoulli and Energy Equations

**Week 6:** Momentum Analysis of Flow Systems

**Week 7:** Dimensional Analysis and Modeling

**Week 8:** Flow in Pipes



# PRINCIPLES OF CONSTRUCTION MANAGEMENT

**PROF. SUDHIR MISHRA**

Department of Civil Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : There are no real 'pre-requisites' to this course but an exposure to construction projects would make the understanding easier.

**INDUSTRIES APPLICABLE TO** : It is hoped that engineers working in different contracting, consulting and other organizations related to construction projects will find the course useful, specially as a tool in induction training.

## COURSE OUTLINE :

Though the course primarily targets students of civil engineering in colleges, other engineering students may also find it interesting. The course seeks to present a rounded view of the divers issues involved in the management of construction projects, and includes aspects like construction economics, quality and safety management, and contract management, apart from time management and scheduling, estimation. It is hoped that engineers working in contracting, consulting and other organizations related to construction projects will also find the course useful.

## ABOUT INSTRUCTOR :

Professor Sudhir Misra is Professor at the Department of Civil Engineering, Indian Institute of Technology Kanpur and has a keen interest in concrete materials, construction and engineering. He has worked with consulting and construction companies also during his 35 years of professional experience, and also led the effort to initiate a graduate programme in Infrastructure Engineering and Management at IIT Kanpur. He has been a member of committees of the BIS and also worked with professional organizations in Japan and India. His research interests include durability and non-destructive testing of concrete and development and utilization of special concretes. A lecture module of Concrete Engineering and Technology by him is also available online under the NPTEL scheme of the Government of India.

## COURSE PLAN :

**Week 01** : General overview and project organization

**Week 02** : Estimation of project cost

**Week 03** : Construction Economics

**Week 04** : Planning and scheduling: part-1

**Week 05** : Planning and scheduling: part-2

**Week 06** : Quality management

**Week 07** : Safety Management

**Week 08** : Legal aspects of a construction project

Transfer matrix method



# PROJECT PLANNING AND CONTROL

**PROF. KOSHY VARGHESE**

Department of Civil Engineering  
IIT Madras

<b>TYPE OF COURSE</b>	: Rerun   Core   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**INTENDED AUDIENCE :** B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES :** Basic Mathematics with Probability & Statistics

**INDUSTRIES APPLICABLE TO :** All leading construction companies.

## COURSE OUTLINE :

This course will cover the basic concepts in Project Planning and Control with a focus on construction projects. The course is relevant to Civil Engineering senior level undergraduate as well as post-graduate students in the area of construction management. Practicing engineers who are part of the planning team on construction projects will also benefit from the concepts covered in the course.

## ABOUT INSTRUCTOR :

Dr. Koshy Varghese is a Professor with the Department of Civil Engineering, Indian Institute of Technology Madras (IITM). Dr. Varghese earned his Doctoral Degree at the University of Texas at Austin in 1992 and worked as a post-doctoral fellow for a year after which he joined IIT Madras. Dr. Varghese is a pioneer in construction management education and research in India and has taught courses in Construction Planning and Control to undergraduates / postgraduate as well as to industry.

## COURSE PLAN :

**Week 01 :** Introduction, Course Context, Construction Project Management

**Week 02 :** Time Management, Work Breakdown Structure (WBS), Gantt Charts

**Week 03 :** Duration Estimation, Network Representation & Analysis -1

**Week 04 :** Network Representation & Analysis -2; Two-Span Bridge: Scheduling, Network Analysis and Application

**Week 05 :** Time-Cost Trade-off (Crashing)

**Week 06 :** Resource Scheduling

**Week 07 :** Precedence Diagramming Method (PDM), Project Monitoring & Control

**Week 08 :** Project Monitoring & Control (Earned Value Concepts), Uncertainty in Project Schedules (PERT), Course Summary



# MATRIX METHOD OF STRUCTURAL ANALYSIS

**PROF. AMIT SHAW**

Dept. of Civil Engineering  
IIT Kharagpur

**PROF. BISWANATH BANERJEE**

Dept. of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**INTENDED AUDIENCE** : B.E/B.Tech,M.S,

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Solid Mechanics, Structural Analysis 1

**INDUSTRIES APPLICABLE TO** : Any Civil, Mechanical and Aerospace company

**COURSE OUTLINE :**

This is a second level course on structural analysis. Herein the concept of matrix method of structural analysis with application in various structural components will be discussed. This course will serve as a bridge between structural analysis 1 (the first course on structural analysis) and more advance topic such as finite element method (FEM).

**ABOUT INSTRUCTOR :**

Prof. Amit Shaw is presently an Associate Professor in the Department of Civil Engineering, IIT Kharagpur. He obtained his Bachelor's degree in Civil Engineering from IEST Shibpur (formerly Bengal Engineering College Shibpur) in 2000, MTech in Structures from IIT Roorkee in 2003 and PhD in Computational Mechanics from IISc Bangalore in 2007. Prior to joining IIT Kharagpur, Professor Shaw spent two years as Research Fellow in University of Aberdeen, UK. He also worked for some time in industries like Gammon India Limited and L&T ECC.

Prof. Biswanath Banerjee is presently an Assistant Professor in the Department of Civil Engineering, IIT Kharagpur. He obtained his Bachelor's degree in Construction Engineering from Jadavpur University in 2000, MTech in Structures from IIT Kharagpur in 2004 and PhD in Computational Mechanics from IISc Bangalore in 2009. Prior to joining IIT Kharagpur, Professor Banerjee spent two years as Post-doctoral Research Fellow in Cornell University, USA. He has also spent for some time in industries like Gammon India Limited, TRF Limited (A Tata enterprise) and Research labs in SERC Chennai (A CSIR Unit) as a Scientist.

**COURSE PLAN :**

**Week 01** : Introduction Structures, loads and response; determinate and indeterminate structures; stiffness and

**Week 02** : Review of analysis of Indeterminate structures: Force and displacement methods

**Week 03** : Mathematical preliminaries: Review of concept of matrix algebra; stiffness and flexibility matrices

**Week 04** : Analysis of Trusses

**Week 05** : Analysis of Beams

**Week 06** : Analysis of plane frames

**Week 07** : Implementation issues

**Week 08** : Beyond matrix method: Introduction to finite element method





# PHOTOGEOLOGY IN TERRAIN EVALUATION (PART – 1 and 2)

**PROF. JAVED MALIK**

Department of Civil Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**PRE-REQUISITES** : Basic knowledge of Earth Science or Physical Geography is recommended.

**COURSE OUTLINE :**

The course introduces the student to a globally applied tool known as Photogeology or Geo-photography; a technique first structured by the United States in late 19th century and later incorporated in United State Geological Survey. The weekly modules will demonstrate the concept and principles of Photogeology and its applications in real life. Students will learn reading the aerial and satellite photographs under the stereoscope and to generate a 3D view of the terrain. Using this tool they will be able to extract all types of information of the earth surface for various engineering and scientific purpose and projects. Students will have wonderful experience of aerial view of the earth surface and will extract information of landforms, sub-surface structures, and rock types etc. to perform terrain evaluation.

**ABOUT INSTRUCTOR :**

Prof. Javed Malik earned his Ph.D in 1998 from M.S. University Baroda, Vadodara, Gujarat (Geology), and did Post-Doctorate (Japan Society for Promotion of Science) from (1999-2001) Hiroshima University, JAPAN.

\* He Joined IIT Kanpur in 2001.

\* Areas of Specialization are : Active Tectonics, Paleoseismology and Paleo-tsunami

**COURSE PLAN :**

**Week 01** : Introduction to Physical and Structural geology, Introduction to Physical and Structural geology - Related Exercise on Identification of structures, Introduction to Lithology – Sedimentary Rocks.

**Week 02** : Introduction to Lithology – Sedimentary Rocks, Metamorphic Rocks, Igneous Rocks.

**Week 03** : Fluvial Geomorphology – Exercise on Landform Mapping, Coastal and Aeolian Landforms, Active Tectonics and Geomorphology.

**Week 04** : Active Tectonics and Geomorphology, Morphometric Analysis – Exercise on performing Morphometric Analysis, Photogeology in Lithological Mapping.

**Week 05** : Introduction to Photogeology and its Applications, Aerial Photography/ Satellite Imaging and their Applications, Aerial/ Satellite Photographs and Exercise on handling photographs, Principles of Stereoscropy and Exercise on creating 3D image using Stereoscope

**Week 06** : Photogrammetry – Exercise on Elements of Photo Interpretation and Line of Flight, Photogrammetry – Exercise on Photographic Measurements and Photo Scale, Role of Vertical Exaggeration in Photogrammetry - Related Lab Exercise, Role of Relief Displacement in Photogrammetry - Related Lab Exercise, Concept of Stereoscopic Parallax - Related Lab Exercise

**Week 07** : Introduction to Lithology – Sedimentary Rocks, Introduction to Lithology – Metamorphic Rocks, Introduction to Lithology – Igneous Rocks –, Related Exercise, Introduction to Physical and Structural geology, Introduction to Physical and Structural geology

**Week 08** : Introduction to Physical and Structural geology - Related Exercise on Identification of structures, Fluvial Geomorphology – Exercise on Landform Mapping, Fluvial Geomorphology – Exercise on Terrace Mapping, Morphometric Analysis – Exercise on performing Morphometric Analysis, Generation of Anaglyph using Stereo-pair in ENVI software – Lab Exercise



# REMOTE SENSING AND DIGITAL IMAGE PROCESSING OF SATELLITE DATA

**DR. ARUN K. SARAF**

Department of Civil Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech,M.Sc,PhD,

**PRE-REQUISITES** : Current students of engineering students and current post graduate science students

**INDUSTRIES APPLICABLE TO** : Remote Sensing / Geoinformatics companies, e.g NIIT, ESRI India, Leica Geoinformatics, MapmyIndia etc.

**COURSE OUTLINE :**

The proposed course provides basic understanding about satellite based Remote Sensing and Digital Image Processing technologies. Presently, remote sensing datasets available from various earth orbiting satellites are being used extensively in various domains including in civil engineering, water resources, earth sciences, transportation engineering, navigation etc. Google Earth has further made access to high spatial resolution remote sensing data available to non-experts with great ease. Knowledge of Digital Image Processing of satellite data allows to process raw satellite images for various applications.

**ABOUT INSTRUCTOR :**

Dr. Arun K. Saraf is Ph. D. (Remote Sensing) from University of Dundee, United Kingdom. Presently he is working as Professor in the Department of Earth Sciences, Indian Institute of Technology, Roorkee, and teaches courses on Remote Sensing, Digital Image Processing, Geographic Information Systems (GIS), Advanced GIS, Geomorphology, Geohydrology etc. to under- and post-graduate students of Geological Technology and Applied Geology. He was also Head of Department of Earth Sciences between Jan. 2012 – Feb. 2015. He was first in the country to introduce GIS course to post-graduate students in the year 1990. In 1986, he was awarded "National Fellowship to Study Abroad" by Govt. of India for his doctoral degree.

**COURSE PLAN :**

- Week 01** : What is Geographic Information Systems?, Different components of GIS, Different types of vector data, Raster data models and their types, TIN data model.
- Week 02** : Advantages and disadvantages associated with vector, raster and TIN, Non-spatial data (attributes) and their type, Raster data compression techniques, Different raster data file formats, Spatial database systems and their types.
- Week 03** : Pre-processing of spatial datasets, Different map projections, Spatial interpolation techniques, Different types of resolutions, Digital Elevation Model (DEM).
- Week 04** : Quality assessment of freely available DEMs, GIS analysis-1, GIS analysis-2 and applications, Errors in GIS, Key elements of maps.
- Week 05** : What is a remote sensing image and how it is represented?, Different techniques of Image acquisition, Why is digital image processing important?, Image characteristics and different resolutions in Remote Sensing, EM spectrum, solar reflection and thermal emission remote sensing.
- Week 06** : Colour representations and transforms, Image Histograms and statistics, Geometric transformations /Georeferencing Technique, Image enhancement techniques –I & II.
- Week 07** : Multispectral transforms: scatter plot, principal component analysis and decorrelation stretch, Spatial filtering techniques, Frequency domain - Fourier transformation, Basic Image Compression techniques and different image file formats, Image classification techniques.
- Week 08** : Principles of image interpretation, SAR Interferometry (InSAR) Technique, Image merging and mosaicking techniques, Applications of Image Analysis, Limitations and future of Digital Image Processing Technique.



# REMOTE SENSING AND GIS

**PROF. RISHIKESH BHARTI**

Department of Civil Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : PG Students

**INDUSTRIES APPLICABLE TO** : Rolta India, RMSI Private Limited, ArcGeosystems

## **COURSE OUTLINE :**

This course will introduce the students to the state-of-the-art concepts and practices of remote sensing and GIS. It starts with the fundamentals of remote sensing and GIS and subsequently advanced methods will be covered. This course is designed to give comprehensive understanding on the application of remote sensing and GIS in solving the research problems. Upon completion, the participants should be able to use remote sensing (Satellite images and Field data) and GIS in their future research work.

## **ABOUT INSTRUCTOR :**

Rishikesh Bharti is a faculty member at the Department of Civil Engineering, Indian Institute of Technology Guwahati. He has been teaching Advanced Remote Sensing, Geohazard Science and Engineering, Advanced Techniques in Geoscience, Engineering Geology to the B.Tech, M.Tech and PhD students at IIT Guwahati. Hydrogeomorphology, Geospatial modelling, Snow and Glacier Studies, Spectroscopy of natural and manmade materials and Advance remote sensing (Hyperspectral and thermal) for the earth and planetary exploration are his major research interests.

## **COURSE PLAN :**

**Week 1:** Remote Sensing Data and Corrections

**Week 2:** Satellite Image Corrections

**Week 3:** Digital Image Processing-I

**Week 4:** Digital Image Processing-II

**Week 5:** Thermal and Microwave

**Week 6:** Imaging Spectroscopy-I

**Week 7:** Imaging Spectroscopy-II & GIS-I

**Week 8:** GIS-II and Application



# GEOMORPHIC PROCESSES: LANDFORMS AND LANDSCAPES

**PROF. JAVED N. MALIK**

Department of Civil Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic course in Earth Sciences

**INTENDED AUDIENCE** : UG students of Science and Engineering.

**INDUSTRIES APPLICABLE TO** : Any company dealing with Landscape mapping

## **COURSE OUTLINE :**

The course introduces the student to basic principles of geomorphology and related geological environment. The modules of this course will help the student to have better understanding towards processes operating in the interior of the earth and also on the earth surface. After this course, a student can be well equipped with the knowledge of the different landforms and processes going on in fluvial, glacial, karst, aeolian, coastal terrains.

## **ABOUT INSTRUCTOR :**

Prof. Javed N. Malik finished his PhD in 1998 from M. S. University Baroda, Vadodara, Gujarat(Geology), did his Post-Doctorate (Japan Society for promotion of science) from (1999-2001) Hiroshima University, Japan. He joined IIT Kanpur in 2001 and his area of experience is Active Tectonics, Paleoseismology and Paleo-tsunami. He is doing research in Active fault mapping and Paleoseismological studies along NW Himalaya and Kachchh, Paleo-Tsunami studies in Andaman & Nicobar Islands and collaborating with Japan, US and France – related to earthquake and tsunami studies

## **COURSE PLAN :**

**Week 1:** Fundamentals of the Earth Surface System and Processes

**Week 2:** Interior of Earth, Plate tectonics and Sea-floor spreading

**Week 3:** The Atmospheric System: Atmospheric composition and mixing, Hydrological cycle, Carbon cycle Greenhouse effect, Milankovitch Cycles

**Week 4:** Fluvial Geomorphology: Drainage basins and river systems, river morphology and hydrology,hydraulic geometry and governing principles of open channel flow;

**Week 5:** Fluvial Geomorphology (continued): fluvial erosion, Sediment transport and depositional landforms, river dynamics.

**Week 6:** Aeolian Geomorphology: Atmospheric circulation, Wind erosion, sediment transport and depositional landforms.

**Week 7:** Glacial Geomorphology: Glacial Basics and Mass Balance; Ice Motion: Deformation, Sliding, and Surging; Glacial Erosional Processes and Landforms; Depositional Glacial Landforms

**Week 8:** Karst Geomorphology: KarstErosional Processes and Landforms; Depositional Landforms; Coastal and submarine Geomorphology: Coastal environment, waves, tides and currents. The relative movement of land and sea, Coastal erosion and resulting topographic features, Coastal deposition and landforms.



# STRENGTH OF MATERIALS

**PROF. SRIMAN KUMAR BHATTACHARYA**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Basic Engineering applications

**INDUSTRIES APPLICABLE TO** : All manufacturing industries, Construction sector, Structural design organisations

## COURSE OUTLINE :

Strength of Materials is a fundamental subject needed primarily for the students of Mechanical sciences. As the engineering design of different components, structures etc. used in practice are done using different kinds of materials, it is essential to understand the basic behavior of such materials. The objective of the present course is to make the students acquainted with the concept of load resultant, consequences and how different kinds of loadings can be withstood by different kinds of members with some specific materials. NPTEL lecture series on Strength of Materials are prepared, explaining the fundamentals in a simple and lucid manner so that the students can grasp the basics of the application of loading system and its consequence in a deformable body.

## ABOUT INSTRUCTOR :

Prof. Sriman Kumar Bhattacharya is a senior Professor and former Head of Civil Engineering at IIT Kharagpur. He was the Director of CSIR-Central Building Research Institute at Roorkee for six years between 2009 to 2015. He has a vast experience in teaching and research in Structural Engineering. Presently he is the Deputy Director of IIT Kharagpur. His areas of research include fluid-structure interaction, structural health monitoring, sustainable materials amongst others. He has published more than 200 papers in peer reviewed National / International journals and conferences. He is a Fellow of Indian National Academy of Engineering, Indian Association of Structural Engineering and Institution of Engineers (India).

## COURSE PLAN :

**Week 01** : Analysis of stresses

**Week 02** : Analysis of strain

**Week 03** : Stress-strain relations

**Week 04** : Uniaxial loading

**Week 05** : Torsion

**Week 06** : Bending of Beams - 1

**Week 07** : Bending of Beams - 2

**Week 08** : Deflection of Beams - 1

**Week 09** : Deflection of Beams - 2

**Week 10** : Combined stresses

**Week 11** : Stability of columns

**Week 12** : Spring



# FOUNDATION ENGINEERING

**PROF. KOUSIK DEB**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Soil Mechanics

**INDUSTRIES APPLICABLE TO** : Most of the Civil Engineering companies

## COURSE OUTLINE :

This course is an undergraduate core course. The course will focus on the design of shallow foundation and axially loaded pile foundation. The field and laboratory soil testing methods will be discussed to determine the required design parameters. Lateral earth pressures theories and design of various retaining structures will be covered. Design of sheet piles and bracing system will also be discussed. It will also focus on soil arching and its application to design the underground conduits. The selection of proper foundation or characteristics of foundations for different soils will be discussed. The course is suitable for undergraduate students who are preparing for competitive examination like GATE, IES and for university or college examinations. Field Engineers can also be benefited from this course.

## ABOUT INSTRUCTOR :

Prof. Kousik Deb is presently working as Associate Professor in Civil Engineering at IIT Kharagpur. Dr. Deb has more than 11 years of research experience and working in the areas of Geosynthetic- Reinforced Earth, Numerical Modeling, Embankment stability. He has published/accepted 90 research articles including about 50 papers in referred journals. He has developed number of numerical and analytical models to study the behavior of improved grounds, embankment stability and underground structures. Under Dr. Deb's guidance, three Ph.D. are awarded and six more are in progress. He has also supervised 13 M.Tech dissertations. Dr. Deb has completed 2 sponsored research projects funded by DST. He has successfully completed more than 12 consultancy projects. As a visiting research fellow at RWTH, Aachen, Germany; Dr. Deb has gained expertise in the cutting edge technologies on ground improvement such as applications of geosynthetics in roadways.

## COURSE PLAN :

- Week 01** : Introduction, Soil Exploration
- Week 02** : Penetration Tests, Geophysical Exploration
- Week 03** : Bearing capacity of shallow foundation
- Week 04** : Settlement of shallow foundations
- Week 05** : Design of shallow foundation
- Week 06** : Deep foundation, load transfer mechanism in piles, pile capacity, Pile load test
- Week 07** : Pile group capacity, settlement of pile, Design of Pile Foundation
- Week 08** : Lateral Earth Pressures-I
- Week 09** : Lateral Earth Pressures-II
- Week 10** : Earth retaining structures
- Week 11** : Sheet Piles and Braced Excavation
- Week 12** : Soil Arching, Underground Conduits





# CONCRETE TECHNOLOGY

**PROF. B. BHATTACHARJEE**

Department of Civil Engineering  
IIT Delhi

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E / B.Tech, M.E / M.Tech

**PRE-REQUISITES** : Basic knowledge of Statistical Mechanics

**INDUSTRIES APPLICABLE TO** : L&T ECC, Ultra Tech Cement, JK Cements, ACC, Star Cement and all other cement companies. CPWD and all other PWDs

## COURSE OUTLINE :

The course on "Concrete Technology" focuses on concrete making materials including supplementary cementitious materials. Concrete production process also forms a part of the discussion. Going through the course one would develop first-hand knowledge on concrete production process and properties and uses of concrete as a modern material of construction. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete.

## ABOUT INSTRUCTOR :

Professor Bishwajit Bhattacharjee is working with the Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi (India). His research interests pertain to the domains of cement and concrete technology, building science, sustainable construction, and health monitoring of structures. His publications in these areas are well cited. He is also a recipient of the Indian Concrete Institute's Life Time Achievement Award.

## COURSE PLAN :

- Week 01** : Introduction concrete as a material, ingredients, Production, composition, and properties; cement chemistry.
- Week 02** : Types of cements; special cements, aggregates :properties, tests and standard
- Week 03** : Water reducers, air entrainers, set controllers, specialty admixtures – structure properties, and effects on concrete properties; Introduction to supplementary cementing materials and pozzolans.
- Week 04** : Fly ash, blast furnace slag, silica fume, and metakaolin – their production, properties, and effects on concrete properties; other reactive and inert mineral additives.
- Week 05** : Basic principles; IS method; ACI method; new approaches based on rheology and particle packing.
- Week 06** : Batching of ingredients; mixing, transport, and placement; consolidation, finishing, and curing of concrete; initial and final set – significance and measurement; workability of concrete and its measurement
- Week 07** : Compressive strength and parameters affecting it; Tensile strength – direct and indirect; Modulus of elasticity and Poisson's ratio; Stress strain response of concrete.
- Week 08** : Modulus of elasticity and Poisson's ratio; Stress strain response of concrete. Creep and relaxation – parameters affecting; Shrinkage of concrete – types and significance; parameters affecting shrinkage; measurement of creep and shrinkage
- Week 09** : Introduction to durability; relation between durability and permeability;
- Week 10** : Chemical attack of concrete corrosion of steel rebars; other durability issues
- Week 11** : Properties and applications of: High strength – high performance concrete, reactive powder concrete; Lightweight, heavyweight, and mass concrete;
- Week 12** : Self-compacting concrete, fibre reinforced concrete; self-compacting concrete; other special concretes.





# DESIGN OF MASONRY STRUCTURES

**PROF. ARUN MENON**

Department of Civil Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Student must have completed courses on Strength of Materials, Structural Analysis, Structural Design (RC or steel), and preferably Seismic design of Structures

**INTENDED AUDIENCE** : The course is appropriate for UG (Civil), and PG students specialising in Structural Engineering.

**INDUSTRIES APPLICABLE TO** : Public Works Departments (CPWD/PWDs), Birla Aerocon (and other AAC block and cement concrete block manufacturers), Bekaert (India), Weinerberger (India)

**COURSE OUTLINE :**

The course aims at elucidating theories on mechanical behaviour of masonry assemblages under different actions, and introduces students to working stress and limit state approaches to analysis and design of unreinforced, reinforced, confined masonry structures for gravity and lateral loads, including earthquake loads. The course will also briefly address behaviour of masonry infill walls and procedures for structural assessment and strengthening of existing masonry structures.

**ABOUT INSTRUCTOR :**

Prof. Arun Menon is an Associate Professor of Structural Engineering at IIT Madras and holds an undergraduate degree in architecture, a masters degree in Civil Engineering from India, and Masters and doctoral degrees in Earthquake Engineering from University of Pavia, Italy. His research interests are in structural aspects of historical constructions, Earthquake-resistant structural masonry, structural assessment and retrofit design.

**COURSE PLAN :**

**Week 1:** Introduction

**Week 2:** Masonry Materials and Properties

**Week 3:** Strength and Behaviour of Masonry

**Week 4:** Strength and Behaviour of Masonry (contd)

**Week 5:** Strength and Behaviour of Masonry (contd)

**Week 6:** Design of Reinforced Masonry

**Week 7:** Design of Reinforced Masonry (contd)

**Week 8:** Design of Reinforced Masonry (contd)

**Week 9:** Design of Reinforced Masonry (contd)

**Week 10:** Design of Reinforced Masonry (contd)

**Week 11:** Design of Reinforced Masonry (contd)

**Week 12:** Confined Masonry, Infill Masonry,



# DESIGN OF REINFORCED CONCRETE STRUCTURES

**PROF. NIRJHAR DHANG**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Arch

**INDUSTRIES APPLICABLE TO** : This course will be recognized by design consultancy firms and construction industries.

**COURSE OUTLINE :**

Design of reinforced concrete structures is an introductory design course in civil engineering. In this course, basic elements governed by bending, shear, axial forces or combination of them are identified and are considered as building blocks of the whole structure. Different methods of design will be briefly described before introducing the limit states of collapse and serviceability. The design will be done as per IS 456:2000

**ABOUT INSTRUCTOR :**

Prof. Nirjhar Dhang is currently Professor of the Department of Civil Engineering, Indian Institute of Technology, Kharagpur, where he teaches Bridge Engineering, Structural Health Monitoring & Control, Design of Reinforced Concrete Structures. He works in the field of structural engineering particularly in the area of concrete, structural health monitoring & control and railway bridges applicable for high speed rail. He has done many consultancy and research project work. He has published 30 papers in International/National journals and conferences.

**COURSE PLAN :**

**Week 01** : Introduction, Different methods of design of reinforced concrete structures

**Week 02** : Working stress method

**Week 03** : Limit state of collapse - flexure

**Week 04** : Design of singly reinforced beam

**Week 05** : Design of doubly reinforced beam

**Week 06** : Limit state of collapse - shear

**Week 07** : Design for shear

**Week 08** : Design of slab

**Week 09** : Design of compression members

**Week 10** : Design of footing

**Week 11** : Design of staircase

**Week 12** : Limit state of serviceability



# DESIGN OF STEEL STRUCTURES

**PROF. DAMODAR MAITY**  
Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Civil Engineering

**INDUSTRIES APPLICABLE TO** : TATA Steel, SAIL, HSCL, EPIL, Jinadal Steel & Power, NBCC, RITES Limited, STUP Consultancy, MN Dastur Co. Ltd., TRF Ltd., Thyssenkrupp, WBHDC Ltd, PWD, CPWD etc.

## COURSE OUTLINE :

The course deals with design of steel structures using "Limit State Design Method". The design methodology is based on the latest Indian Standard Code of Practice for general construction (IS 800:2007). The subject covers all the necessary components such as material specifications, connections and elementary design of structural members for designing industrial steel structures. The course provides material specifications and design considerations. It provides relevant material properties of different types of steel. It deals with two types of connections namely welded and bolted connections.

## ABOUT INSTRUCTOR :

Prof. Damodar Maity did his graduation and post-graduation from Jadavpur University, Kolkata and Ph. D. from IIT Kharagpur. He has worked in Research Engineers Pvt. Ltd. as System Analyst for two years on the development of Software STAAD.Pro which includes steel design. He has served as faculty member in IIT Guwahati for seven years. He is currently Professor in the Department of Civil Engineering, IIT Kharagpur. His research works concentrated mainly in computational mechanics which includes structural health monitoring, earthquake analysis of dams, vibration control of highrise buildings etc. He has published more than 70 technical papers in various journals of National and International repute. Many of his papers have become top downloaded articles. Prof. Maity organized several training courses for teachers of Engineering Colleges as well as engineers of Government organizations like PWD, CPWD, NF Railway, NEC etc. He is member of Technical Advisory Committee of National Disaster Management Authority, Government of India.

## COURSE PLAN :

- Week 01** : Introduction: Material Overview
- Week 02** : Introduction: Design Overview
- Week 03** : Bolted Connections
- Week 04** : Welded Connections
- Week 05** : Eccentric Connections
- Week 06** : Failure and Strength Calculations of Tension Members
- Week 07** : Design of Tension Members
- Week 08** : Design of Compression Members
- Week 09** : Design of Lacing and Batten Systems
- Week 10** : Design of laterally supported Beams
- Week 11** : Design of laterally unsupported Beams
- Week 12** : Design of Column Base



# STRUCTURAL ANALYSIS - I

**PROF. AMIT SHAW**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Civil Engineering, Architecture

**PRE-REQUISITES** : Solid Mechanics

**INDUSTRIES APPLICABLE TO** : All civil engineering companies

## COURSE OUTLINE :

This is an elementary course on Structural Analysis. Various methods and their underlying mechanics in determining response of structures when subjected to external agitation will be discussed in this course. This course is comprehensive at the basic level. Journey through this course will help students to build the foundation for more advanced courses related to structural engineering.

## ABOUT INSTRUCTOR :

Prof. Amit Shaw is presently an Associate Professor in the Department of Civil Engineering, IIT Kharagpur. He obtained his Bachelor's degree in Civil Engineering from IEST Shibpur (formerly Bengal Engineering College Shibpur) in 2000, MTech in Structures from IIT Roorkee in 2003 and PhD in Computational Mechanics from IISc Bangalore in 2007. Prior to joining IIT Kharagpur, Professor Shaw spent two years as Research Fellow in University of Aberdeen, UK. He also worked for some time in industries like Gammon India Limited and L&T ECC. Professor Shaw's research area is in the field of Computational Mechanics and Impact Dynamics.

## COURSE PLAN :

**Week 1:** Equilibrium, Stability and Determinacy of structures; Review of shear force and bending moment diagram in beams and frames

**Week 2:** Analysis of statically determinate structures 1; Plane truss: method of joints and method of sections

**Week 3:** Analysis of statically determinate structures 2; Deflection of truss: Method of virtual work

**Week 4:** Analysis of statically determinate structures 3; Deflection of beams and frames 1: Moment area method, conjugate beam method and virtual work method

**Week 5:** Analysis of statically determinate structures 4; Deflection of beams and frames 2: Moment area method, conjugate beam method and virtual work method

**Week 6:** Analysis of statically determinate structures 5; Influence line diagram and moving loads

**Week 7:** Analysis of statically indeterminate structures 1; Introduction to force and stiffness method

**Week 8:** Analysis of statically indeterminate structures 2; Plane truss using method of consistent deformations

**Week 9:** Analysis of statically indeterminate structures 3; Beams and Frames: Method of consistent deformations

**Week 10:** Analysis of statically indeterminate structures 4; Beams and Frames: Moment distribution method

**Week 11:** Analysis of statically indeterminate structures 5; Beams and Frames: Slope deflection method

**Week 12:** Introduction to direct stiffness method



# INTEGRATED WASTE MANAGEMENT FOR A SMART CITY

**PROF. BRAJESH KUMAR DUBEY**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, PhD, Field Professionals and Academicians

**PRE-REQUISITES** : Environmental Sciences, Introduction to Environmental Engineering

**INDUSTRIES APPLICABLE TO** : Larsen and Turbo, Tata Group of Industries, Ramky Group of Industries, IF&LS Environment

## COURSE OUTLINE :

This course has emphasises on Integrated Solid Waste Management aspects within the broad subject area of Integrated Waste Management for a Smart City. The issues of Municipal Solid Waste (MSW) management, Construction and Demolition (C&D) Waste and Electronic Waste Management will be covered in this course. The topics will include: generation rates and waste composition; Integrated waste management issues, collection, recovery, reuse, recycling, energy-from-waste, and landfilling; Biological treatment of the organic waste fraction - direct land application, composting, and anaerobic digestion. The environmental impact of waste management and its relationship on the big picture sustainable development and smart city development will be discussed. A major focus of this course will be the role of MSW management within the various initiatives of the Govt. of India including: Swachh Bharat Mission, Smart Cities as well as Make in India. The challenges of waste management for smart cities will also be discussed taking case studies from the first list of 20 smart cities identified in the first phase for this program. This will be followed by overview of the Construction and Demolition (C&D) Waste and Electronic Waste (E-Waste) management issues in India in general and for the smart cities in particular. The new rules with respect of C&D Waste and E-Waste Management will be covered. The challenges of managing these waste streams effectively will be discussed.

## ABOUT INSTRUCTOR :

Dr. Brajesh Kumar Dubey is an Associate Professor in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than a decade of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, Life Cycle Assessment (LCA) and Sustainable Engineering. He has collaborated with UN agencies, World Bank, National Science foundation, Ontario Ministry of Environment and Auckland Regional Council on various projects including that in the area of LCA.

## COURSE PLAN :

**Week 01** : Introduction to Solid Waste Management

**Week 02** : Municipal Solid Waste Characteristics and Quantities

**Week 03** : MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program

**Week 04** : Municipal Solid Waste Collection, Transportation, Segregation and Processing

**Week 05** : Disposal of Municipal Solid Waste

**Week 06** : Biochemical Processes and Composting

**Week 07** : Energy Recovery from Municipal Solid Waste

**Week 08** : Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country

**Week 09** : Construction and Demolition (C&D) Waste Management - Overview

**Week 10** : C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials

**Week 11** : Electronic Waste (E-Waste) Management – Issues and Status in India and Globally

**Week 12** : E-Waste Management Rules 2016 and Management Challenges



# WASTEWATER TREATMENT AND RECYCLING

**PROF. MANOJ KUMAR TIWARI**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, Ph.D.

**INDUSTRIES APPLICABLE TO** : Municipal Corporations of various cities Public Health Engineering Departments Companies working in water/wastewater management sector, such as TCE, L&T, CH2MHill, Thermax, Veolia Water, Phonix, WABAG, Vulture Innovations, Wipro Infra etc.

**COURSE OUTLINE :**

With growing concerns over freshwater availability, concept of treating and recycling wastewater is progressively getting more pertinent. However, wastewater to be recycled need to be treated first for ensuring its quality sufficiently fit for designated uses, such as irrigation, industrial processes, toilet flushing, ground water recharge etc. Wastewater treatment can be specifically tailored to meet the water quality requirements of a planned reuse, as some would need only moderate treatment while few others may require higher degree purification. This course aims to discuss the various treatment technologies and their application for producing reuse quality water from wastewater. The course will largely cover topics including the basic philosophy of wastewater treatment, principles of various wastewater treatment units, conventional treatment systems, advanced treatment processes, recycling and reuse opportunities and wastewater reuse criteria. The purpose of this course is to instil in participants the comprehensive knowledge and understanding on technologies for water reclamation and reuse.

**ABOUT INSTRUCTOR :**

Dr. Manoj Kumar Tiwari [Ph.D. (IIT Kanpur)] is a Civil Engg. graduate with specialization in Environmental Engg. and holds expertise in water and wastewater treatment, water distribution systems, water pricing, and contaminant fate and transport. He is a recipient of prestigious Fulbright Fellowship. Dr. Tiwari has co-authored several papers in apex international journals, and has presented his research in various top ranked conferences across the globe. Dr. Tiwari has over 8 years of teaching experience with both UG as well as PG level course. He has designed several new courses at IIT Kharagpur for Master's programme in Water Engineering and Management.

**COURSE PLAN :**

- Week 01** : Introduction: General outline; Introduction to wastewater
- Week 02** : Wastewater Generation and Characteristics
- Week 03** : Natural Attenuation of Pollutants in Wastewater
- Week 04** : Treatment Philosophy; Objectives of wastewater treatment
- Week 05** : Preliminary and Primary Treatment Processes
- Week 06** : Secondary Treatment Processes
- Week 07** : Secondary Treatment Processes-Anaerobic
- Week 08** : Sludge Management
- Week 09** : Tertiary (Advanced) Treatment Processes
- Week 10** : Current Treatment Approaches
- Week 11** : Wastewater Recycling: Scope and demands
- Week 12** : Technology Selection and Decision Making





# ENVIRONMENTAL GEOTECHNICS

**PROF. D. N. SINGH**

Department of Civil Engineering  
IIT Bombay

**TYPE OF COURSE** : New | Core/Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Sufficient exposure to Soil Mechanics

**INTENDED AUDIENCE** : Civil Engineering, Geo- Technical Engineering, Environmental Engineering, Geo-Environmental Engineering.

**INDUSTRIES APPLICABLE TO** : Those that deal with: power generation, Manufacturing, Mining, Mineral Processing, Chemicals & Pharmaceuticals, Agriculture, Aquaculture, Oil and Petroleum, Dredging, ports, Landfilling, Construction, Infrastructure

**COURSE OUTLINE :**

A consideration of technical and scientific aspects of key geo-societal issues. Case studies and analysis of current and historic databases will be used to illustrate topics including, but not limited to, impact of climate change, energy resources, water and soil pollution, and health risks posed by heavy metals and emerging pollutants.

**ABOUT INSTRUCTOR :**

Prof. Devendra Narain Singh is an Institute Chair Professor in Department of Civil Engineering at Indian Institute of Technology Bombay. He obtained his Bachelors, Masters and Ph.D degrees from Indian Institute of Technology Kanpur. His research focuses on geomaterial characterization, contaminant-geomaterial interaction, sensors for soil moisture measurement, utilization of industrial by-products, synthesis and characterization of gas hydrates for renewable energy, municipal solid waste management and other fields associated with environmental geotechnics. He is a fellow of INAE, ASCE and ICE (UK).

**COURSE PLAN :**

**Week 1** : Basic introduction, Scope and Genesis

**Week 2** : Contemporary Civil Engineering, Recent Trends

**Week 3** : Natural and Manmade Environments, What is Geomaterial, Soil: a living entity

**Week 4** : Soil- Water- Environment Interaction, Soil- contaminant Interaction

**Week 5** : Contaminant transport and Fate of contaminants, Case Studies, Soil Remediation

**Week 6** : Methods for Soil Remediation: Soil Washing, Thermal Desorption, Soil vapor Extraction, Air stripping, Bioventilation, Bio-sparging, Ground freezing, soil heating

**Week 7** : Waste: Classification, Sources, forms, Utilization potential, Waste decomposition: Case Studies

**Week 8** : Landfills, Leachate generation and detection, Energy generation, Hazardous Waste, Case study: Nuclear waste disposal and its importance

**Week 9** : Sustainable development, Utilization of geomaterial for sustainable development, Industrial by-products and their applications

**Week 10** : Need and Characterization of Geo-material

**Week 11** : Geotechnical Characterization, Physical Characterization, Mineralogical Characterization

**Week 12** : Chemical Characterization, concluding remarks and way forward



# SUSTAINABLE MATERIALS AND GREEN BUILDINGS

**PROF. B BHATTACHARJEE**

Department of Civil Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : BE/BSc. Level Physics & Mathematics

**INTENDED AUDIENCE** : Civil Engineering & Architecture students and professionals

**INDUSTRIES APPLICABLE TO** : All Industry involved in Building design and construction.

L&T,MES,CPWD

## **COURSE OUTLINE :**

The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as Concrete, Bricks, and achieving the same through lower Carbon cements, Superior brick kilns and Recycled aggregate minimizing consumption of natural resources including water. VOC and indoor air quality. Exposing the student to concepts of embodied, Operational and Life Cycle Energy, Minimizing Energy consumption by optimal design, use of BIPV. The course also intend to make student aware of ECBC, LEED, GRIHA etc

## **ABOUT INSTRUCTOR :**

Professor Bishwajit Bhattacharjee is working with the Department of Civil Engineering, Indian Institute of Technology, Delhi. He completed his PhD from IIT Delhi. His research interests pertain to the domains of Building science, Sustainable construction, Concrete technology, and Health monitoring of structures etc. His publications in these areas are well cited. He is also a recipient of the Indian Concrete Institute's Life Time Achievement Award.

## **COURSE PLAN :**

**Week 1** : Introduction

**Week 2** : Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity and calculation of planet equivalent

**Week 3** : Role of Material:Carbon from Cement,alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete

**Week 4**: Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability'

**Week 5**: Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction.Operational energy in building role of materials and thermal conductivity

**Week 6**: Clay Bricks, Types kilns, Comparative energy performance emission performance and financial performance, Indoor air quality

**Week 7**: Paints,Adhesive and sealants for use in building,Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard

**Week 8**: Operational energy reduction and net zero building,Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm

**Week 9**: Radiation budget,Surface water balance, Effects of trees and microclimatic modification through greening,

**Week 10**:Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency

**Week 11**: Energy codes ECBC requirement, Concepts of OTTV etc

**Week 12**: Green Performance rating, requirements of LEED, GRIHA etc.



# GLASS IN BUILDINGS : DESIGN AND APPLICATIONS

**PROF. K.N. SATYANARAYANA**

Department of Civil Engineering  
IIT Tirupathi

**PROF. E. RAJASEKAR**

Department of Architecture  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Elective for third Year Civil Engineering and fourth year Architecture students.

**INDUSTRIES APPLICABLE TO** : Structural Glass Industry/ Building Façade Industry

**COURSE DURATION** : 12 weeks ((29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**COURSE OUTLINE :**

The field of Building Envelope Design & Construction has become a specialized field with several codes emphasizing energy efficiency to buildings both on mandatory and voluntary basis. Glass is one of the energy efficient materials that lend aesthetic and functional value to a building. Glass being extensively used in buildings, whereas the fields aligning including the right selection, analysis, design including facade design and consulting is tremendously facing lack of knowledge and competent professionals across the country. This course on 'Glass in Buildings: Design and Applications' will holistically cover the critical aspects of glass facade engineering and glass architecture & design

**ABOUT INSTRUCTOR :**

Dr. K N Satyanarayana is presently working as an Professor at IIT Tirupati. His area of interests are Construction project Management ,Quality management & Construction methods and equipments, Construction Contracts etc.He completed his PhD from Clemson University,USA.

Dr.E Rjasekhar is working as an Asst. Professor in the department of Architecture in IIT Roorkee. His area of interests are Thermal comfort, Energy efficiency and Carbon foot print of built environment. He had completed his PhD from IIT Madras.

**COURSE PLAN :**

**Week 01** : Introduction – Glass the Building Material

**Week 02** : Float Glass Manufacturing Process

**Week 03** : Building Envelope Design

**Week 04** : Glass Application on Facades and future of facades

**Week 05** : Architectural Glass – The Basics

**Week 06** : Fire Resistant Glazing

**Week 07** : Acoustic Glass Solutions

**Week 08** : Interior Glazing Applications

**Week 09** : Introduction to National Building Code (NBC) 2016

**Week 10** : Case Study – Design and selection of Glass and Glazing system – Safety and Structural Performance

**Week 11** : Design and selection criteria for energy performance of Glass and Glazing system

**Week 12** : Design and application of sealant



# GLASS PROCESSING TECHNOLOGY

**PROF. K.N. SATYANARAYANA**

Department of Civil Engineering  
IIT Tirupathi

**PROF. E. RAJASEKAR**

Department of Architecture  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : Anyone can learn

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Should be supervisors, shop floor managers, technicians etc. in the Glass Processing units and the diploma students from mechanical stream can enroll.

**INDUSTRIES APPLICABLE TO** : Glass Processing Industry

**COURSE OUTLINE :**

Glass Processing Technology is a significant component of the value chain in the glass façade industry where the basic float glass goes to the processor and from them to the fabricator and installed in the building façade. There are important processes that go in to it and needs detailed understanding and expertise. This course starts from the basics of unloading a glass to more complicated procedures like tempering before it is laminated and insulated. This course also gives importance to team building, behavioural skills etc. and helps them gain an overall perspective for effective shop floor management.

**ABOUT INSTRUCTOR :**

Dr. K N Satyanarayana is presently working as an Professor at IIT Tirupati. His area of interests are Construction project Management ,Quality management & Construction methods and equipments, Construction Contracts etc.He completed his PhD from Clemson University,USA.

Dr.E Rjasekhar is working as an Asst. Professor in the department of Architecture in IIT Roorkee. His area of interests are Thermal comfort, Energy efficiency and Carbon foot print of built environment. He had completed his PhD from IIT Madras.

**COURSE PLAN :**

**Week 01** : Introduction – Glass Processing

**Week 02** : Warehouse Management

**Week 03** : Unloading, Storage and Handling of Glass

**Week 04** : Production Planning & Control

**Week 05** : Cutting and Scoring of Glass, Cutting Oil/Coolant, Snapping, Drilling, Grinding and Washing

**Week 06** : Quality Check – Pre Processing and Standard Operating Procedures

**Week 07** : Tempering

**Week 08** : Insulation and Lamination

**Week 09** : 5S Safety

**Week 10** : People Capability, Customer Delight

**Week 11** : Sustainability

**Week 12** : Quality Management Systems



# ADVANCED CONCRETE TECHNOLOGY

**PROF. MANU SANTHANAM**

Department of Civil Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : M.E/M.Tech,M.S,PhD,

**PRE-REQUISITES** : Basic course on Construction Materials in UG level. Additional course on Concrete Technology (UG level) is optional.

**INDUSTRIES APPLICABLE TO** : Civil contracting firms, Ready mixed concrete companies, Cement companies, Construction chemicals companies, Materials research laboratories etc

## COURSE OUTLINE :

This course explores the materials science of concrete, and attempts to bring about the understanding of concrete behavior from a fundamental perspective. The first part of the course discusses the structure and properties of concrete making materials. This is followed by mixture proportioning of high performance concrete, and a study of selected topics regarding fresh and hardened concrete behavior. The final part of the course deals with long term performance issues, related to creep, shrinkage and durability of concrete.

## ABOUT INSTRUCTOR :

Dr. Manu Santhanam is a Professor in the Department of Civil Engineering at IIT Madras, where he has worked since October 2001. His primary research interests are in Cement Chemistry, Durability of Concrete and Non-Destructive Evaluation. He has published more than 75 refereed journal papers, and has guided 10 PhD theses, in addition to being lead investigator on several sponsored projects.

## COURSE PLAN :

**Week 01** : Cement production and composition

**Week 02** : Cement chemistry

**Week 03** : Aggregates for concrete

**Week 04** : Chemical admixtures

**Week 05** : Chemical and Mineral admixtures

**Week 06** : Mineral admixtures

**Week 07** : High performance concrete mixture proportioning

**Week 08** : Topics in fresh concrete

**Week 09** : Topics in hardened concrete

**Week 10** : Creep and shrinkage

**Week 11** : Durability of concrete

**Week 12** : Durability of concrete



# STRUCTURAL GEOLOGY

**PROF. SANTANU MISRA**

Department of Earth Sciences

IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Math/Physics and some knowledge of Geological/Earth Sciences

**INTENDED AUDIENCE** : BE - Civil Engineering

**INDUSTRIES APPLICABLE TO** : Construction Industry / Hydrocarbon Exploration and Mining Industries

## **COURSE OUTLINE :**

The subject **STRUCTURAL GEOLOGY** deals with the shape (geometry), Displacements (kinematics/strain) and forces (dynamics/stress) in Earth and Planetary bodies. In other words, the subject deals with the deformation of rocks and their architecture and development through geological time scales. Deformed rocks and structures conceal a series of tales, decoding of which is the challenge of a structural geologist in presenting the evolution of our planet earth. The knowledge of structural geology is applied in many practical fields e.g., Hydrocarbon, Mineral and groundwater explorations, Construction industries, natural hazard analysis, landscape evolution etc. This course will primarily focus upon the basics and introductory level understanding of the subject.

## **ABOUT INSTRUCTOR :**

Santanu Misra is a Professor of Structural Geology in the Department of Earth Sciences of Indian Institute of Technology, Kanpur. He is also a DST Swarnajayanti Fellow, PK Kelkar Research Fellow and INSA Young Scientist. Santanu teaches Structural Geology and leads the Experimental Rock Deformation Laboratory in IIT Kanpur. His main research focus is to understand the mechanical response of composite rock systems at various deformation conditions.

## **COURSE PLAN :**

**Week 1:** Introduction, Basic Concepts

**Week 2:** Structural Elements, Measurements, Stereographic Projection

**Week 3:** Stereographic Projections of linear and planar features

**Week 4:** Concept of Stress

**Week 5:** Concept of Strain

**Week 6:** Rheology of Rocks

**Week 7:** Deformation Mechanism of Rocks

**Week 8:** Folds and mechanisms

**Week 9:** Superposed folds

**Week 10:** Foliation and Lineation

**Week 11:** Boudinage and related structures

**Week 12:** Faults and Joints, Ductile Shear Zone, Structural Mapping, Summary and Final Discussion



# **COMPUTER SCIENCE & ENGINEERING**





# COMPUTER SCIENCE & ENGINEERING

## 04 weeks

01. C Programming and Assembly Language
02. Introduction to parallel Programming in Open MP
03. Python for Data Science
04. Demystifying networking

## 08 weeks

1. Programming in C++
2. Programming, Data Structures And Algorithms Using Python
3. Introduction to Programming in C
4. Data Base Management System
5. Design and analysis of algorithms
6. Object oriented analysis and design
7. Introduction to Operating Systems
8. Introduction to Machine Learning
9. Data Science for Engineers
10. Scalable Data Science
11. Advanced Computer Architecture
12. Cloud Computing
13. Hardware modeling using verilog
14. Spatial Informatics
15. Modern Algebra
16. Theory of Computation
17. Introduction To Haskell Programming
18. Practical Machine Learning with Tensorflow
19. Human Computer Interactions

## 12 weeks

01. An Introduction To Programming Through C++
02. The Joy of Computing using Python
03. Problem Solving through Programming in C
04. Discrete Mathematics
05. Operating System Fundamentals
06. Introduction to Machine Learning
07. Deep Learning
08. Reinforcement Learning
09. Natural Language Processing
10. Applied Natural Language Processing
11. Computer Vision
12. Blockchain Architecture Design and Use Cases
13. Introduction to Internet of Things
14. Social Networks
15. Discrete Mathematics
16. Ethical Hacking
17. Software Engineering
18. Software Project Management
19. Software testing
20. Synthesis of Digital Systems
21. Switching Circuits and Logic Design
22. Fuzzy Systems and Applications
23. Machine Learning for Engineering and Science Applications
24. Artificial Intelligence Search Methods For Problem Solving
25. Programming In Java
26. Deep Learning – Part 1



# C PROGRAMMING AND ASSEMBLY LANGUAGE

**PROF. JANAKIRAMAN VIRARAGHAVAN**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Students who have completed a course on C programming and Microprocessors

**INDUSTRIES APPLICABLE TO** : Almost all software companies and many hardware companies

**COURSE OUTLINE :**

The course explains about how the function calls are translated to assembly; parameters are passed to a function; local variables are stored on stack; local variables go out of scope after the function call

**ABOUT INSTRUCTOR :**

Prof. Janakiraman Viraraghavan is an Assistant Professor at the Department of Electrical Engineering, IIT Madras and is part of the Integrated Circuits and Systems (ICS) group. His research interests include porting Machine-Learning Algorithms on to hardware and Statistical Analysis in VLSI. He also has a keen interest in Microprocessors and Programming in general.

**COURSE PLAN :**

**Week 1** : Introduction to Microprocessors

Assembly Language Programming

**Week 2** : Introduction to C

Inline Assembly

**Week 3** : Compiling C to Assembly Language

**Week 4** : C++ and some special Functions



# INTRODUCTION TO PARALLEL PROGRAMMING IN OPEN MP

**PROF. YOGISH SABHARWAL**

Dept. of Computer Science and Engineering  
IIT Delhi

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Computer Science and non-Computer Science Students with interest in parallel programming for HPC applications.

**PRE-REQUISITES** : Students enrolling for this course should be comfortable with programming in C.

**INDUSTRIES APPLICABLE TO** : IBM, Intel, Amazon, Google, Microsoft, Cray.

**COURSE OUTLINE :**

This course focuses on the shared memory programming paradigm. It covers concepts & programming principles involved in developing scalable parallel applications. Assignments focus on writing scalable programs for multi-core architectures using OpenMP and C. This is an introductory course in shared memory parallel programming suitable for computer science as well as non-computer science students working on parallel/HPC applications and interested in parallel programming.

**ABOUT INSTRUCTOR :**

Prof. Yogish Sabharwal is a researcher at IBM Research and serves as an adjunct faculty at IIT Delhi. At IBM, he manages the high performance computing group, that ensures that real-world applications are able to extract the best performance out of HPC systems. He has 70+ papers including 3 best paper awards, 2 best paper nominations and a Gordon Bell finalist. His work has won several competitions organized in the HPC community.

**COURSE PLAN :**

**Week 1** : Single Processor Architecture and Basic OpenMP constructs & functions

**Week 2** : More OpenMP constructs & functions

**Week 3** : Basic Linear Algebra using OpenMP and OpenMP tasks

(Assignment 1: Programming assignment to implement and evaluate blocked matrix multiply in OpenMP)

**Week 4** : Critical Sections, locks and Matrix Factorization using OpenMP

(Assignment 2: Programming assignment to implement and evaluate task based algorithm for a BLAS routine).



# PYTHON FOR DATA SCIENCE

**PROF. RAGHUNATHAN RENGASAMY**

Department of Chemical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Knowledge of basic data science algorithms

**INTENDED AUDIENCE** : 4th year Engineering Undergraduates

**INDUSTRIES APPLICABLE TO** : Honeywell, Abb, Ford, Gyan Data pvt. Ltd.

**COURSE OUTLINE :**

The course aims at equipping participants to be able to use python programming for solving data science problems

**ABOUT INSTRUCTOR :**

Prior to joining IIT Madras as a Prof..Rengaswamy was a Professor of Chemical Engineering and Co-director of the Process control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a Professor and Associate Professor at Clarkson University, USA and an Assistant Professor at IIT Bombay. His major research interests are in the areas of Fault Detection and Diagnosis and Development of Data Science Algorithms for Manufacturing industries.

**COURSE PLAN :**

**Week 1&2:** Basics of Python,  
Control structures,  
Scripts and Functions, Graphs in python,  
Numpy Pandas Data structures

**Week 3&4:** Case study illustration in python using 2-3 ml algorithms.



# DEMYSTIFYING NETWORKING

**PROF. SRIDHAR IYER**

Department of Computer Science and Engineering  
IIT Bombay

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Computer Networking

**INDUSTRIES APPLICABLE TO** : Computer Networks

**COURSE OUTLINE :**

This course will provide students with an overview of networking concepts and technologies. It is meant as a primer for non-majors, i.e., for students who don't have networking as a core course in their curriculum. After this primer, students may choose to take other networking courses for delving deeper into specific technologies

**ABOUT INSTRUCTOR :**

Prof. Sridhar Iyer is a faculty member in the Inter-Disciplinary Program in Educational Technology, and Department of Computer Science and Engineering at IIT Bombay. His current research interests include: Technology Enhanced learning Environments for Thinking skills, Pedagogies for effective use of Educational Technologies, and Computer Science Education Research. Prof. Sridhar Iyer received his B.Tech, M.Tech and Ph.D from the Department of Computer Science and Engineering at IIT Bombay.

**COURSE PLAN :**

**Week 1** : Layering analogy Protocols, Top down view, Bottom up view, Issues at each layer, Mobile Networks

**Week 2** : MAC analogy, MAC concepts Example - Ethernet Example - WiFi Example – 3G Mobile – 3G/4G

**Week 3** : Routing analogy Routing concepts Example – RIP/OSPF Transport concepts Example – UDP/TCP Mobile - Roaming

**Week 4** : Applications overview Client-Sever Example – Web Example – Streaming Cloud services Mobile - Apps



# PROGRAMMING IN C++

**PROF. PARTHA PRATIM DAS**

Dept. of Computer Science and Engineering  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: Rerun   Core   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc

**PRE-REQUISITES** : Basic knowledge of programming & Data structure, C Programming, Attending a course on OOP with this course will help

**INDUSTRIES APPLICABLE TO** : Programming in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

## COURSE OUTLINE :

There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Index for April 2016 indicates – Java (21%), C (14%), C++ (6%), C#(4%), and Python (3%) together control nearly half the programming community. Given this, it is still important to learn C and C++ because of the efficiency they offer. While we appreciate that Java is good for applications, for graphics; and we acknowledge that Python is appropriate for portable software, engineering problem solving, and graphics; it is worth bearing in mind that the JVM and Python interpreter are indeed written in C++, making C++ the father of all languages today. Well, hence, C++ is the systems language. Why should I learn it if my primary focus is on applications? This is where the recent updates of C++, namely, C++11, C++14, and C++17 offer excellent depths and flexibility for C++ that no language can match. These extensions attempt to alleviate some of the long-standing shortcomings for C++ including porous resource management, error-prone pointer handling, expression semantics and better readability. The present course builds up on the knowledge of C programming and basic data structure (array, list, stack, queue etc.) to create a strong familiarity with C++98 and C++03. Besides the constructs, syntax and semantics of C++ (over C), we also focus on various idioms of C++ and attempt to go to depth with every C++ feature justifying and illustrating them with several examples and assignment problems. On the way, we illustrate various OOP concepts.

While this course can be understood independently (after a course in C programming), it would help in developing understanding in OOP. Hence this course is advised in conjunction with OOP.

## ABOUT INSTRUCTOR :

Dr. Partha Pratim Das received his B.Tech, M.Tech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

## COURSE PLAN :

- Week 01** : Programming in C++ is Fun : Build and execute a C program in C++, Write equivalent programs in C++.
- Week 02** : C++ as Better C : Procedural Extensions of C.
- Week 03** : Overview of OOP in C++ : Classes and basic Object-Oriented features (encapsulation).
- Week 04** : Overview of OOP in C++ : More OO features, overloading, namespace and using struct and union.
- Week 05** : Inheritance : Generalization / Specialization of Object Modeling in C++.
- Week 06** : Polymorphism : Static and Dynamic Binding.
- Week 07** : Type Casting & Exceptions : C++ cast operators; C++ Exceptions & standard exception classes.
- Week 08** : Templates & STL – Function and Class templates and using STL like containers, algorithms.



# PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

**PROF. MADHAVAN MUKUND**

Dept. of Computer Science and Engineering  
CMI

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc, M.E/M.Tech, M.S, M.Sc

**PRE-REQUISITES** : School level mathematics.

**INDUSTRIES APPLICABLE TO** : This course should be of value to any company requiring programming skills.

**COURSE OUTLINE :**

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

**ABOUT INSTRUCTOR :**

Madhavan Mukund studied at IIT Bombay (B.Tech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Dean of Studies. His main research area is formal verification. In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD.

**COURSE PLAN :**

- Week 01** : Informal introduction to programming, algorithms and data structures  
viagcd, Downloading and installing Python, gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions.
- Week 02** : Python: types, expressions, strings, lists, tuples | Python memory model: names, mutable and immutable values | List operations: slices etc - Binary search | Inductive function denitions: numerical and structural induction | Elementary inductive sorting: selection and insertion sort | In-place sorting.
- Week 03** : Basic algorithmic analysis: input size, asymptotic, complexity,  $O()$  notation | Arrays vs lists | Merge sort | Quicksort | Stable sorting.
- Week 04** : Dictionaries | More on Python functions: optional arguments, default values | Passing functions as arguments | Higher order functions on lists: map, lter, list comprehension.
- Week 05** : Exception handling | Basic input/output | Handling files | String processing.
- Week 06** : Backtracking: N Queens, recording all solutions | Scope in Python: local, global, nonlocal names | Nested functions | Data structures: stack, queue | Heaps.
- Week 07** : Abstract datatypes | Classes and objects in Python | "Linked" lists: find, insert, delete | Binary search trees: find, insert, delete | Height-balanced binary search trees.
- Week 08** : Efficient evaluation of recursive denitions: memoization | Dynamic programming: examples | Other programming languages: C and manual memory management | Other programming paradigms: functional programming.





# INTRODUCTION TO PROGRAMMING IN C

**PROF. SATYADEV NANDAKUMAR**

Dept. of Computer Science and Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Anyone can learn

**PRE-REQUISITES** : Prior programming not required; mathematical maturity of a second level UG student in science or engineering

## COURSE OUTLINE :

This is a course in programming in C. No prior programming experience is assumed; however, mathematical maturity at the level of a second year science or engineering undergraduate is assumed. We emphasize solving problems using the language, and introduce standard programming techniques like alternation, iteration and recursion. We will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams.

## ABOUT INSTRUCTOR :

Prof. Satyadev Nandakumar is an Assistant Professor at the Department of Computer Science & Engineering, IIT Kanpur. He is specialized in Computable Analysis, Algorithmic Information Theory, Symbolic Dynamics. His research interests lies in the areas of:

- \* Algorithmic Information Theory, Kolmogorov complexity, and effective fractal dimension.
- \* Effective symbolic measure-theoretic and topological dynamical systems.
- \* Normal numbers, continued fractions, finite-state dimension.
- \* Computability and complexity in analysis.
- \* Computational complexity theory, pseudorandomness.

## COURSE PLAN :

**Week 01** : Introduction. Straight-Line Code. Variables, Operators, Expressions and Conditionals.

**Week 02** : Loops.

**Week 03** : Functions.

**Week 04** : One-Dimensional Arrays and Pointers.

**Week 05** : Recursion.

**Week 06** : Multi-dimensional Arrays, Linked Lists.

**Week 07** : Operating on Files.

**Week 08** : Organizing C projects, working with multiple source directories, makefiles.



# DATA BASE MANAGEMENT SYSTEM

**PROF. PARTHA PRATIM DAS**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, BCA, MCA

**PRE-REQUISITES** : Knowledge of Programming, Data Structure and Algorithms

**INDUSTRIES APPLICABLE TO** : Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart

## COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain. While DBMS's differ in details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course would examine data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. It would also introduce query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client/server architectures based and Web-based database applications will also be introduced.

## ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

## COURSE PLAN :

- Week 01** : Course Overview. Introduction to RDBMS.
- Week 02** : Structured Query Language (SQL).
- Week 03** : Relational Algebra. Entity-Relationship Model .
- Week 04** : Relational Database Design.
- Week 05** : Application Development. Case Studies. Storage and File Structure.
- Week 06** : Indexing and Hashing. Query Processing.
- Week 07** : Query Optimization. Transactions (Serializability and Recoverability) .
- Week 08** : Concurrency Control. Recovery Systems. Course Summarization.



# DESIGN AND ANALYSIS OF ALGORITHMS

**PROF. MADHAVAN MUKUND**

Dept. of Computer Science and Engineering  
CMI

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks(26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : Exposure to introductory courses on programming and data structures.

**INDUSTRIES APPLICABLE TO** : This course should be of value to any company working in the area of software services and products.

**COURSE OUTLINE :**

This course will cover basic concepts in the design and analysis of algorithms: Asymptotic complexity,  $O()$  notation | Sorting and search | Algorithms on graphs: exploration, connectivity, shortest paths, directed acyclic graphs, spanning trees | Design techniques: divide and conquer, greedy, dynamic programming | Data structures: heaps, union of disjoint sets, search trees | Intractability.

**ABOUT INSTRUCTOR :**

Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Dean of Studies. His main research area is formal verification. In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD.

**COURSE PLAN :**

- Week 01** : Introduction, Examples and motivation, Asymptotic complexity: informal concepts, formal notation, examples.
- Week 02** : Searching in list: binary search, Sorting: insertion sort, selection sort, merge sort, quicksort, stability and other issues.
- Week 03** : Graphs: Motivation, Graph exploration: BFS, DFS; DFS numbering and applications, Directed acyclic graphs.
- Week 04** : Shortest paths: unweighted and weighted, Single source shortest paths:Dijkstra, Minimum cost spanning trees: Prim's algorithm, Kruskal's Algorithm; Union-Find data structure.
- Week 05** : Divide and conquer: counting inversions, nearest pair of points; Priority queues, heaps,Dijkstra/Prims revisited using heaps, Search Trees: Introduction.
- Week 06** : Search Trees: Traversals, insertions, deletions, Balancing; Greedy : Interval scheduling, Proof strategies, Huffman coding; Dynamic Programming: weighted interval scheduling.
- Week 07** : Dynamic Programming: Memoization, Edit distance, Longest ascending subsequence, Matrix multiplication; Shortest paths: Bellman Ford, shortest Floyd Warshall
- Week 08** : Intractability: NP completeness, Reductions, Examples; Misc topics.



# OBJECT ORIENTED ANALYSIS AND DESIGN

**PROF. PARTHA PRATIM DAS**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Computer Science and non-Computer Science Students with interest in parallel programming for HPC applications.

**PRE-REQUISITES** : 1. Basic Knowledge of Programming & Data Structure  
2. Experience of Programming Projects would help; but is not mandatory  
3. Attending a course on C++ with this course will help

**INDUSTRIES APPLICABLE TO** : Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

**COURSE OUTLINE :**

The complexity of software systems is ever on the rise – more complex problem domains being attempted (complex embedded systems), ever growing man-power engaged in increasingly intricate development processes to turnaround in shorter and shorter time, possible flexibility of software being stretched to the limit with XaaS, platforms getting challenging with widely expanding distribution, cloud computation etc. Hence the analysis and design of software require well-organized and structured approaches to manage the challenges of complexity.

**ABOUT INSTRUCTOR :**

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Terra Systems, Inc as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

**COURSE PLAN :**

**Week 1:** Software Complexity: Understanding the challenges OOAD can address

**Week 2:** Object Model: Defining the primitives of the OO paradigm

**Week 3:** Classes and Objects: Bringing in the broader perspectives

**Week 4:** Classes and Objects: Identification approaches using OOAD

**Week 5:** Unified Modeling Language

**Week 6:** Unified Modeling Language

**Week 7:** Unified Modeling Language

**Week 8:** OOAD Case Studies: Applying OOAD in different contexts



# INTRODUCTION TO OPERATING SYSTEMS

**PROF. CHESTER REBERIO**

Dept. of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E./Msc (Computer Science)

**PRE-REQUISITES** : Good knowledge of C, Computer Organization and Architecture, x86 Assembly level programming.

**COURSE OUTLINE :**

Operating systems (OS) provide the crucial interface between a computer's hardware and the applications that run on it. It allows us to write programs without bothering much about the hardware. It also ensures that the computer's resources such as its CPU, hard disk, and memory, are appropriately utilized. In this course, we dwell into how the OS manages to do all this in an efficient manner. This is an introductory course, for students with prior knowledge of computer organization. The course is based on an OS called xv6, which in many ways is similar to the Linux operating systems.

**ABOUT INSTRUCTOR :**

Prof. Chester Rebeiro is an Assistant Professor at IIT Madras. He completed his PhD from IIT Kharagpur and a post-doc from Columbia University. His research interests are in cryptography, system security, especially hardware and operating system security.

**COURSE PLAN :**

**Week 1:** Introduction

**Week 2:** Memory Management

**Week 3:** Processes

**Week 4:** Interrupts and Context Switching

**Week 5:** Scheduling

**Week 6:** Synchronization

**Week 7:** Deadlocks

**Week 8:** Operating System Security



# INTRODUCTION TO MACHINE LEARNING

**PROF. SUDESHNA SARKAR**

Dept of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : BE, ME, MS, MSc, PhD

**PRE-REQUISITES** : Basic programming skills (in Python), algorithm design, basics of probability & statistics

**INDUSTRIES APPLICABLE TO** : Data science companies and many other industries value machine learning skills.

## COURSE OUTLINE :

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. We will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, k-nearest neighbour, an introduction to Bayesian learning and the naïve Bayes algorithm, support vector machines and kernels and neural networks with an introduction to Deep Learning. We will also cover the basic clustering algorithms. Feature reduction methods will also be discussed. We will introduce the basics of computational learning theory. In the course we will discuss various issues related to the application of machine learning algorithms. We will discuss hypothesis space, overfitting, bias and variance, tradeoffs between representational power and learnability, evaluation strategies and cross-validation. The course will be accompanied by hands-on problem solving with programming in Python and some tutorial sessions.

## ABOUT INSTRUCTOR :

Sudeshna Sarkar is a Professor and currently the Head of the Department of Computer Science and Engineering at IIT Kharagpur. She completed her B.Tech. in 1989 from IIT Kharagpur, MS from University of California, Berkeley, and PhD from IIT Kharagpur in 1995. She served briefly as faculty at IIT Guwahati and at IIT Kanpur before joining IIT Kharagpur in 1998. Her research interests are in Machine Learning, Natural Language Processing, Data and Text Mining.

## COURSE PLAN :

**Week 01** : Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

**Week 02** : Linear regression, Decision trees, overfitting.

**Week 03** : Instance based learning, Feature reduction, Collaborative filtering based recommendation.

**Week 04** : Probability and Bayes learning.

**Week 05** : Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

**Week 06** : Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

**Week 07** : Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

**Week 08** : Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.



# DATA SCIENCE FOR ENGINEERS

## PROF. RAGUNATHAN RENGASAMY

Dept. of Chemical Engineering  
IIT Madras

## PROF. SHANKAR NARASIMHAN

Dept. of Chemical Engineering  
IIT Madras

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG	<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 23 Aug '19)
<b>PRE-REQUISITES</b>	: 10 hrs of pre-course material on R will be provided. Participants need to practice this.	<b>EXAM DATE</b>	: 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Honeywell, ABB, Ford, Gyan Data pvt. Ltd.

## COURSE OUTLINE :

### Learning Objectives :

1. Introduce R as a programming language
2. Introduce the mathematical foundations required for data science
3. Introduce the first level data science algorithms
4. Introduce a data analytics problem solving framework
5. Introduce a practical capstone case study

### Learning Outcomes:

1. Describe a flow process for data science problems (Remembering)
2. Classify data science problems into standard typology (Comprehension)
3. Develop R codes for data science solutions (Application)
4. Correlate results to the solution approach followed (Analysis)
5. Assess the solution approach (Evaluation)
6. Construct use cases to validate approach and identify modifications required (Creating)

## ABOUT INSTRUCTOR :

Prior to joining IIT Madras as a Professor, Prof. Rengasamy was a Professor of Chemical Engineering and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a Professor and Associate Professor at Clarkson University, USA and an Assistant Professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

Prof. Shankar Narasimhan is currently a Professor in the Department of Chemical Engineering at IIT Madras. His major research interests are in the areas of data mining, process design and optimization, fault detection and diagnosis and fault tolerant control. He has co-authored several important papers and a book titled Data Reconciliation and Gross Error Detection: An Intelligent Use of Process Data which has received critical appreciation in India and abroad.

## COURSE PLAN :

**Week 1 :** Linear algebra for data science (algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse) ,

**Week 2 :** Linear algebra for data science (geometric view - vectors, distance, projections, eigenvalue decomposition)

**Week 3 :** Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix)

**Week 4 :** Optimization

**Week 5 :** Optimization; Typology of data Science problems and a solution framework

**Week 6 :** Univariate and multivariate linear regression Model assessment (including cross validation)

**Week 7 :** Verifying assumptions used in linear regression , Assessing importance of different variables, subset selection

**Week 8 :** Introduction to classification and classification using logistics regression ,Classification using various clustering techniques





# SCALABLE DATA SCIENCE

## PROF. ANIRBAN DASGUPTA

Dept. of Computer Science and Engineering  
IIT Kharagpur

## PROF. SOURANGSHU BHATTACHARYA

Dept. of Computer Science and Engineering  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: New   Elective   PG	<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>INTENDED AUDIENCE</b>	: B.E/B.Tech, M.E/M.Tech, M.Sc, Ph.D	<b>EXAM DATE</b>	: 29 Sep 2019
<b>PRE-REQUISITES</b>	: Algorithms, Machine Learning		
<b>INDUSTRIES APPLICABLE TO</b>	: Google, Microsoft, Facebook, Amazon, Flipkart, LinkedIn etc.		

## COURSE OUTLINE :

Consider the following example problems: One is interested in computing summary statistics (word count distributions) for a set of words which occur in the same document in entire Wikipedia collection (5 million documents). Naïve techniques, will run out of main memory on most computers. One needs to train an SVM classifier for text categorization, with unigram features (typically ~10 million) for hundreds of classes. One would run out of main memory, if they store uncompressed model parameters in main memory. One is interested in learning either a supervised model or find unsupervised patterns, but the data is distributed over multiple machines. Communication being the bottleneck, naïve methods to adapt existing algorithms to such a distributed setting might perform extremely poorly. In all the above situations, a simple data mining / machine learning task has been made more complicated due to large scale of input data, output results or both. In this course, we discuss algorithmic techniques as well as software paradigms which allow one to develop scalable algorithms and systems for the common data science tasks.

## ABOUT INSTRUCTOR :

Anirban Dasgupta is currently an Associate Professor of Computer Science & Engineering at IIT Gandhinagar. Prior to this, he was a Senior Scientist at Yahoo! Labs Sunnyvale. Anirban works on algorithmic problems for massive data sets, large scale machine learning, analysis of large social networks and randomized algorithms in general. He did his undergraduate studies at IIT Kharagpur and doctoral studies at Cornell University.

Sourangshu Bhattacharya is an Assistant Professor in the Department of Computer Science and Engineering, IIT Kharagpur. He was a Scientist at Yahoo! Labs from 2008 to 2013, where he was working on prediction of Click-through rates, Ad-targeting to customers, etc on the Rightmedia display ads exchange. He was a visiting scholar at the Helsinki University of Technology from January - May 2008.

## COURSE PLAN :

- Week 01** : Background: Introduction | Probability: Concentration inequalities | Linear algebra: PCA, SVD | Optimization: Basics, Convex, GD | Machine Learning: Supervised, generalization, feature learning, clustering.
- Week 02** : Memory-efficient data structures: Hash functions, universal / perfect hash families | Bloom filters | Sketches for distinct count | Misra-Gries sketch | Statistical Mechanics an overview.
- Week 03** : Memory-efficient data structures (contd.): Count Sketch, Count-Min Sketch | Approximate near neighbors search: Introduction, kd-trees etc | LSH families, MinHash for Jaccard, SimHash for L2.
- Week 04** : Approximate near neighbors search: Extensions e.g. multi-probe, b-bit hashing, Data dependent variants | Randomized Numerical Linear Algebra Random projection.
- Week 05** : Randomized Numerical Linear Algebra CUR Decomposition | Sparse RP, Subspace RP, Kitchen Sink.
- Week 06** : Map-reduce and related paradigms Map reduce - Programming examples - (page rank, k-means, matrix multiplication) | Big data: computation goes to data. + Hadoop ecosystem.
- Week 07** : Map-reduce and related paradigms (Contd.) Scala + Spark (1 hr) Distributed Machine Learning and Optimization: Introduction | SGD + Proof.
- Week 08** : Distributed Machine Learning and Optimization: ADMM + applications | Clustering | Conclusion.



# ADVANCED COMPUTER ARCHITECTURE

**PROF. JOHN JOSE**

Department of Computer Science and Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : A basic understanding of Computer Organisation & Architecture or Microprocessors

**INTENDED AUDIENCE** : Anyone in CSE and related fields (like ECE, EEE, IT etc.) with an interest of exploring Computer Architecture

**INDUSTRIES APPLICABLE TO** : Intel, AMD, IBM, Nvidia etc

**COURSE OUTLINE :**

Applications and hand held devices are part and parcel of our day to day life. We need high end microprocessors to effectively operate these applications. Single processor supercomputers have achieved unheard of speeds and have been pushing hardware technology to the physical limit of chip manufacturing. But there is limit to the computational power that can be achieved with a single processor system. This course will provide an introduction to the advances made in computer architectures.

**ABOUT INSTRUCTOR :**

Dr. John Jose is an Assistant Professor in Department of Computer Science and Engineering, Indian Institute of Technology, Guwahati. Prior to this he worked as faculty in Rajagiri School of Engineering and Technology and Viswajyothi College of Engineering and Technology, Kerala for 7 years. He completed his Ph.D degree in Department of Computer Science and Engineering, Indian Institute of Technology, Madras. He has guided over 8 M.Tech thesis and is currently supervising 6 PhD thesis and 2 M.Tech thesis. His area of interest is in on-chip interconnection networks and cache management techniques for large multicore systems. He is the principal investigator of two sponsored R&D projects funded by DST, Govt of India. He is having active research collaboration with University of Catania-Italy, ITRI Taiwan, and BITS Pilani-Dubai Campus.

**COURSE PLAN :**

- Week 1:** Instruction execution fundamentals, Von-Neumann architecture, concept of memory and addressing. Performance measurement of computer hardware-MIPS, IPC, CPI, benchmarks. speed-up & Amdahl's Law. Instruction set principles, classification of instructions, addressing modes, instruction set encoding, MIPS instruction set, RISC vs CISC architectures.
- Week 2:** Concept of instruction pipelining, RISC instruction set, RISC 5 stage pipeline, pipeline hazards, operand forwarding, branch prediction techniques, basic MIPS pipeline
- Week 3:** MIPS pipeline for handling multi-cycle operations, Design issues with multi-cycle pipeline. Case Study: MIPS R4000 pipeline. Introduction to gem5 simulator
- Week 4:** Compiler techniques to exploit ILP, pipeline scheduling, loop unrolling, advanced branch prediction schemes, dynamic scheduling, Tomasulo's approach, hardware base speculation, VLIW approach for multi-issue.
- Week 5:** Multi threading - fine grained and coarse grained, super scalar and super pipelining, hyper threading. Vector architectures, organizations and performance tuning. GPU architecture and internal organization, Elementary concepts in CUDA programming.
- Week 6:** Introduction to memory hierarchy, locality of reference, cache memory fundamentals, cache performance parameters. Block level issues -mapping, identification, cache replacement techniques, write strategy, types of misses-compulsory, capacity, conflict misses.
- Week 7:** Basic cache optimizations by adjusting cache size, block size, associativity. Advanced cache optimizations-way prediction, pipelined and non-blocking caches, multi-banked caches, critical word first, early restart approaches, compiler optimizations, hardware pre-fetching, write buffer merging
- Week 8:** Introduction to TCMP, NoC, topology, routing, flow control, virtual channels, input buffered router micro-architecture. Input and output selection strategies, allocators and arbiter algorithms for crossbar switch.



# CLOUD COMPUTING

**PROF. SOUMYA KANTI GHOSH**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basics of computer architecture and Organisation

**INDUSTRIES APPLICABLE TO** : IT Industries

**INTENDED AUDIENCE** : CSE, ECE, EE

## COURSE OUTLINE :

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

## ABOUT INSTRUCTOR :

Prof. Soumya Kanti Ghosh, Department of Computer Science & Engineering, IIT Kharagpur, Professor received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

## COURSE PLAN :

**Week 1** : Introduction to Cloud Computing

**Week 2** : Cloud Computing Architecture

**Week 3** : Service Management in Cloud Computing

**Week 4** : Data Management in Cloud Computing

**Week 5** : Resource Management in Cloud

**Week 6** : Cloud Security

**Week 7** : Open Source and Commercial Clouds, Cloud Simulator

**Week 8** : Research trend in Cloud Computing, Fog Computing



# HARDWARE MODELING USING VERILOG

**PROF. INDRANIL SENGUPTA**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : CSE, ECE, EE

**PRE-REQUISITES** : Basic concepts in digital circuit design, Familiarity with a programming language like C or C++

**INDUSTRIES APPLICABLE TO** : Intel, Cadence, Mantor Graphics, Synopsys, Xilinx

**COURSE OUTLINE :**

The course will introduce the participants to the Verilog hardware description language. It will help them to learn various digital circuit modeling issues using Verilog, writing test benches, and some case studies.

**ABOUT INSTRUCTOR :**

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering (CSE) from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of CSE, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences.

**COURSE PLAN :**

**Week 01** : Introduction to digital circuit design flow

**Week 02** : Verilog variables, operators and language constructs

**Week 03** : Modeling combinational circuits using Verilog

**Week 04** : Modeling sequential circuits using Verilog

**Week 05** : Verilog test benches and design simulation

**Week 06** : Behavioral versus structural design modeling

**Week 07** : Behavioral versus structural design modeling

**Week 08** : Processor design using Verilog



# SPATIAL INFORMATICS

**PROF.SOUMYA K GHOSH**

Department of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic knowledge of Database Management

**INTENDED AUDIENCE** : CSE, ECE, EE and other Departments (working with Geo-spatial datasets/applications)

**INDUSTRIES APPLICABLE TO** : IT industries dealing with Geo-Spatial applications/services [e.g. ESRI, Oracle-Spatial, ERDAS Imagine, RMSI, RSI Softech India Pvt. Ltd. etc.]

**COURSE OUTLINE :**

Spatial Informatics is a multi-disciplinary field and the computer science principles/algorithms are increasingly applied to address various challenges/problems of these large scale spatial datasets. The course will cover different topics in spatial informatics, namely, spatial data models, spatial database, spatial computing and data analysis, spatial data mining, geographical information system (GIS), spatial web services etc. Few case studies will be also discussed to demonstrate the applicability of spatial informatics.

**ABOUT INSTRUCTOR :**

Prof. Soumya K. Ghosh received PhD and M.Tech degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining here, he worked for the Indian Space Research Organization in the area of Satellite Remote sensing and Geographical Information Systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include Spatial Data Science, Spatial Web Services and Cloud Computing.

**COURSE PLAN :**

**Week 1:** Introduction to Spatial Informatics, Spatial Database, Spatial Data Models

**Week 2:** Spatial Query Processing

**Week 3:** Spatial Data Management

**Week 4:** Spatial Networks

**Week 5:** Spatial Computing, Spatial Analysis

**Week 6:** Remote Sensing & Geographical Information System (GIS)

**Week 7:** Spatial Web Services, GML, Spatial Data Infrastructure

**Week 8:** Geo-Visualization, Spatial Cloud



# MODERN ALGEBRA

**PROF. MANINDRA AGRAWAL**

Dept. of Computer Science and Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : All undergraduate science and engineering students

**COURSE OUTLINE :**

The course discusses how algebra allows us to abstract out the geometric objects and numbers. This leads to an understanding of fundamental properties of geometry and numbers as well as allows us to manipulate them in ways not possible directly. This has resulted in some of the most remarkable applications of mathematics in real life.

**ABOUT INSTRUCTOR :**

Prof. Manindra Agrawal is a computer scientist by training and mathematician by profession, thus allowing him to wear different hats as per convenience. Most of his time is spent in proving, about certain problems of interest, that no one can ever solve them quickly (and deriving pleasure by the look of disappointment on those trying to solve these problems). At times, this quest, rather unexpectedly, results in a quick solution of a problem. He made his name due to one such problem: how to test if a number is prime. As a consequence, he was bestowed with several awards and honors including Shanti Swarup Bhatnagar prize, Godel prize, Fulkerson prize, Infosys prize, and Padma Shri.

**COURSE PLAN :**

**Week 1:** Introduction to abstraction; Introduction to Groups

**Week 2:** Properties of Finite Groups; Applications of Groups

**Week 3:** Introduction to Rings; Properties of Finite Rings

**Week 4:** Introduction to Ideals

**Week 5:** Properties of Ideals

**Week 6:** Applications of Ideals and Rings

**Week 7:** Introduction to Fields

**Week 8:** Applications of Finite Fields





# THEORY OF COMPUTATION

**PROF. RAGUNATH TEWARI**

Dept. of Computer Science and Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'18)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Computer Science undergraduate students.

**PRE-REQUISITES** : Basic knowledge of probabilities for the lectures and python for programming assignment

**INDUSTRIES APPLICABLE TO** : Microsoft Research, Google, Adobe, Xerox, Flipkart, Amazon

**COURSE OUTLINE :**

This is an introductory course on Theory of Computation intended for undergraduate students in computer science. In this course we will introduce various models of computation and study their power and limitations. We will also explore the properties of the corresponding language classes defined by these models and the relations between them. We will assume the student is comfortable in analytical reasoning and has preferably done a course on Data Structures and Algorithms.

**ABOUT INSTRUCTOR :**

Prof. Ragunath Tewari is an Assistant Professor in the department of Computer Science and Engineering at the Indian Institute of Technology, Kanpur. His primary research interest is in the area of computational complexity theory. Dr. Tewari did his B.Sc. from Chennai Mathematical Institute in 2005 and Ph.D. from University of Nebraska-Lincoln in 2011.

**COURSE PLAN :**

**Week 1:** Finite Automata – deterministic and nondeterministic, regular operations

**Week 2:** Regular Expression, Equivalence of DFA, NFA and REs, closure properties

**Week 3:** Non regular languages and pumping lemma, DFA Minimization,

**Week 4:** CFGs, Chomsky Normal Form

**Week 5:** Non CFLs and pumping lemma for CFLs, PDAs, Equivalence of PDA and CFG

**Week 6:** Properties of CFLs, DCFLs, Turing Machines and its variants

**Week 7:** Configuration graph, closure properties of decidable languages, decidability properties of regular languages and CFLs

**Week 8:** Undecidability, reductions, Rice's Theorem, introduction to complexity theory





# INTRODUCTION TO HASKELL PROGRAMMING

**PROF. MADHAVAN MUKUND**

Dept. of Computer Science and Engineering  
CMI

**PROF. S P SURESH**

Dept. of Computer Science and Engineering  
CMI

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

## COURSE OUTLINE

Functional programming is an elegant, concise and powerful programming paradigm. This style encourages breaking up programming tasks into logical units that can be easily translated into provably correct code. Haskell brings together the best features of functional programming and is increasingly being used in the industry, both for building rapid prototypes and for actual deployment.

## ABOUT INSTRUCTOR

Prof. Madhavan Mukund, Department of Computer Science Engineering, Chennai Mathematical Institute, studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Dean of Studies. His main research area is formal verification. In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Board. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD.

Prof. S P Suresh Chennai Mathematical Institute, studied at REC Trichy (MCA) and The Institute of Mathematical Sciences (PhD). He has been a faculty member at the Chennai Mathematical Institute since 2004, currently an Associate Professor. His main research interests are logic in computer science, formal methods for security and proof theory.

## COURSE PLAN

**Week 1** : Introduction to Haskell and the ghci interpreter

**Week 2** : Defining functions: guards, pattern matching and recursion

**Week 3** : Lists, strings and tuples

**Week 4** : Types and polymorphism

**Week 5** : Higher order functions on lists: map, filter, list comprehension

**Week 6** : Computation as rewriting, lazy evaluation and infinite data structures

**Week 7** : Conditional polymorphism and type classes

**Week 8** : User defined datatypes: lists, queues, trees; Input/output and the ghc compiler; Arrays



# PRACTICAL MACHINE LEARNING WITH TENSORFLOW

**Prof.Mr. Ashish Tendulkar**

Department of Computer Science and Engineering  
Google

**PROF. BALARAMAN RAVINDRAN**

Department of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : New | Core | UG  
**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Programming, Data Mining or Machine Learning or Data Science

**COURSE OUTLINE :**

This will be an applied Machine Learning Course jointly offered by Google and IIT Madras. We will cover the basics of Tensorflow and Machine Learning in the initial sessions and advanced topics in the latter part. After this course, the students will be able to build ML models using Tensorflow.

**ABOUT INSTRUCTOR :**

Prof. Balaraman Ravindran is currently an associate professor in Computer Science at IIT Madras. He has nearly two decades of research experience in machine learning and specifically reinforcement learning. Currently his research interests are centered on learning from and through interactions and span the areas of data mining, social network analysis, and reinforcement learning.

Mr. Ashish Tendulkar is an experienced AI/ML professional with specialization in deep learning and natural language processing. He carry 18 years of experience of working in the domain on AI and machine learning. This includes 11 years of post-PhD experience in multiple domains, including fintech, fashion, online media and advertising, oil and gas, manufacturing, IT systems, healthcare and messaging. He had acted as trusted machine learning advisor for start ups in diverse areas including fashion, fintech, agritech, healthcare, smart messaging, autonomous IT systems, HR and retail.

**COURSE PLAN :**

**Week 1:** Getting started with Tensorflow

**Week 2:** Overview of Machine Learning (Process and Techniques, Demonstration of ML concepts with Deep Playground)

**Week 3:** Data Input and Preprocessing with Tensorflow

**Week 4:** Machine Learning Model Building

**Week 5:** Prediction with Tensorflow

**Week 6:** Monitoring and evaluating models using Tensorboard

**Week 7:** Advance Tensorflow (Building custom models - CNNs, Scaling up for large datasets)

**Week 8:** Distributed training with hardware accelerators



# HUMAN COMPUTER INTERACTION

**PROF. K. PONNURANGAM**

Dept. of Computer Science and Engineering  
IIIT Delhi

**TYPE OF COURSE**

: Rerun | Elective | UG

**COURSE DURATION**

: 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE**

: 16 Nov 2019

**PRE-REQUISITES**

: Interest in interfaces, curiosity in fixing interface issues

**INDUSTRIES APPLICABLE TO**

: Any company which is interested in HCI will be interested in recruiting the students finishing the course.

**COURSE OUTLINE :**

Why are things so hard to use these days? Why does this thing I just bought work? Why is this web site so hard to use? Why is the phone app so confusing? Why are users not liking my design? Why is my app not getting popular? These are frustrations that we have all faced from systems not designed with people in mind. The question this course will focus on is: how can we design human-centered systems that people find useful and usable? This course is an introduction to designing, prototyping, and evaluating user interfaces. If you can take only one course in Human-Computer Interaction, this is the course for you.

**ABOUT INSTRUCTOR :**

Ponnurangam Kumaraguru ("PK") Associate Professor, is currently the Hemant Bharat Ram Faculty Research Fellow at the Indraprastha Institute of Information Technology (IIIT), Delhi, India. PK is the Founding Head of Cybersecurity Education and Research Centre (CERC). PK is one of ACM India Eminent Speakers. He received his Ph.D. from the School of Computer Science at Carnegie Mellon University (CMU). His research interests include Usable Security, Privacy, e-Crime, and Online Social Media, in particular, these days he has been dabbling with complex networked systems (e.g. social web systems like Twitter, Facebook, and telephone logs). Government of India has been funding PK for the last 8 years for studying Online Social Media, he manages research projects of about 2 Crores INR. PK has received research funds from Government of India, National Science Foundation (NSF), USA, industry bodies in India, and International funding agencies.

**COURSE PLAN :**

**Week 01** : Components of HCI Types of interfaces; Design process.

**Week 02** : Contextual inquiry Importance of users talking to users Task analysis

**Week 03** : Sketching Low & hi fidelity prototyping

**Week 04** : Mental models

**Week 05** : Usability evaluation Think aloud, observing users Modeling users, expert evaluations

**Week 06** : Information visualization

**Week 07** : HCI & mobility New faces of HCI

**Week 08** : Refresher for all modules seen in the course



# AN INTRODUCTION TO PROGRAMMING THROUGH C++

**PROF. ABHIRAM RANADE**

Department of Computer Science and Engineering  
IIT Bombay

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Standard XII in the Science stream.

**INTENDED AUDIENCE** : First and second year students in degree programs including Engineering and Science degree programs.

**COURSE OUTLINE :**

This course provides an introduction to problem solving and programming using the C++ programming language. The topics include: Basic programming notions, Program design, Programming applications, Standard Library of C++

**ABOUT INSTRUCTOR :**

Prof. Abhiram G. Ranade is a Professor of Computer Science and Engineering at IIT Bombay. He obtained a B. Tech degree in Electrical Engineering from IIT Bombay in 1981. In 1988, he obtained a Ph.D in Computer Science from Yale University, USA. His research interests are Algorithms, Combinatorial Optimization, Scheduling in Transportation Systems, and Programming Education.

**COURSE PLAN :**

**Week 1:** Introduction to computers using graphics

**Week 2 :** Basic data types, Variables Assignment statement

**Week3:** Statements of C++ for conditional execution and looping, Applications such as computing mathematical functions, root finding.

**Week 4:** Statements of C++ for conditional execution and looping, Applications such as computing mathematical functions, root finding.(Contd)

**Week 5:** Functions. Parameter passing. Recursion, Correctness issues, Breaking larger programs into functions.

**Week 6:** Functions. Parameter passing. Recursion, Correctness issues, Breaking larger programs into functions.(Contd)

**Week 7:** Basic array processing strategies including passing arrays to functions, Applications illustrating use of arrays to store ordered and unordered sequences, sets Multidimensional arrays.

**Week 8:** Basic array processing strategies including passing arrays to functions, Applications illustrating use of arrays to store ordered and unordered sequences, sets Multidimensional arrays. (Contd)

**Week 9:** Recursive algorithms involving arrays, Structures and classes

**Week 10:** Recursive algorithms involving arrays(Contd), Structures and classes

**Week 11:** Heap memory management, Issues such as memory leaks and dangling pointers How to design classes which hide memory management

**Week 12:** Standard Library, String, vector and Map classes, Applications



# THE JOY OF COMPUTING USING PYTHON

**PROF. SUDARSHAN IYENGAR**

Dept. of Computer Science and Engineering  
IIT Ropar

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : 10th standard/high school

**INDUSTRIES APPLICABLE TO** : Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

**COURSE OUTLINE :**

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

**ABOUT INSTRUCTOR :**

Sudarshan Iyengar has a PhD from the Indian Institute of Science and is currently working as an Assistant Professor at IIT Ropar and has been teaching this course for the past 4 years.

**COURSE PLAN :**

**Week 01** : Motivation for Computing | Welcome to Programming.

**Week 02** : Variables and Expressions, Design your own calculator | Loops and Conditionals, Hopscotch once again.

**Week 03** : Lists, Tuples and Conditionals, Lets go on a trip | Abstraction Everywhere : Apps in your phone.

**Week 04** : Counting Candies : Crowd to the rescue | Birthday Paradox : Find your twin.

**Week 05** : Google Translate : Speak in any Language | Currency Converter : Count your foreign trip expenses.

**Week 06** : Monte Hall : 3 doors and a twist | Sorting : Arrange the books.

**Week 07** : Searching : Find in seconds | Substitution Cipher : What's the secret !!

**Week 08** : Sentiment Analysis : Analyse your Facebook data | I can read your mind.

**Week 09** : Permutations : Jumbled Words | Spot the similarities : Dobble game.

**Week 10** : Count the words : Hundreds, Thousands or Millions | Rock, Paper and Scissor : Cheating not allowed !!

**Week 11** : Lie detector : No lies, only TRUTH | Calculation of the Area : Don't measure. | Six degrees of separation : Meet your favourites | Image Processing : Fun with images.

**Week 12** : Tic tac toe : Let's play | Snakes and Ladders : Down the memory lane | Recursion : Tower of Hanoi | Page Rank : How Google Works !!



# PROBLEM SOLVING THROUGH PROGRAMMING IN C

**PROF. ANUPAM BASU**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BE/B.Tech, BCA/MCA, M.Sc

**INDUSTRIES APPLICABLE TO** : All IT Industries

**COURSE OUTLINE :**

This course is aimed at enabling the students to, formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors, implement conditional branching, iteration and recursion, decompose a problem into functions and synthesize a complete program using divide and conquer approach, use arrays, pointers and structures to formulate algorithms and programs, apply programming to solve matrix addition and multiplication problems and searching and sorting problems, apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

**ABOUT INSTRUCTOR :**

Anupam Basu is Professor in the Dept. of Computer Science & Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems.

**COURSE PLAN :**

- Week 01** : Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation process, Syntax and Semantic errors, Variables and Data Types
- Week 02** : Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching.
- Week 03** : Conditional Branching and Iterative Loops
- Week 04** : Arranging things : Arrays
- Week 05** : 2-D arrays, Character Arrays and Strings
- Week 06** : Basic Algorithms including Numerical Algorithms
- Week 07** : Functions and Parameter Passing by Value
- Week 08** : Passing Arrays to Functions, Call by Reference
- Week 09** : Recursion
- Week 10** : Structures and Pointers
- Week 11** : Self-Referential Structures and Introduction to Lists
- Week 12** : Advanced Topics





# DISCRETE MATHEMATICS

**PROF. SAJITH GOPALAN**

Dept. of Computer Science and Engineering  
IIT Guwahati

**PROF. BENNY GEORGE K**

Dept. of Computer Science and Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : UG students interested in computer science, combinatorics, etc.

**COURSE OUTLINE :**

Discrete Mathematics is the study of discrete objects as opposed to continuous objects like real numbers. The discrete objects like proofs, sets, graphs, color-ings, algebraic structures, algorithms etc arise naturally and frequently in many areas of mathematics and computer science and are fundamental in an undergraduate curriculum of Computer Science and Mathematics. In this course, we will focus on Logic, Set Theory, Number Theory, Algebraic Structures, Combinatorics and Graph Theory.

**ABOUT INSTRUCTOR :**

Prof. Sajith Gopalan [PhD (IIT Kanpur, 1998), MTech (IIT Kanpur, 1993), BTech (REC Calicut, 1991)] has been in the faculty of Computer Science and Engineering at IIT Guwahati since 1997. Research interests: Algorithms, Parallel Computing, Complexity Theory, Game Theory

Prof. Benny George is working as an Assistant Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Guwahati. His research interests are mainly in combinatorics of words. He is also interested in theoretical aspects of computer science.

**COURSE PLAN :**

**Week 1:** Mathematical Logic

**Week 2:** Mathematical Logic (contd)

**Week 3:** Set Theory

**Week 4:** Set Theory, Number Theory

**Week 5:** Number Theory

**Week 6:** Algebraic Structures

**Week 7:** Algebraic Structures (contd)

**Week 8:** Recurrences

**Week 9:** Recurrences, Combinatorics

**Week 10:** Combinatorics, Graph Theory

**Week 11:** Graph Theory

**Week 12:** Graph Theory (contd)





# OPERATING SYSTEM FUNDAMENTALS

**PROF.SANTANU CHATTOPADHYAY**

Department of Computer Science Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Students of B.Sc, M.Sc, MCA, MS

**INDUSTRIES APPLICABLE TO** : All software industries

## **COURSE OUTLINE :**

Operating System is a computer software that manages the hardware components. It acts as an intermediary between the users and the hardware. It is responsible for managing the system resources and providing a smooth working environment for the users. As a subject, it is an amalgamation of the fields like computer architecture, algorithms, data structure and so on. A course on fundamentals of operating systems is essential to equip the students for taking up the challenges in understanding and designing of computer systems. This course will address all the fundamental points, starting from the foundations to the architectural issues to correlation with existing commercial operating systems.

## **ABOUT INSTRUCTOR :**

Prof. Santanu Chattopadhyay received his BE degree in Computer Science and Technology from Calcutta University (B.E. College) in 1990. He received M.Tech in Computer and Information Technology and PhD in Computer Science and Engineering from Indian Institute of Technology Kharagpur in 1992 and 1996, respectively. He is currently a Professor in the Department of Electronics and Electrical Communication Engineering, IIT Kharagpur. Prior to this, he had been a faculty member in the IIST Sibpur and IIT Guwahati in the departments of Computer Science and Engineering. In both these places he has taught the subject Operating Systems several times. His research interests include Digital Design, Embedded Systems, System-on-Chip (SoC) and Network-on-Chip (NoC) Design and Test, Power- and Thermal-aware Testing of VLSI Circuits and Systems. He has also published more than 150 papers in reputed international journals and conferences and several text and reference books on Compiler Design.

## **COURSE PLAN :**

**Week 1:** Introduction

**Week 2:** Processes and Threads – Part I

**Week 3:** Processes and Threads – Part II

**Week 4:** Interprocess Communication

**Week 5:** Concurrency and Synchronization – Part I

**Week 6:** Concurrency and Synchronization – Part II

**Week 7:** Deadlock

**Week 8:** CPU Scheduling

**Week 9:** Memory Management

**Week 10:** Virtual Memory – Part I

**Week 11:** Virtual Memory – Part II

**Week 12:** File System



# INTRODUCTION TO MACHINE LEARNING

**PROF. BALARAMAN RAVINDRAN**

Dept of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INDUSTRIES APPLICABLE TO** : Any company in the data analytics/data science /big data domain would value this course.

## COURSE OUTLINE

With the increased availability of data from varied sources there has been increasing attention paid to the various data driven disciplines such as analytics and machine learning. In this course we intend to introduce some of the basic concepts of machine learning from a mathematically well motivated perspective. We will cover the different learning paradigms and some of the more popular algorithms and architectures used in each of these paradigms.

## ABOUT INSTRUCTOR

Prof. Balaraman Ravindran is Currently an Associate Professor in the Department of Computer Science and Engineering, Indian Institute of Technology, Madras, He has nearly two decades of research experience in machine learning and specifically reinforcement learning. Currently his research interests are centered on learning from and through interactions and span the areas of data mining, social network analysis, and reinforcement learning.

## COURSE PLAN

- Week 0** : Probability Theory (Recap), Linear Algebra (Recap), Convex Optimization (Recap)"
- Week 1** : Introduction: Statistical Decision Theory - Regression, Statistical Decision Theory -Classification, Bias Variance"
- Week 2** : Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares
- Week 3** : Linear Classification, Logistic Regression, LDA
- Week 4** : Perceptron, SVM
- Week 5** : Neural Networks - Introduction, Early Models, Perceptron Learning, Neural Networks - Backpropagation, Neural Networks - Initialization, Training & Validation, Parameter Estimation
- Week 6** : Decision Trees, Regression Tree, Decision Trees - Stopping Criterion & Pruning, Loss functions, Decision Trees - Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability, Example, Evaluation Measures-1"
- Week 7** : Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Ensemble Methods - Boosting"
- Week 8** : Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks"
- Week 9** : Undirected Graphical Models, HMM, Variable elimination, belief propagation
- Week 10** : Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering"
- Week 11** : Gaussian Mixture Models, Expectation Maximization"
- Week 12** : Learning Theory, Introduction to Reinforcement Learning + Optional videos (RL framework and TD Learning, Solution Methods and Applications)



# DEEP LEARNING

**PROF. PRABIR KUMAR BISWAS**

Department of Computer Science Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Knowledge of Linear Algebra, DSP, PDE will be helpful.

**INTENDED AUDIENCE** : Electronics and Communication Engineering, Computer Science, Electrical Engineering

**INDUSTRIES APPLICABLE TO** : Google, Adobe, TCS, DRDO etc.

## COURSE OUTLINE :

The availability of huge volume of image and video data over the internet has made the problem of data analysis and interpretation a really challenging task. Deep Learning has proved itself to be a possible solution to such computer vision tasks. Not only in computer vision, Deep Learning techniques are also widely applied in Natural Language Processing tasks. In this course we will start with traditional Machine Learning approaches, e.g. Bayesian Classification, Multilayer Perceptron etc. and then on to modern Deep Learning architectures like Convolutional Neural Networks, Autoencoders etc. On completion of the course, students will acquire the knowledge of applying Deep Learning techniques to solve various real life problems.

## ABOUT INSTRUCTOR :

Prof. Prabir Kumar Biswas received his B.Tech., M.Tech., and Ph.D. degrees in Electronics and Electrical Communication Engineering from the Indian Institute of Technology Kharagpur in 1985, 1989, and 1991 respectively. He served Bharat Electronics Ltd. (BEL), Ghaziabad as a Deputy Engineer from 1985 to 1987. In 1991, he joined as a faculty in the Department of Electronics and Electrical Communication Engineering at IIT Kharagpur. He also served as the Head of the Computer and Informatics Center at IIT Kharagpur from March 2008 to December 2014. Prof. Biswas visited the University of Kaiserslautern, Germany during March 2002 to February 2003 as Alexander von Humboldt Fellow. His research interests include Image and Video Processing, Pattern Recognition, Machine Learning, Multimedia Systems, Cyber Physical Systems etc.

## COURSE PLAN :

**Week 1:** Introduction to Deep Learning, Bayesian Learning, Decision Surfaces

**Week 2:** Linear Classifiers, Linear Machines with Hinge Loss

**Week 3:** Optimization Techniques, Gradient Descent, Batch Optimization

**Week 4:** Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

**Week 5:** Unsupervised Learning with Deep Network, Autoencoders

**Week 6:** Convolutional Neural Network, Building blocks of CNN, Transfer Learning

**Week 7:** Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

**Week 8:** Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

**Week 9:** Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network Fully Connected CNN etc.

**Week 10:** Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic segmentation Object Detection etc.

**Week 11:** LSTM Networks

**Week 12:** Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network



# REINFORCEMENT LEARNING

**PROF. BALARAMAN RAVINDRAN**

Dept of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INDUSTRIES APPLICABLE TO** : Data analytics/data science/robotics

## COURSE OUTLINE

Reinforcement learning is a paradigm that aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. It has roots in operations research, behavioral psychology and AI. The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research.

## ABOUT INSTRUCTOR

Prof. Balaraman Ravindran is Currently an Associate Professor in the Department of Computer Science and Engineering, Indian Institute of Technology, Madras, He has nearly two decades of research experience in machine learning and specifically reinforcement learning. Currently his research interests are centered on learning from and through interactions and span the areas of data mining, social network analysis, and reinforcement learning.

## COURSE PLAN

- Week 1** : Introduction
- Week 2** : Bandit algorithms – UCB, PAC
- Week 3** : Bandit algorithms –Median Elimination, Policy Gradient
- Week 4** : Full RL & MDPs
- Week 5** : Bellman Optimality
- Week 6** : Dynamic Programming & TD Methods
- Week 7** : Eligibility Traces
- Week 8** : Function Approximation
- Week 9** : Least Squares Methods
- Week 10** : Fitted Q, DQN & Policy Gradient for Full RL
- Week 11** : Hierarchical RL
- Week 12** : POMDPs



# NATURAL LANGUAGE PROCESSING

**PROF. PAWAN GOYAL**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E./Msc (Computer Science)

**PRE-REQUISITES** : Basic knowledge of probabilities for the lectures and python for programming assignment

**INDUSTRIES APPLICABLE TO** : Microsoft Research, Google, Adobe, Xerox, Flipkart, Amazon

**COURSE OUTLINE :**

This course starts with the basics of text processing including basic pre-processing, spelling correction, language modeling, Part-of-Speech tagging, Constituency and Dependency Parsing, Lexical Semantics, distributional Semantics and topic models. Finally, the course also covers some of the most interesting applications of text mining such as entity linking, relation extraction, text summarization, text classification, sentiment analysis and opinion mining.

**ABOUT INSTRUCTOR :**

Prof. Pawan Goyal joined the Department of Computer Science and Engineering, Indian Institute of Technology, Kharagpur as an Assistant Professor on July 30th, 2013. Prior to that, he was working at INRIA Paris-Rocquencourt as a post doctoral fellow with Prof. Gérard Huet on The Sanskrit Heritage Site. He did his B. Tech. in Electrical Engineering from Indian Institute of Technology, Kanpur. He received his Ph. D. from Intelligent Systems Research Centre, Faculty of Computing and Engineering, University of Ulster, UK. His main research interests include Text Mining, Natural Language Processing, Information Retrieval and Sanskrit Computational Linguistics. He has published over 40 research articles in various CS journals and conferences including ACL, Coling, TKDE, CACM, KDD, CIKM, JCDL.

**COURSE PLAN :**

**Week 1:** Introduction and Basic Text Processing

**Week 2:** Spelling Correction, Language Modeling

**Week 3:** Advanced smoothing for language modeling, POS tagging

**Week 4:** Models for Sequential tagging – MaxEnt, CRF

**Week 5:** Syntax – Constituency Parsing

**Week 6:** Dependency Parsing

**Week 7:** Lexical Semantics

**Week 8:** Distributional Semantics

**Week 9:** Topic Models

**Week 10:** Entity Linking, Information Extraction

**Week 11:** Text Summarization, Text Classification

**Week 12:** Sentiment Analysis and Opinion Mining



# APPLIED NATURAL LANGUAGE PROCESSING

**PROF. RAMASESHAN R**

Department of Computer Science and Engineering  
Chennai Mathematical Institute

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Essential – Algorithms, Python Proficiency, Elementary probability and statistics, Linear Algebra, basic understanding of machine learning

**COURSE OUTLINE :**

A major portion of communication now is through text and any organization has more than 90% of its content in the unstructured form. Natural Language Processing (NLP), an important part in Artificial Intelligence, is one of the important technologies that would help in activities such as classification, retrieving and extraction of information, identifying important documents, etc. Students will gather knowledge in the fundamentals of NLP, methods and techniques and gain skills to use them in practical situations.

**ABOUT INSTRUCTOR :**

Prof. Rameseshan R is currently working as a Visiting faculty at Chennai Mathematical Institute and teaches this course to the students there. He has more than 30 years of experience in Research and Development, Teaching, Product Development, Information Technology, Innovation and Convergence.

**COURSE PLAN :**

**Week 1:** Introduction to language processing – tokens, sentences, paragraphs

**Week 2:** Regular expressions - extraction of information using Regex

**Week 3:** Document Similarity measures - Cosine and cluster measures

**Week 4:** Spelling correction - Edit distance

**Week 5:** Information retrieval, extraction

**Week 6:** Document Classification, Clustering, topic modeling techniques

**Week 7:** Vector Space Model - word vectors, GloVe/Word2Vec model, word embedding

**Week 8:** Text Classification, Clustering, and Summarization

**Week 9:** Machine Learning, Perceptron

**Week 10:** Back Propagation, Recurrent Neural network relevant to NLP

**Week 11:** Machine Translation, Language Generation

**Week 12:** Applications – Sentiment Analysis, Spam Detection, Resume Mining, AInstein





# COMPUTER VISION

**PROF. JAYANTA MUKHOPADHYAY**

Department of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Linear Algebra, Vector Calculus, Data Structures and Programming

**INTENDED AUDIENCE** : Computer Science/ Electronics/ Electrical Engineering

**COURSE OUTLINE :**

The course will have a comprehensive coverage of theory and computation related to imaging geometry, and scene understanding. It will also provide exposure to clustering, classification and deep learning techniques applied in this area.

**ABOUT INSTRUCTOR :**

Prof. Jayanta Mukhopadhyay received his B.Tech., M.Tech., and Ph.D. degrees in Electronics and Electrical Communication Engineering from the Indian Institute of Technology (IIT), Kharagpur. He joined the faculty of the Department of Electronics and Electrical Communication Engineering at IIT, Kharagpur in 1990 and later moved to the Department of Computer Science and Engineering where he is presently a Professor. He was a Humboldt Research Fellow at the Technical University of Munich in Germany for one year in 2002. He also has held short term visiting positions at the University of California, Santa Barbara, University of Southern California, and the National University of Singapore. His research interests are in image processing, pattern recognition, computer graphics, multimedia systems and medical informatics. He has published about 250 research papers in journals and conference proceedings in these areas. He received the Young Scientist Award from the Indian National Science Academy in 1992.

**COURSE PLAN :**

**Week 1:** Fundamentals of Image Processing

**Week 2:** 2-D Projective Geometry and Homography

**Week 3:** Properties of Homography

**Week 4:** Camera Geometry

**Week 5:** Stereo Geometry

**Week 6:** Feature detection and description

**Week 7:** Feature matching and model fitting

**Week 8:** Color Processing

**Week 9:** Range image processing

**Week 10:** Clustering and classification

**Week 11:** Dimensionality Reduction and Sparse Representation

**Week 12:** Deep Neural Architecture and applications





# BLOCKCHAIN ARCHITECTURE DESIGN AND USE CASES

**PROF. SANDIP CHAKRABORTY**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**Dr. PRAVEEN JAYACHANDRAN**

Research Staff Member  
IBM

Technical Partner



**TYPE OF COURSE** : Rerun | Elective | UG/

**INTENDED AUDIENCE** : PG CSE, ECE, EE, Maths

**INDUSTRIES APPLICABLE TO** : IT Industries

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**COURSE OUTLINE :**

The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way. The concept and applications of Blockchain have now spread from cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on. This course is a joint venture from academia and industry, where the target is to cover both the conceptual as well as application aspects of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains.

**ABOUT INSTRUCTOR :**

Prof. Sandip Chakraborty received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Guwahati, India. Presently, he is an Assistant Professor with Department of Computer Science and Engineering, IIT Kharagpur.

Dr. Praveen Jayachandran is a research staff member, master inventor and manager of the Blockchain and Smart Contracts team at IBM Research, India. His work spans different aspects of blockchain technology, including developing an enterprise-grade blockchain platform, development of smart contracts, and reimagining industry use cases in a blockchain world.

**COURSE PLAN :**

**Week 01** : Introduction to Blockchain

**Week 02** : Crypto Primitives and Bitcoin

**Week 03** : Consensus

**Week 04** : Permissioned Blockchain

**Week 05** : Hyperledger Fabric

**Week 06** : Fabric Demo

**Week 07** : Blockchain Use Cases - Finance

**Week 08** : Blockchain Use Cases - Industry

**Week 09** : Blockchain in Government and Blockchain Security

**Week 10** : Security and Research Aspects

**Week 11** : Research Aspects in Blockchain

**Week 12** : AI, Blockchain and Big Data



# INTRODUCTION TO INTERNET OF THINGS

**PROF. SUDIP MISRA**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks ( 29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : CSE, IT, ECE, EE

**PRE-REQUISITES** : Basic Programming Language

**COURSE OUTLINE :**

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

**ABOUT INSTRUCTOR :**

Dr. Sudip Misra is an Associate Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Kharagpur. Prior to this he was associated with Cornell University (USA), Yale University (USA), Nortel Networks (Canada) and the Government of Ontario (Canada). He received his Ph.D. degree in Computer Science from Carleton University, in Ottawa, Canada. He has several years of experience working in the academia, government, and the private sectors in research, teaching, consulting, project management, architecture, software design and product engineering roles.

**COURSE PLAN :**

**Week 01** : Introduction to IoT, Sensing, Actuation, Basics of Networking.

**Week 02** : Basics of Networking, Communication Protocols.

**Week 03** : Communication Protocols, Sensor Networks.

**Week 04** : Sensor Networks, Machine-to-Machine Communications.

**Week 05** : Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

**Week 06** : Introduction to Python programming, Introduction to Raspberry.

**Week 07** : Implementation of IoT with Raspberry Pi, Introduction to SDN.

**Week 08** : SDN for IoT, Data Handling and Analytics, Cloud Computing.

**Week 09** : Cloud Computing, Sensor-Cloud.

**Week 10** : Fog Computing, Smart Cities and Smart Homes.

**Week 11** : Connected Vehicles, Smart Grid, Industrial IoT.

**Week 12** : Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring.



# SOCIAL NETWORKS

**PROF. SUDARSHAN IYENGAR**

Dept. of Computer Science and Engineering  
IIT Ropar

**PROF. POONAM SAINI**

Dept. of Computer Science and Engineering  
Punjab Engineering College

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks(29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : The course doesn't assume any pre-requisites. We expect one has undergone a first course in basic programming.

**INDUSTRIES APPLICABLE TO** : This is a much sought after field in computer science and many industries value/recognize this course. Today, social network analysis is being employed in private as well as public sectors. Some of the areas where it is used are Modeling the Networks of Organizations, Understanding Customer Interaction, Development of Information Systems, Digital Marketing, Risk Management, Banking, Telecommunication Analytics, Bioinformatics, Criminal Intelligence, Human Resources Development, Designing Leader Engagement Strategies, Community based Problem Solving, Knowledge Management.

**COURSE OUTLINE :**

The world has become highly interconnected and hence more complex than ever before. We are surrounded by a multitude of networks in our daily life, for example, friendship networks, online social networks, world wide web, road networks etc. All these networks are today available online in the form of graphs which hold a whole lot of hidden information. They encompass surprising secrets which have been time and again revealed with the help of tools like graph theory, sociology, game theory etc. The study of these graphs and revelation of their properties with these tools have been termed as Social Network Analysis.

**ABOUT INSTRUCTOR :**

Sudarshan Iyengar has a Ph.D. from the Indian Institute of Science and is currently working as an assistant professor at IIT Ropar and has been teaching this course from the past 5 years. Apart from this course, he has offered several other courses in IIT Ropar like Discrete Mathematics, Theory of Computation, Cryptography, Probability and Computing etc. His research interests include social networks, crowdsourced knowledge building and computational social sciences.

Prof. Poonam Saini is currently working as Assistant Professor in Department of Computer Science and Engineering at Punjab Engineering College, Chandigarh, India. She has received her PhD degree in Computer Engineering. Her research interest includes Big Data Analytics, Social Analytics, Block Chain Technology etc. She has more than 40 publications in reputed Journals.

**COURSE PLAN :**

- Week 01** : Introduction
- Week 02** : Handling Real-world Network Datasets
- Week 03** : Strength of Weak Ties
- Week 04** : Strong and Weak Relationships (Continued) & Homophily
- Week 05** : Homophily Continued and +Ve / -Ve Relationships
- Week 06** : Link Analysis
- Week 07** : Cascading Behaviour in Networks
- Week 08** : Link Analysis (Continued)
- Week 09** : Power Laws and Rich-Get-Richer Phenomena
- Week 10** : Power law (contd..) and Epidemics
- Week 11** : Small World Phenomenon
- Week 12** : Pseudocore (How to go viral on web)



# DISCRETE MATHEMATICS

**PROF. SUDARSHAN IYENGAR**

Dept. of Computer Science and Engineering  
IIT Ropar

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B,Tech, M.E,M.Tech

**INDUSTRIES APPLICABLE TO** : Every industry expects candidates to have good aptitude. This course sharpens the overall Quant skills.

## COURSE OUTLINE :

The course will be an introduction to Discrete Mathematics which comprises of the essentials for a computer science student to go ahead and study any other topics in the subject. The emphasis will be on problem solving as well as proofs. We will be providing motivational illustrations and applications through out the course. The course doesn't assume any pre-requisites except for high school level arithmetic and algebra.

## ABOUT INSTRUCTOR :

Prof. Sudarshan Iyengar has a Ph.D. from the Indian Institute of Science and is currently working as an assistant professor at IIT Ropar and has been teaching this course from the past 5 years. Apart from this course, he has offered several other courses in IIT Ropar like Discrete Mathematics, Theory of Computation, Cryptography, Probability and Computing etc. His research interests include social networks, crowdsourced knowledge building and computational social sciences.

## COURSE PLAN :

**Week 01** : Set Theory

**Week 02** : Logic

**Week 03** : Counting 1 (The Basics)

**Week 04** : Counting 2 (The Essentials)

**Week 05** : Counting 3 (Advanced Counting)

**Week 06** : Mathematical Induction

**Week 07** : Generating Functions

**Week 08** : Recurrence Relations in Computer Science

**Week 09** : Graph Theory - 1

**Week 10** : Graph Theory - 2

**Week 11** : Number theory and Cryptography

**Week 12** : Algebra and Coding Theory



# ETHICAL HACKING

## PROF. INDRANIL SENGUPTA

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

**EXAM DATE** : 16 Nov 2019

**PREREQUISITES** : Basic concepts in programming and networking

**INDUSTRIES APPLICABLE TO** : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

## COURSE OUTLINE

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants.

## ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of CSE, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He was also the Managing Director of Science and Technology Entrepreneurship Park (STEP), and the Professor-in-Charge of a Centre of Excellence in Information Assurance funded by the Ministry of Defense.

## COURSE PLAN

**Week 1** : Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

**Week 2** : IP addressing and routing. Routing protocols.

**Week 3** : Introduction to network security. Information gathering: reconnaissance, scanning, etc.

**Week 4** : Vulnerability assessment: OpenVAS, Nessus, etc. System hacking: password cracking, penetration testing, etc.

**Week 5** : Social engineering attacks. Malware threats, penetration testing by creating backdoors.

**Week 6** : Introduction to cryptography, private-key encryption, public-key encryption.

**Week 7** : Key exchange protocols, cryptographic hash functions, applications.

**Week 8** : Steganography, biometric authentication, lightweight cryptographic algorithms.

**Week 9** : Sniffing: Wireshark, ARP poisoning, DNS poisoning. Hacking wireless networks, Denial of service attacks. **Week**

**10** : Elements of hardware security: side-channel attacks, physical unclonable functions.

**Week 11** : Hacking web applications: vulnerability assessment, SQL injection, cross-site scripting.

**Week 12** : Case studies: various attacks scenarios and their remedies.



# SOFTWARE ENGINEERING

**PROF. RAJIB MALL**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : CSE, IT

**PRE-REQUISITES** : C Programming, Java or C++ programming

**COURSE OUTLINE :**

Large scale software development poses special challenges. This course targets to expose the students to the challenges of large scale software development and would expose the students as to how to overcome those. Starting with basic life cycle model concepts, it would discuss requirements specification, design, and testing issues. The concepts will be illustrated with appropriate examples.

**ABOUT INSTRUCTOR :**

Rajib Mall is Professor, Department of Computer Science and Engineering at Indian Institute of Technology Kharagpur, West Bengal. He has more than two decades of teaching experience in the areas of real-time systems, program analysis and testing. He has written five text books and over 150 refereed research papers.

**COURSE PLAN :**

**Week 01** : Introduction

**Week 02** : Life Cycle Models I

**Week 03** : Life Cycle Models II

**Week 04** : Requirements analysis and specification

**Week 05** : Basics of software design

**Week 06** : Procedural design methodology

**Week 07** : Object-oriented concepts

**Week 08** : Introduction to UML: Class and Interaction Diagrams

**Week 09** : Object-oriented analysis and design

**Week 10** : Testing I

**Week 11** : Testing II

**Week 12** : Testing III



# SOFTWARE PROJECT MANAGEMENT

**PROF. RAJIB MALL**  
**PROF. DURGA PRASAD**  
Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 NOV 2019

**PRE-REQUISITES** : Basic Programming Course

**INTENDED AUDIENCE** : CSE, IT

## **COURSE OUTLINE :**

This course describes the key aspects of Software Project. It introduces the strategies required for managing projects from their genesis to completion. The course brings about Software Project Planning, Cost Estimation, scheduling and management tools

## **ABOUT INSTRUCTOR :**

Prof. Rajib Mall is Professor in the Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, West Bengal. He has more than two decades of teaching experience in the areas of real-time systems, program analysis and testing. He has written five text books and over 150 refereed research papers.

Prof. Durga Prasad Mohapatra is a Professor, in Department of Computer Science and Engineering, National Institute of Technology Rourkela, Odisha. He has more than two decades of teaching experience in the areas of Software Engineering, Discrete Mathematics, Real-Time Systems, and Software Testing. He has written one text book on Discrete Mathematics and more than 100 refereed research papers.

## **COURSE PLAN :**

**Week 1:** Introduction to Software Project Management

**Week 2:** Selection of a Project Approach

**Week 3:** Project Estimation Techniques

**Week 4:** Project Estimation Techniques (Contd)

**Week 5:** Project Planning and Project Scheduling

**Week 6:** Project Planning and Project Scheduling (Contd)

**Week 7:** Project Organization and Team Structures

**Week 8:** Risk Management

**Week 9:** Resource Allocation

**Week 10:** Project Monitoring and Control, Software Configuration Management

**Week 11:** Software Quality Management

**Week 12:** Managing Contracts and Project closeout





# SOFTWARE TESTING

**PROF. MEENAKSHI D'SOUZA**

Dept. of Computer Science and Engineering  
IIIT Bangalore

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : Programming, Algorithms, Discrete Mathematics (basics)

**INDUSTRIES APPLICABLE TO** : The material of this course has been used to offer training for Samsung, ABB and Mindtree. The course will be useful for any firm that does tests their software.

## COURSE OUTLINE :

This course will cover various techniques for test case design, as used for testing of software artifacts including requirements, design and code. We will discuss algorithms and techniques for test case design based on graphs, logic, syntax of programming languages and on inputs. Special techniques for testing object-oriented features and web applications will also be discussed. The course will end with symbolic testing techniques. These broadly will cover test cases for both white-box and black-box.

## ABOUT INSTRUCTOR :

Meenakshi D Souza is currently an Associate Professor at IIIT-Bangalore. Meenakshi did her Master TMs in Mathematics from University of Madras, Chennai and her Ph. D. in Theoretical Computer Science from The Institute of Mathematical Sciences, Chennai. She joined the research department of Honeywell Technology Solutions, Bangalore soon after completing her Ph. D. and worked there in the areas of Formal Verification of Software Design, Model Based Development and Physical Access Control before joining IIIT-Bangalore. Her research interests are in Formal Methods, Model Based Development, Software Testing and Automata Theory.

## COURSE PLAN :

**Week 01** : Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.

**Week 02** : Graphs based testing: Data flow coverage criteria

**Week 03** : Graphs based testing: Data flow coverage criteria (contd)

**Week 04** : Graphs coverage for source code, design elements and requirements

**Week 05** : Techniques and algorithms for test case design: Logic based testing- Predicates, logic based coverage criteria

**Week 06** : Specification based logic coverage, logic coverage on finite state machines

**Week 07** : Input space partitioning: Input domain modeling, combination strategies criteria

**Week 08** : Syntax based testing: Coverage criteria based on syntax, mutation testing

**Week 09** : Test case design (as learnt above) applied to object-oriented applications

**Week 10** : Test case design (as learnt above) applied to web applications

**Week 11** : Symbolic testing

**Week 12** : Concolic testing, Conclusion



# SYNTHESIS OF DIGITAL SYSTEMS

**PROF. PREETI RANJAN PANDA**

Dept. of Computer Science and Engineering  
IIT Delhi

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Digital Design (or Logic Design), Data Structures

**INDUSTRY SUPPORT** : Synopsys, Cadence Design Systems, Mentor Graphics, Intel, NXP, IBM

## COURSE OUTLINE

This course is about the automatic generation of digital circuits from high-level descriptions. Modern electronic systems are specified in Hardware Description Languages and are converted automatically into digital circuits. We will introduce the VHDL Hardware Description Language, and follow it up with a discussion of the basics of synthesis topics including High-level Synthesis, FSM Synthesis, Retiming, and Logic Synthesis.

## ABOUT INSTRUCTOR

Prof. Preeti Ranjan Panda received his B. Tech. degree in Computer Science and Engineering from the Indian Institute of Technology Madras and his M. S. and Ph.D. degrees in Information and Computer Science from the University of California at Irvine. He is currently a Professor in the Department of Computer Science and Engineering at the Indian Institute of Technology Delhi. He has previously worked at Texas Instruments, Bangalore, India, and the Advanced Technology Group at Synopsys Inc., Mountain View, USA, and has been a visiting scholar at Stanford University. His research interests are: Embedded Systems Design, CAD/VLSI, Post-silicon Debug/Validation, System Specification and Synthesis, Memory Architectures and Optimisations, Hardware/Software Codesign, and Low Power Design.

## COURSE PLAN

**Week 1** : Course Outline and Introduction to VLSI Design Automation

**Week 2** : Hardware Description Languages and VHDL

**Week 3** : Specifying Behaviour and Structure in HDL

**Week 4** : Introduction to High-level Synthesis

**Week 5** : Compiler Transformations in High-level Synthesis

**Week 6** : Scheduling

**Week 7** : Register Allocation and Timing Issues

**Week 8** : Finite State Machine Synthesis

**Week 9** : The Retiming Problem

**Week 10** : Introduction to Logic Synthesis and Binary Decision Diagrams

**Week 11** : Two-level and Multi-level Logic Optimisation

**Week 12** : Technology Mapping, Timing Analysis, and Physical Synthesis



# SWITCHING CIRCUITS AND LOGIC DESIGN

**PROF. INDRANIL SENGUPTA**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : CSE, ECE, IT, EE

**PRE-REQUISITES** : Basic knowledge of electronics and electrical circuits

**INDUSTRIES APPLICABLE TO** : TCS, Wipro, CTS, Google, Microsoft, HP, Intel, IBM

**COURSE OUTLINE :**

This course will discuss the basic background of switching circuits, and discuss techniques for mapping the theory to actual hardware circuits. Synthesis and minimization techniques of combinational and sequential circuits shall be discussed in detail. Designing circuits using high-level functional blocks shall also be discussed. The course will closely follow the undergraduate curriculum existing in most engineering colleges.

**ABOUT INSTRUCTOR :**

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering (CSE) from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of CSE, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences.

**COURSE PLAN :**

**Week 01** : Introduction to number systems and codes, error detection and correction, binary arithmetic.

**Week 02** : Switching primitives and logic gates, logic families: TTL, CMOS, memristors, all-optical realizations.

**Week 03** : Boolean algebra: Boolean operations and functions, algebraic manipulation, minterms and maxterms, sum-of-products and product-of-sum representations, functional completeness.

**Week 04** : Minimization of Boolean functions: K-map method, prime implicants, don't care conditions, Quine-McCluskey method, multi-level minimization.

**Week 05** : Design of combinational logic circuits: adders and subtractors, comparator, multiplexer, demultiplexer, encoder, etc.

**Week 06** : Representation of Boolean functions: binary decision diagram, Shannon's decomposition, Reed-Muller canonical form, etc.

**Week 07** : Design of latches and flip-flops: SR, D, JK, T. Master-slave and edge-triggered flip-flops. Clocking and timing issues.

**Week 08** : Synthesis of synchronous sequential circuits, Mealy and Moore machines, state minimization.

**Week 09** : Design of registers, shift registers, ring counters, binary and BCD counters. General counter design methodology.

**Week 10** : Algorithmic state machine and data/control path design.

**Week 11** : Asynchronous sequential circuits: analysis and synthesis, minimization, static and dynamic hazards.

**Week 12** : Testing and fault diagnosis in digital circuits: fault modeling, test generation and fault simulation, fault diagnosis, design for testability and built-in self-test.



# MACHINE LEARNING FOR ENGINEERING AND SCIENCE APPLICATIONS

**PROF. BALAJI SRINIVASAN**

Dept. of Computer Science and Engineering  
IIT Madras

**PROF. GANAPTHY KRISHNAMURTHI**

Dept. of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : Postgraduate students in all  
engineering and science disciplines.

**EXAM DATE** : 17 Nov 2019

Mature senior undergraduate students may also attempt the course.

**PREREQUISITES** : Familiarity with Multivariable Calculus, Linear Algebra, Probability, Statistics.  
Comfortable with programming in Python

**INDUSTRIES APPLICABLE TO** : Should be of interest to companies trying to employ engineers familiar with  
Machine Learning

## COURSE OUTLINE

Functional programming is an elegant, concise and powerful programming paradigm. This style encourages breaking up programming tasks into logical units that can be easily translated into provably correct code. Haskell brings together the best features of functional programming and is increasingly being used in the industry, both for building rapid prototypes and for actual deployment.

## ABOUT INSTRUCTOR

Prof. Balaji Srinivasan is a faculty member in the Mechanical Engineering Department at IIT-Madras. His areas of research interest include Numerical Analysis, Computational Fluid Dynamics and applications of Machine Learning.

Prof. Ganapthy Krishnamurthi is a faculty member in the Engineering Design Department at IIT-Madras. His areas of research interest include Medical Image Analysis and Image Reconstruction.

## COURSE PLAN

**Week 1** : Mathematical Basics 1 – Introduction to Machine Learning, Linear Algebra

**Week 2** : Mathematical Basics 2 – Probability

**Week 3** : Computational Basics – Numerical computation and optimization, Introduction to Machine Learning packages

**Week 4** : Linear and Logistic Regression – Bias/Variance Tradeoff, Regularization, Variants of Gradient Descent, MLE, MAP, Applications

**Week 5** : Neural Networks – Multilayer Perceptron, Backpropagation, Applications

**Week 6** : Convolutional Neural Networks 1 – CNN Operations, CNN architectures

**Week 7** : Convolutional Neural Networks 2 – Training, Transfer Learning, Applications

**Week 8** : Recurrent Neural Networks – RNN, LSTM, GRU, Applications

**Week 9** : Classical Techniques 1 – Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications

**Week 10** : Classical Techniques 2 – k-Means, kNN, GMM, Expectation Maximization, Applications

**Week 11** : Advanced Techniques 1 – Structured Probabilistic Models, Monte Carlo Methods

**Week 12** : Advanced Techniques 2 – Autoencoders, Generative Adversarial Networks



# ARTIFICIAL INTELLIGENCE : SEARCH METHODS FOR PROBLEM SOLVING

**PROF. DEEPAK KHEMANI**

Dept. of Computer Science and Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B,Tech, M.E/M.Tech

**PRE-REQUISITES** : Exposure to data structures and programming and an ability to discuss algorithms is the only pre-requisite.

**INDUSTRIES APPLICABLE TO** : Microsoft, Google, Facebook, Ford, General Electric, Amazon and Flipkart.

## COURSE OUTLINE :

For an autonomous agent to behave in an intelligent manner it must be able to solve problems. This means it should be able to arrive at decisions that transform a given situation into a desired or goal situation. The agent should be able to imagine the consequence of its decisions to be able to identify the ones that work. In this first course on AI we study a wide variety of search methods that agents can employ for problem solving.

## ABOUT INSTRUCTOR :

Deepak Khemani is Professor at Department of Computer Science and Engineering, IIT Madras. He completed his B.Tech. (1980) in Mechanical Engineering, and M.Tech. (1983) and PhD. (1989) in Computer Science from IIT Bombay, and has been with IIT Madras since then. In between he spent a year at Tata Research Development and Design Centre, Pune and another at the then youngest IIT at Mandi. He has had shorter stays at several Computing departments in Europe.

## COURSE PLAN :

**Week 01** : Introduction: Overview and Historical Perspective, Turing Test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

**Week 02** : State Space Search: Depth First Search, Breadth First Search, DFID

**Week 03** : Heuristic Search: Best First Search, Hill Climbing, Beam Search

**Week 04** : Traveling Salesman Problem, Tabu Search, Simulated Annealing

**Week 05** : Population Based Search: Genetic Algorithms, Ant Colony Optimization

**Week 06** : Branch & Bound, Algorithm A, Admissibility of A

**Week 07** : Monotone Condition, IDA, RBFS, Pruning OPEN and CLOSED in A

**Week 08** : Problem Decomposition, Algorithm AO, Game Playing

**Week 09** : Game Playing: Algorithms Minimax, AlphaBeta, SSS

**Week 10** : Rule Based Expert Systems, Inference Engine, Rete Algorithm

**Week 11** : Planning: Forward/Backward Search, Goal Stack Planning, Sussman's Anomaly

**Week 12** : Plan Space Planning, Algorithm Graphplan



# PROGRAMMING IN JAVA

**PROF. DEBASIS SAMANTA**

Dept. of Computer Science and Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : CSE, IT, EE, ECE, etc.

**PRE-REQUISITES** : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

**INDUSTRIES APPLICABLE TO** : All IT companies.

**COURSE OUTLINE :**

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

**ABOUT INSTRUCTOR :**

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Dr. Samanta currently works as a faculty member at the Department of Computer Science & Engineering at IIT Kharagpur.

**COURSE PLAN :**

**Week 1** : Overview of Object-Oriented Programming and Java

**Week 2** : Java Programming Elements

**Week 3** : Input-Output Handling in Java

**Week 4** : Encapsulation

**Week 5** : Inheritance

**Week 6** : Exception Handling

**Week 7** : Multithreaded Programming

**Week 8** : Java Applets and Servlets

**Week 9** : Java Swing and Abstract Windowing Toolkit (AWT)

**Week 10** : Networking with Java

**Week 11** : Java Object Database Connectivity (ODBC)

**Week 12** : Interface and Packages for Software Development





# DEEP LEARNING - PART 1

**PROF. MITESH M. KHAPRA**

**PROF. SUDARSHAN IYENGAR**

Dept. of Computer Science and Engineering  
IIT Madras & IIT Ropar

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**PRE-REQUISITES** : Working knowledge of Linear Algebra, Probability Theory. It would be beneficial if the participants have done a course on Machine Learning.

## COURSE OUTLINE :

Deep Learning has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. to solve a wide range of problems in Computer Vision and Natural Language Processing. In this course we will learn about the building blocks used in these Deep Learning based solutions. Specifically, we will learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms. We will also look at various optimization algorithms such as Gradient Descent, Nesterov Accelerated Gradient Descent, Adam, AdaGrad and RMSProp which are used for training such deep neural networks. At the end of this course students would have knowledge of deep architectures used for solving various Vision and NLP tasks.

## ABOUT INSTRUCTOR :

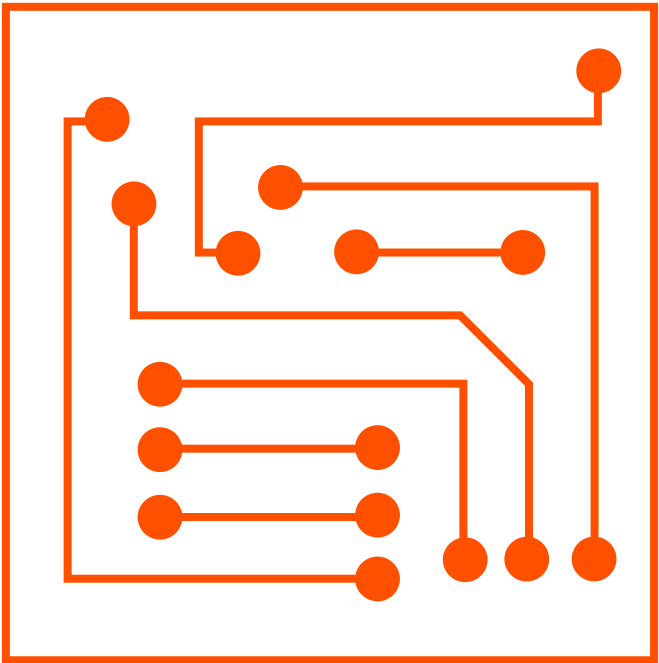
Prof. Mitesh M. Khapra is an Assistant Professor in the Department of Computer Science and Engineering at IIT Madras. While at IIT Madras he plans to pursue his interests in the areas of Deep Learning, Multimodal Multilingual Processing, Dialog systems and Question Answering. Prior to that he worked as a Researcher at IBM Research India. During the four and half years that he spent at IBM he worked on several interesting problems in the areas of Statistical Machine Translation, Cross Language Learning, Multimodal Learning, Argument Mining and Deep Learning.

Sudarshan Iyengar has a PhD from the Indian Institute of Science, Bangalore and is currently working as an Assistant Professor at IIT Ropar and has been teaching this course for the past 4 years.

## COURSE PLAN :

- Week 01** : History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm.
- Week 02** : Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks.
- Week 03** : FeedForward Neural Networks, Backpropagation.
- Week 04** : Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp.
- Week 05** : Principal Component Analysis and its interpretations, Singular Value Decomposition .
- Week 06** : Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders.
- Week 07** : Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying.
- Week 08** : Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.
- Week 09** : Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.
- Week 10** : Learning Vectorial Representations of Words.
- Week 11** : Recurrent Neural Networks, Backpropagation through time.
- Week 12** : Encoder Decoder Models, Attention Mechanism, Attention over images.





# **ELECTRICAL ENGINEERING**



# ELECTRICAL ENGINEERING

## 08 weeks

01. Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink
02. Principles of Communication Systems - Part II
03. Principles of Modern CDMA/ MIMO/ OFDM Wireless Communications
04. Digital Switching - I
05. Electrical Distribution System Analysis
06. Dc Microgrid
07. Introduction to Smart Grid
08. Fundamentals of Electric Drives

## 12 weeks

1. Mapping Signal Processing Algorithms to DSP Architectures
2. Introduction to Computer Vision
3. Fundamentals of Electrical Engineering
4. Basic Electric Circuits
5. Power Electronics
6. Analog Electronic Circuit
7. Op-Amp Practical Applications: Design, Simulation and Implementation
8. Fabrication Techniques for MEMS- based sensors: Clinical Perspective
9. Sensors and Actuators
10. Control engineering
11. Linear System Theory
12. Electrical Measurement and Electronic Instruments
13. Analog Communication
14. Introduction to Wireless and Cellular Communications
15. Digital Signal Processing
16. Digital Circuits
17. Neural Networks for Signal Processing – I
18. Microelectronics: Devices To Circuits
19. Digital Image Processing
20. Pattern Recognition and Application
21. Microwave Theory and Techniques
22. Principles and Techniques of Modern Radar Systems
23. Computational Electromagnetics
24. Electrical Machines - I
25. Power System Analysis
26. Fiber-Optic Communication Systems and Techniques
27. Microwave Engineering
28. Electrical Machines



# ADVANCED LINEAR CONTINUOUS CONTROL SYSTEMS: APPLICATIONS WITH MATLAB PROGRAMMING AND SIMULINK

**PROF. YOGESH VIJAY HOTE**

Department of Electrical Engineering  
IIT Roorkee

<b>TYPE OF COURSE</b>	: Rerun   Core/Elective   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**COURSE OUTLINE :**

Today, there is an utmost need to understand advanced control engineering on account of its multidisciplinary applications in various areas of engineering. The main thrust in this course is on fundamentals of advanced linear continuous control system. In this course, various methodology of modelling in state space, state transition matrix and solution in state equation will be studied. Further, stability analysis issues in state space will be discussed. Finally, the concepts of controllability, observability, controller design, and observer design will also be discussed. The theory is supported by numerical examples, practical examples and Matlab programming.

**ABOUT INSTRUCTOR :**

Yogesh Vijay Hote is an Associate Professor in the Department of Electrical Engineering at Indian Institute of Technology, Roorkee. He received B. E. degree in Electrical Engineering from Government College of Engg., Amravati, Amravati University in 1998 and M.E. degree in Electrical Engineering with specialization in Control Systems from Government College of Engg., Pune, Pune University in 2000. He also received Ph.D degree in Instrumentation and Control Engineering., Faculty of Technology, University of Delhi, in 2009.

Dr. Hote has nearly 17 years of teaching and research experience. His main fields of expertise include robust controller design, model order reduction techniques and their applications in load frequency control, dc-dc converters and robotic systems. He is teaching courses related to control systems in Electrical Engineering department, IIT Roorkee from seven year. He has guided 5 Ph.D research scholars & 20 M.Tech students and 4 Ph.D research scholars & 4 M.Tech students are under process. He has published 80 articles in reputed journals and conferences. He has also published a monograph related to stability analysis of uncertain systems.

**COURSE PLAN :**

- Week 01** : Introduction to State Space, State Space Representation: Companion Form (Controllable Canonical Form), Extended Controllable Canonical Form, Observable Canonical Form.
- Week 02** : State Space Representation: Diagonal Canonical Form ,Jordan Canonical Form, State Space Representation: Numerical Examples on State Space Modelling.
- Week 03** : Modelling of Mechanical Systems in State Space: Modelling of DC Servo Motor, Modelling of DC Servo Motor ,Determination of Transfer Function from State Space Model.
- Week 04** : Stability Analysis in State Space: Concept of Eigenvalues and Eigenvectors, Lyapunov Stability Analysis (Sylvester's Criterion), Lyapunov Stability Analysis (Stability Criterion), Lyapunov Stability Analysis (Direct Method).
- Week 05** : Concept of Diagonalization, Solution of State Equation , Solution of State Equation (Forced system), Steady State Error for State Space System ,State Transition Matrix (Part-I).
- Week 06** : State Transition Matrix (Part-II), State Transition Matrix using Caley Hamilton Theorem (Part-III), MATLAB Programming with State Space, Controllability in State Space.
- Week 07** : Observability in State Space , Pole Placement by State Feedback.
- Week 08** : Tracking Problem in State Feedback Design, State Observer Design.



# PRINCIPLES OF COMMUNICATION SYSTEMS: PART - II

**PROF. ADITYA K. JAGANNATHAM**

Dept. of Computer Science and Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Intended audience is students, practicing engineers, technical and non-technical managers of telecomm companies, students preparing for competitive exams with communication engineering subject.

**PRE-REQUISITES** : Basic knowledge of - Probability, Calculus

**INDUSTRIES APPLICABLE TO** : Most companies in wireless communications area should find this useful. Examples are Qualcomm, Broadcom, Intel etc.

**COURSE OUTLINE :**

This course is a sequel to Principles of Communication-Part I and covers fundamental concepts of communication systems, especially focusing on various aspects of modern digital communication systems. However, all the modules in this course will be independent of the previous course and hence students who could not participate in Principles of Communication-Part I will also be able to follow the course. Beginning with the basic theory of digital communication systems pertaining to pulse shaping, modulation and optimal detection, the course will also cover several important digital modulation techniques such as Binary Phase Shift Keying (BPSK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM), M-ary Phase Shift Keying (M-PSK) etc. Other fundamental concepts such as Information Theory, Channel Capacity, Entropy Coding and Error Control Coding will be dealt with in the later parts of the course.

**ABOUT INSTRUCTOR :**

Prof. Aditya K. Jagannatham (<http://home.iitk.ac.in/~adityaj/index.html>) received his Bachelors degree from the Indian Institute of Technology, Bombay and M.S. and Ph.D. degrees from the University of California, San Diego, U.S.A.. From April '07 to May '09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he worked on developing 3G UMTS/WCDMA/HSDPA mobile chipsets as part of the Qualcomm CDMA technologies division. His research interests are in the area of next-generation wireless communications and networking, sensor and ad-hoc networks, digital video processing for wireless systems, wireless 3G/4G cellular standards and CDMA/OFDM/MIMO wireless technologies.

**COURSE PLAN :**

**Week 1:** Basic tools of Digital communication, Transmission Pulse Shaping, Power Spectral Density, Additive White Gaussian Noise (AWGN) Channel

**Week 2:** Optimal Receiver Design, Signal-to-Noise Power Ratio (SNR), Matched Filtering (MF)

**Week 3:** Maximum Likelihood (ML) Receiver, Probability of Error, Binary Phase Shift Keying and associated Prob. of Error, Amplitude Shift Keying (ASK) and Other Schemes

**Week 4:** Signal Space Theory, Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM), M-ary Phase Shift Keying (MPSK) and associated Prob. of Error

**Week 5:** Introduction to Wireless Communication, Performance of Digital Modulation in Fading Channels, Introduction to Information Theory, Channel Capacity

**Week 6:** Source Coding, Entropy Codes, Huffman Coding, Linear Block Codes

**Week 7:** Hamming Weight and Distance Properties, Syndrome Decoding, Convolutional Codes, Trellis Structure and Decoding of Convolutional Codes

**Week 8:** Pulse Shaping Filter Design, Nyquist Pulse Shaping Criterion, Raised-Cosine Filter, Passband-Baseband Equivalence



# PRINCIPLES OF MODERN CDMA/ MIMO/ OFDM WIRELESS COMMUNICATIONS

**PROF. ADITYA K. JAGANNATHAM**

Department of Electrical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (26 JAUG`19 -18 OCT`19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic knowledge of - Probability, random variables, Digital modulation, BPSK, QPSK etc

## COURSE OUTLINE :

The field of wireless communications has witnessed revolutionary technology developments in the last decade. While previously there existed only 2G GSM based communication systems which supported a data rate of around 10 Kbps, several radical wireless technologies have been developed in the last 10 years to enable broadband wireless access with rates in excess of 100 Mbps. These have subsequently led to the development of 3G and 4G wireless technologies such as HSDPA (High Speed Downlink Packet Access), LTE (Long Term Evolution) and WiMAX (Worldwide Interoperability for Microwave Access). This has been made possible through breakthrough wireless technologies such as Code Division for Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Multiple Input Multiple Output (MIMO). These techniques form the basis of understanding the world of 3G/4G wireless communication systems. This course will present an elaborate introduction to the principles and performance of these fundamental 3G/ 4G wireless technologies.

## ABOUT INSTRUCTOR :

Prof. Aditya K. Jagannatham (<http://home.iitk.ac.in/~adityaj/index.html>) received his Bachelors degree from the Indian Institute of Technology, Bombay and M.S. and Ph.D. degrees from the University of California, San Diego, U.S.A.. From April '07 to May '09 he was employed as a senior wireless systems engineer at Qualcomm Inc., San Diego, California, where he worked on developing 3G UMTS/WCDMA/HSDPA mobile chipsets as part of the Qualcomm CDMA technologies division. His research interests are in the area of next-generation wireless communications and networking, sensor and ad-hoc networks, digital video processing for wireless systems, wireless 3G/4G cellular standards and CDMA/OFDM/MIMO wireless technologies. He has contributed to the 802.11n high throughput wireless LAN standard and has published extensively in leading international journals and conferences.

## COURSE PLAN :

**Week 1** : Introduction to Wireless Systems

**Week 2** : Performance in Fading wireless channels

**Week 3** : Multiple Antenna Wireless Systems and Diversity

**Week 4** : Wireless Channel Characterization - Delay Spread and Doppler

**Week 5** : Principles of CDMA Wireless Communication

**Week 6** : Principles of MIMO Wireless Communication

**Week 7** : Principles of MIMO Wireless Communication (Continued)

**Week 8** : Principles of OFDM Wireless Communication



# DIGITAL SWITCHING - I

**PROF. YATINDRA NATH SINGH**

Department of Electrical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E. / B.Tech

**PRE-REQUISITES** : Basics of Digital Communications, and Digital Communication Networks.

**INDUSTRIES APPLICABLE TO** : People from telecom industry.

## COURSE OUTLINE

The course will introduce the learners to basics of digital telephony. It will start with crossbar switch and move to theory of switches. Towards end, packet switching basics will be looked into.

## ABOUT INSTRUCTOR

Prof. Yatindra Nath Singh, Department of Electrical Engineering Indian Institute of Technology, Kanpur, He did his B.Tech Electrical Engineering from REC Hamirpur (Now NIT Hamirpur), and M.Tech in Optoelectronics and Optical Communications from IIT Delhi. He was awarded Ph.D for his work on optical amplifier placement problem in all-optical broadcast networks in 1997 by IIT Delhi. In July 1997, he joined EE Department, IIT Kanpur. He was given AICTE young teacher award in 2003. Currently, he is working as professor. He is fellow of IETE, senior member of IEEE and ICEIT, and member ISOC. He has interests in telecommunications' networks specially optical networks, switching systems, mobile communications, distributed software system design. He has supervised 11 Ph.D and more than 115 M.Tech theses so far. He has filed three patents for switch architectures, and have published many journal and conference research publications. He has also written lecture notes on Digital Switching which are distributed as open access content through content repository of IIT Kanpur. He has also been involved in open source software development. He has started Brihaspati ([brihaspati.sourceforge.net](http://brihaspati.sourceforge.net)) initiative, an open source learning management system, BrihaspatiSync a live lecture delivery system over Internet, BGAS - general accounting systems for academic institutes.

## COURSE PLAN

**Week 1** : Introduction, Basic signaling, Strowger exchange, crossbar, crossbar operation algorithm.

**Week 2** : Call congestion and time congestion; Lee's approach, Karnaugh's approach

**Week 3** : Strictly Non-blocking networks, Rearrangeably non-blocking networks; Clos Network; Paull's matrix; Clos theorem; Strictly non-blocking for f-way multicasting.

**Week 4** : Slepian Duguid theorem, its proof; Paull's theorem; Recursive construction; Crosspoint complexity for rearrangeably and strictly non-blocking networks

**Week 5** : Cantor network; proof; Wide-sense non-blocking network – example network and proof.

**Week 6** : Packet Switching, Buffering strategies, Input Queued Switch, Output Queued switch

**Week 7** : Banyan Networks, Delta Network, Shufflenet as Delta network – proof.

**Week 8** : Buffered Banyan network (buffering at each switching element), Computational analysis.





# ELECTRICAL DISTRIBUTION SYSTEM ANALYSIS

**PROF. G.B. KUMBHAR**

Department of Electrical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**PRE-REQUISITES** : Power System Analysis

**INDUSTRIES APPLICABLE TO** : Power distribution utilities - Load dispatch centers - Distribution system equipment manufacturers

## COURSE OUTLINE :

The structure and load patterns of a power distribution system are significantly different than transmission system. In addition, distribution systems are transitioning from passive to active with the adoption of distributed generation, storage, and smart-grid technologies. Therefore, the analysis tools developed for a transmission system will not be directly applicable to a distribution network. This course shall introduce the modeling of the components (feeders, distribution transformer, regulators, capacitors, loads, distributed generation, storage, etc.) and analysis methods (load flow, short-circuit, etc.), specially developed for the distribution system.

## ABOUT INSTRUCTOR :

Dr. Ganesh B. Kumbhar received the B.E. Degree in Electrical Engineering from Government College of Engineering, Karad in 1999, the M. Tech. Degree from the IIT-Madras in 2002, and the Ph.D. degree from the IIT Bombay in 2007. Currently, he is working as Assistant Professor at Department of Electrical Engineering, IIT-Roorkee. Previously, he has worked with Eaton Corporation Ltd., Tata Consultancy Services Ltd., and Crompton Greaves Ltd. in the areas of design and analysis of power system equipment. He has also worked as a Postdoctoral Research Scholar at the Centre for Energy System Research at Tennessee Tech. University, Cookeville, Tennessee, USA. His research interests include distribution system analysis, distributed generation planning and analysis, smart grid technologies and applications, power and distribution transformers, modeling and simulation, design and analysis.

## COURSE PLAN :

- Week 01** : Structure of a distribution system: Distribution feeder configurations and substation layouts, Nature of loads.
- Week 02** : Approximate methods of analysis: Computation of transformer and feeder loading -“K” Factors, voltage drop and power loss calculations -Distribution of loads and various geometric configurations.
- Week 03** : Modeling of distribution system components-I: Overhead lines, feeders and cables ,Single and three phase distribution transformers, Generalized model of a transformer for load flow studies.
- Week 04** : Modeling of distribution system components-II: Voltage regulators,Capacitor banks and load models -Distributed generation and storage.
- Week 05** : Load flow analysis-1: Backward/forward sweep method - Algorithm & Example
- Week 06** : Load flow analysis-1I: Direct approach based methods - Algorithm & Example, Impedance matrix (ZBus) based method.
- Week 07** : Short-Circuit analysis-I : Short-circuit analysis of radial system, Short-circuit analysis - Example
- Week 08** : Distribution system analysis tools ; Applications: Feeder reconfiguration, volt-var optimization, load balancing, etc.,Distribution system analysis and future smart-grid





## DC MICROGRID

**PROF. AVIK BHATTACHARYA**

Department of Electrical Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Power electronics, Power system and Control system

**INTENDED AUDIENCE** : M.Tech and PhD students in Power electronics and Power system

**INDUSTRIES APPLICABLE TO** : ABB, GE, CESC

### **COURSE OUTLINE :**

This course is suitable for PG students studying Power electronics, Power system and System & control. The course details the fundamental concepts of Microgrid and its components, types of Microgrids, advantages of Microgrid compared to the central conventional grid. The course also describes general concepts and application, control strategies and principle of operation of DC Microgrid. The course is applicable for students and researchers who do research in fast growing and emerging renewable energy technology.

### **ABOUT INSTRUCTOR :**

Dr Avik Bhattacharya joined IIT Roorkee in February 2014. His fields of interest are DC Microgrids, FACTS, Power Quality, Solid state transformer, SIC and GAN devices. He has taught Power Electronics in IIT Roorkee for two years and FACT Devices for four years. Dr. Bhattacharya, before joining IIT Roorkee, has served in power electronics industries. His teaching thus has a proper blend of industry and academic orientation.

### **COURSE PLAN :**

**Week 1:** Brief introduction and Concepts of Microgrid

**Week 2:** Types of Microgrid system, Microgrids vs Central Conventional power system

**Week 3:** AC and DC Microgrids, Comparison between AC and DC Microgrids

**Week 4:** Power Electronic Converters in Microgrid application, DC Microgrid Topologies

**Week 5:** DC Power source components, application of DC Microgrids

**Week 6:** DC Microgrid operations, Some Standards related with DC Power Circuit

**Week 7:** Control methods in DC Microgrid

**Week 8:** Linear and nonlinear Stability system in DC Microgrid



# INTRODUCTION TO SMART GRID

**PROF. N.P. PADHY**

Department of Electrical Engineering  
IIT Roorkee

**PROF. PREMALATA JENA**

Department of Electrical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core / Elective | UG / PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic Understanding of Power System and Power Electronics Engineering

**INDUSTRY SUPPORT** : State Power Transmission and Distribution companies, DISCOMs, TRANSCO, POWER GRID, Private sector: ABB, Schneider, Siemens, etc.

**COURSE OUTLINE :**

This course mainly focuses on background and fundamental building blocks of smart grid with stringent emphasis on practical applications in the existing power system network. This course provides overview of smart grid and its potential in different types of power sectors such as power generation, transmission and distribution in Metro, Urban/Semi urban and remote locations of India. This also emphasizes on renewable energy source integration in present grids as well as in micro and nano grids as part of the course and explores its issues in operation, analysis, management, control, protection and monitoring. In addition to it, this further provides detailed utility level analysis in terms of energy management, network analysis and operation of renewable based smart grids.

**ABOUT INSTRUCTOR :**

Narayana Prasad Padhy is working as a Professor in the Department of Electrical Engineering and Dean of Academic Affairs, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He received the Ph.D. degree in power systems engineering from Anna University, Chennai, India, in the year 1997.

Premalata Jena is currently an Assistant Professor in the Department of Electrical Engineering, Indian Institute of Technology, Roorkee, India. She received Ph.D. degree in power system protection from the Indian Institute of Technology Kharagpur, Kharagpur, India, in 2011.

**COURSE PLAN :**

- Week 01** : Introduction to Smart Grid, Architecture of Smart Grid, Smart Grid standards and policies, Smart Grid control layer and elements.
- Week 02** : Distributed generation resources, Smart Grid components control elements, Smart Grid Technologies, Plug-in-Hybrid Vehicles (PHEV).
- Week 03** : State Estimation for low voltage networks, Smart Grid Monitoring, Phasor measurement units, Phasor estimation, Dynamic Phasor estimation.
- Week 04** : Islanding detection, Islanding relays, Fault Detection, Isolation, and Service Restoration. Digital relays for Smart Grid protections; relay co-ordination.
- Week 05** : Modelling of AC Smart Grid components, Modelling of DC Smart Grid components, Modelling of DC Smart Grid components, Modelling of storage devices.
- Week 06** : Operation and control of AC Smart Grid, Operation and control of DC Smart Grid, Simulation and case study of AC microgrid.
- Week 07** : Simulation and case study of DC microgrid, Operation and control of hybrid Smart Grid-I, Operation and control of hybrid Smart Grid-II, System analysis of AC/DC Smart Grid, Simulation and case study of hybrid microgrid.
- Week 08** : Demand side management of Smart Grid, Demand response analysis of Smart Grid, Energy Management, Design and Practical study of Smart Grid test bed, Conclusions .



# FUNDAMENTALS OF ELECTRIC DRIVES

**PROF. SHYAMA PRASAD DAS**

Department of Electrical Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Electrical Machines, Power Electronics

**INTENDED AUDIENCE** : UG and PG students in Electrical Engineering

**INDUSTRIES APPLICABLE TO** : GE Global Research, Hitachi Hi-Rel Power Electronics Pvt Ltd, Gandhi Nagar, Amtech Electronics (India) Ltd, etc

**COURSE OUTLINE :**

The course aims at giving a broad overview of Electrical Drive Systems. It is assumed that the students have prior exposure to Electrical Machines and Power Electronics. The control principles of various DC and AC motors using solid state converters are discussed. Principles of selection of Electric Motors are introduced. Some of the applications of Electrical Drives are also highlighted.

**ABOUT INSTRUCTOR :**

Prof. S. P. Das received the B.Tech. (with Honors) degree in Electrical Engineering, the M.Tech. degree in 'Machine Drive and Power Electronics' and the Ph.D. degree from the Indian Institute of Technology, Kharagpur, India, in 1990, 1992, and 1997, respectively. He has been with the Department of Electrical Engineering, IIT Kanpur since 1997. He has guided 7 PhD theses and over 50 MTech theses. His research interests include Power electronics, High performance industrial drives, Power quality conditioners, and Microprocessor-based control and instrumentation. He is a Senior Member of IEEE (USA) and a Fellow of Institute of Electronics and Telecom Engineers (IETE), India.

**COURSE PLAN :**

**Week 1 :** Introduction to Electrical Drives; Dynamics of Electrical Drives; Review of Torque-Speed Characteristics of DC Motors (Shunt and Series) including Motoring and Braking

**Week 2:** Converter (Half Controlled Converter, Full Controlled Converter, Dual Converters); Control of DC Motor Drives; Torque Speed Characteristics of Converter-fed DC Drives

**Week 3:** Chopper Controlled DC Drives (Single and Multi-quadrant Converters), Motoring and Braking operations

**Week 4:** Induction Motor Drives – Equivalent circuits; Torque-speed characteristics; Operation of Induction Motor with Unbalanced Source Voltages; Analysis of Induction Motor from Non-sinusoidal Voltage Supply; Starting and Braking of Induction Motor

**Week 5:** Stator Voltage Control of Induction Motor; Variable Voltage/ Current; Variable Frequency Control of Induction Motor Fed from VSI and CSI; Control of Slip-ring Induction Motor

**Week 6:** Synchronous Motor Characteristics (Cylindrical and Salient Pole); CSI-fed Synchronous Motor Drive; Permanent Magnet Synchronous Motor Drive; Brushless DC Motor Drives

**Week 7:** Traction Drives – Characteristics of Traction Drives; Drive Power Requirement; DC and AC Traction

**Week 8:** Switched Reluctance Motor – Construction; Analysis and Closed-loop Control; Various Types of Stepper Motor and their Characteristics



# MAPPING SIGNAL PROCESSING ALGORITHMS TO DSP ARCHITECTURES

**PROF. NITIN CHANDRACHOODAN**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : - Digital Design fundamentals (UG) - Digital Signal Processing (UG) - Processor architecture (UG)

**INTENDED AUDIENCE** : Students interested in hardware (VLSI / FPGA) implementations of DSP systems; also useful for those using custom parallel architectures (GPU)

## **COURSE OUTLINE :**

This course deals with the analysis of algorithms, and mapping them to architectures that are either custom designed or have specific extensions that make them better suited to certain kinds of operations. Topics covered include fundamental bounds on performance, mapping to dedicated and custom resource shared architectures, and techniques for automating the process of scheduling. Aspects of architectures such as memory access, shared buses, and memory mapped accelerators will be studied.

## **ABOUT INSTRUCTOR :**

Prof. Nitin Chandrachoodan received his BTech (Electronics and Communication Engineering) from IIT Madras in 1996, and PhD from the University of Maryland at College Park in 2002, in the area of high-level synthesis techniques for mapping DSP algorithms to architectures. He has been with the Department of Electrical Engineering at IIT Madras since 2004, where he is currently an Associate Professor. His research interests include Digital Systems Design and Design Automation Tools and techniques, as well as Design of embedded systems with a special focus on assistive technologies. He has taught graduate courses on Digital Integrated Circuit Design and on mapping algorithms to architectures, and a UG course on data structures and algorithms, as well as a laboratory course on digital design using FPGAs. He is an Associate Editor of the Springer Journal of Signal Processing Systems.

## **COURSE PLAN :**

**Week 1:** Review: Digital systems, DSP, computer architecture

**Week 2:** DSP system models; quality metrics and bounds; number representations

**Week 3:** DSP system models; quality metrics and bounds; number representations (contd)

**Week 4:** Implementation: dedicated hardware; transforms; resource sharing; Scheduling: time and resource bounds; allocation, binding, scheduling; techniques

**Week 5:** Implementation: dedicated hardware; transforms; resource sharing; Scheduling: time and resource bounds; allocation, binding, scheduling; techniques (contd)

**Week 6:** Implementation: dedicated hardware; transforms; resource sharing; Scheduling: time and resource bounds; allocation, binding, scheduling; techniques (contd)

**Week 7:** Architectures: programmable systems; FSMs and microprograms; instruction extensions; peripheral accelerators

**Week 8:** Architectures: programmable systems; FSMs and microprograms; instruction extensions; peripheral accelerators (contd)

**Week 9:** Architectures: programmable systems; FSMs and microprograms; instruction extensions; peripheral accelerators (contd)

**Week 10:** Memory and communication systems: bus structures; DMA; networks-on-chip

**Week 11:** Memory and communication systems: bus structures; DMA; networks-on-chip (contd)

**Week 12:** Specialized architectures: Systolic arrays; CORDIC; GPU



# INTRODUCTION TO COMPUTER VISION

**PROF. BREJESH LALL**

Department of Electrical Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic calculus, Linear algebra: Matrix transpose, Basic probability and statistics

**INDUSTRIES APPLICABLE TO** : Samsung, Qualcomm, LG, TI, Google, Microsoft, amazon, Facebook

**COURSE OUTLINE :**

This course will introduce the audience to the subject of computer vision. The camera model will be introduced and Camera calibration and Epipolar geometry concepts will be explained. Object and texture representation will be discussed, and effect of light and shading and colour will be introduced. Use of CNN in vision will be taught, especially for object detection/classification and depth estimation.

**ABOUT INSTRUCTOR :**

Prof. Brejesh Lall is a faculty member of Electrical Engineering Department, IIT Delhi. He is also the head of Bharti School of Telecom Technology and Management. Besides, he is the co-ordinator of the Ericsson 5G center of excellence at IIT Delhi. His research interests include Signal Processing, Image Processing, Computer Vision and Wireless communications.

**COURSE PLAN :**

**Week 1** : Introduction to computer vision, Basics of linear algebra and geometry

**Week 2** : Edge Detection and RANSAC, Interest Points and Corners, Local Image Features (SIFT, FAST, HARRIS) and Feature Matching

**Week 3** : Introduction to CNN; CNN basics, Networks: VGGNet, InceptionNet, ResNet, 3D CNN, RNN, LSTM and GAN

**Week 4** : Object detection and classification: CNN based approaches – R-CNN to FASTER and Single shot detector architectures such as YOLO

**Week 5** : Texture representation

**Week 6** : Light and Shading

**Week 7** : Color

**Week 8** : Camera model and camera calibration

**Week 9** : Flow estimation: Traditional and CNN based, Flow based tracking

**Week 10** : Epipolar geometry and introduction to depth estimation; stereopsis

**Week 11** : Dense correspondence and depth propagation

**Week 12** : Overview of action recognition using (a) RNN (b) 3D CNN



# FUNDAMENTALS OF ELECTRICAL ENGINEERING

**PROF. DEBAPRIYA DAS**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**INDUSTRIES APPLICABLE TO** : Power Grid, NTPC, NHEC, DVC and State Electricity Boards. In general, this basic course is for all engineering professionals.

## COURSE OUTLINE :

This course is mainly for undergraduate First-Year Engineering students from all Specializations. This course will introduce and explain the fundamental concepts of basic electrical engineering. The basic concepts of DC and AC (Single Phase and Three Phase Circuits) network analysis, first order DC transients, steady state and phasor analysis of AC networks, series and parallel resonance and magnetic coupled circuits. This course will also cover Single Phase Transformers, Three Phase Induction Machines and DC Machines. By the end of the course, the students should be able to gather high-quality knowledge of basic Electrical Engineering.

## ABOUT INSTRUCTOR :

Debapriya Das obtained his B.E. degree from Calcutta University ( B.E. College ( Presently known as IEST ), Shibpur, Howrah, WB ), M.Tech. from I.I.T. Kharagpur and Ph.D. from IIT Delhi. He has nearly thirty years of experience in teaching and research. For more information, one can visit his IIT Kharagpur website as well as his personal website [www.ddas.co.in/](http://www.ddas.co.in/). One can also visit the website <https://scholar.google.co.in/citations?user=yZj2uFYAAAAJ>.

## COURSE PLAN :

- Week 01** : Basic Concepts and Basic Laws
- Week 02** : Methods of Analysis
- Week 03** : DC Network Theorems
- Week 04** : Capacitors and Inductors and First Order Circuits
- Week 05** : Sinusoidal and Phasors
- Week 06** : Sinusoidal Steady-State Analysis
- Week 07** : AC Circuit Analysis and Network Theorems
- Week 08** : Series and Parallel Resonance and Magnetically Coupled Circuits.
- Week 09** : Three Phase Circuits and Power Measurements
- Week 10** : Single Phase Transformers
- Week 11** : Three Phase Induction Machines
- Week 12** : DC Machines





# BASIC ELECTRIC CIRCUITS

**PROF. ANKUSH SHARMA**

Department of Electrical Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Students belonging to Electrical Engineering, Electronics Engineering streams; and for those students for whom Basic Electrical Circuits course is compulsory core course

**INDUSTRIES APPLICABLE TO** : All companies working in Electrical Engineering area

**COURSE OUTLINE :**

This course offers comprehensive knowledge about basic electrical circuits. This is considered to be the foundation course for all electrical and electronics engineers.

**ABOUT INSTRUCTOR :**

Prof. Ankush Sharma has around 18 years of teaching, consultancy, and R&D experience. He has worked in TCS, Wipro, and IIT Bhubaneswar at various capacities. He is now an Assistant Professor in Department of Electrical Engineering at IIT Kanpur. His research Interests are Power Systems, Smart Grid Technology, State Estimation, IT Application into Power Systems, Smart City, Multi-Agent Systems, Wide Area Monitoring & Control of Power System, Energy Market, Demand Response Management and Internet of Things.

**COURSE PLAN :**

**Week 1:** Basic circuit elements and waveforms

**Week 2:** Mesh and node analysis

**Week 3:** Network Theorems -1

**Week 4:** Network Theorems -2

**Week 5:** First Order And Second Order Networks

**Week 6:** The Laplace Transform And Its Application

**Week 7:** Circuit Analysis Using Laplace Transform

**Week 8:** Twoport Network

**Week 9:** Sinusoidal Steady State Analysis -1

**Week 10:** Sinusoidal Steady State Analysis -2

**Week 11:** Analogous System

**Week 12:** State Variable Analysis





# POWER ELECTRONICS

**PROF. G. BHUVANESHWARI**

Department of Electrical Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Electrical Engineering, Circuit theory, Signals and Systems

**INTENDED AUDIENCE** : UG students and instructors

**INDUSTRIES APPLICABLE TO** : UPS manufacturing, SMPS manufacturing and Power Electronic Converter Industries

## **COURSE OUTLINE :**

The course discusses power processing electronic circuits like rectifiers, AC voltage controllers, Frequency converters, DC-DC converters and inverters apart from introducing the basics of power semiconductor devices like SCRs, power BJTs, IGBTs and MOSFETs. The analysis of these power circuits are presented in detail along with the waveforms and control techniques. Finally, applications of power electronic technology in generation sector, transmission sector and also in day-to-day applications like battery charger, motor drives, power supplies are covered.

## **ABOUT INSTRUCTOR :**

Prof. Bhuvaneshwari has been working as a faculty member in the Department of Electrical Engineering IIT Delhi since 1997. She did her BE from College of Engineering, Guindy, Anna University and then completed her M.Tech and PhD from IIT Madras in 1987 and 1992 respectively. She worked as a lecturer in College of Engineering, Guindy after which she was working for the Electric utility company ComEd in Chicago, IL, USA before joining as a faculty member in IIT Delhi. She has more than 150 international and National journal and conference papers to her credit. She is Fellow of IEEE-USA, IETUK, IETE, IE(I) and a life member of ISTE. Her areas of interest are Power Electronics, Electrical Machines, Drives, Power Quality, Power Conditioning and Renewable energy.

## **COURSE PLAN :**

**Week 1:** Introduction to Power Electronics

**Week 2:** Power devices : Diodes, SCRs, GTO, BJT, MOSFET, IGBT- Characteristics, Working, selection and protection

**Week 3:** AC-DC converter: Half wave & Full wave; uncontrolled, Semi-controlled & Fully controlled; single-phase and three-phase

**Week 4:** Single-phase and Three-phase converters and simulations

**Week 5:** AC-AC converters: AC voltage controllers and Cycloconverters

**Week 6:** Non-isolated DC-DC converters: Buck, Boost, Buck-boost & Cuk

**Week 7:** Isolated DC-DC converters

**Week 8:** DC-AC Inverters: Single-phase and three-phase, Modulation techniques

**Week 9:** Current Source inverter

**Week 10:** Applications of Power Electronics in Generation, Transmission, Distribution & Utilization sectors

**Week 11:** Isolated DC-DC converters: Problems and simulation

**Week 12:** DC-AC inverters (single-phase and three-phase): Problems and Simulation



# ANALOG ELECTRONIC CIRCUIT

**PROF. SHOURI CHATTERJEE**

Department of Electrical Engineering  
IIT Delhi

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 -18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Should know basic circuit analysis

**INDUSTRIES APPLICABLE TO** : Texas Instruments, Cypress Semiconductors, Sandisk Technology, Western Digital, STMicroelectronics, Qualcomm, Freescale Semiconductors, Cadence, Synopsys

## COURSE OUTLINE :

This is a basic analog electronics course. The most important objective for electronic circuits is to build an amplifier. This course will develop the principles behind the design of an amplifier. You should be able to design an operational-amplifier independently well before the end of the course. The course will use MOS devices exclusively. Other analog circuit building blocks such as voltage regulators and power amplifiers will also be discussed.

## ABOUT INSTRUCTOR :

Prof. Shouri Chatterjee received the B.Tech. degree in Electrical Engineering from the Indian Institute of Technology, Madras, in 2000, and the M.S. and Ph.D. degrees in Electrical Engineering from Columbia University, New York, in 2002 and 2005, respectively. From 2005 to 2006, he was a design engineer in the wireless division at Silicon Laboratories Inc., Somerset, NJ. Since November 2006 he has been with the faculty of the department of Electrical Engineering of the Indian Institute of Technology, Delhi, India. Currently he is the NXP/Philips chair professor at IIT Delhi.

## COURSE PLAN :

**Week 1** : Non-linear circuit analysis, diodes, load line concepts, introduction to the MOSFET

**Week 2** : DC operating point, biasing the MOSFET, small signal model of the MOSFET, small signal analysis

**Week 3** : Thevenin and Norton models, common source, common gate, common drain Circuits

**Week 4** : Source degenerated common source amplifier, cascode and cascaded circuits

**Week 5** : Current sources and current mirrors, biasing with current sources, constant gm circuits

**Week 6** : Differential amplifiers, common mode and differential mode gains, CMRR, structure of a complete amplifier

**Week 7** : Folded cascode differential amplifier, self-biased active-load differential Amplifier

**Week 8** : Feedback: examples of feedback amplifiers, current and voltage sensing, current and voltage feedback; op-amps and op-amp circuits

**Week 9** : High frequency model of the MOSFET, revision of common-gate, common- source, common-drain circuits; poles and zeros in the transfer function

**Week 10** : Poles and zeros of cascode amplifier, Miller theorem, phase margin, unity gain bandwidth, compensation of the cascaded amplifier

**Week 11** : Voltage regulators, LDOs, stability of regulators, power supply rejection, bandwidth

**Week 12** : Power amplifiers, audio power amplifier, class-A/class-AB/class-B/class-C; push-pull class-AB power amplifier



# OP-AMP PRACTICAL APPLICATIONS: DESIGN, SIMULATION AND IMPLEMENTATION

## PROF. HARDIK JEETENDRA PANDYA

Department of Electrical Engineering  
IISc Bangalore

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG	<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>PRE-REQUISITES</b>	: Op-Amps fundamentals, Basic Electronics and Circuits and Networks	<b>EXAM DATE</b>	: 17 Nov 2019
<b>INTENDED AUDIENCE</b>	: B.E/B.Tech, M.E/M.Tech		

## COURSE OUTLINE :

This course is a system design-oriented course aimed to provide exposure on applications of op-amps and its importance in the real world. Since analog circuits play a crucial role in the implementation of an electronic system, this course emphasis On complete system design with initial discussion on circuit design. As part of this course student can build analog systems using analog ICs and study their macro models. Below are some of the course outcomes. (1)To expose the operation of the basic building blocks of analog system. (2)To understand and analyze the Op-Amps. (3)To understand feedback techniques and its advantage. (4)Ability to design amplifiers using Op-Amps. (5)Ability to analyze and design filters using Op-Amps. (6)To develop the skill to build and troubleshoot Analog circuits. (7)To develop the skill to build complete system using analog circuits.

## ABOUT INSTRUCTOR :

Prof. Hardik J. Pandya is a core faculty member in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is developing Advanced Microsystems and Biomedical Devices Facility for Clinical Research and Biomedical and Electronic (10-6-10-9) Engineering Systems Laboratory to carry out cutting-edge research on novel devices to solve unmet problems in biology and medicine.

## COURSE PLAN :

- Week 01** : Understanding the Datasheet of Op-Amps
- Week 02** : Introduction to op-amps and discussion on its characteristics by simulation and experiment
- Week 03** : Understand the basics of Hysteresis and the need of hysteresis in switching circuits
- Week 04** : Op-Amp Circuits Analog-to-Digital Converter (ADC)
- Week 05** : Digital-to-Analog Converter (DAC) using Op-Amps
- Week 06** : To design and build a function generator capable of generating square wave and a triangular wave of a known frequency using simulation and experiment by TI analog system lab kit pro
- Week 07** : To design and build a voltage-controlled oscillator using simulation and TI analog system lab kit pro
- Week 08** : To design and build an automatic volume control using simulation and TI analog system lab kit pro
- Week 09** : To design and build a constant current drive circuit for measuring unknown resistance using simulation and Experiment on bread board
- Week 10** : To design and build a temperature controlled system using op-amps as ON-OFF controller and Proportional controller by simulation and Experiment on bread board
- Week 11** : To design and build a signal conditioning circuit for the thermocouple to compensate for temperature correction
- Week 12** : To design and Implement a speed controller of a DC motor using simulation and experiment



# FABRICATION TECHNIQUES FOR MEMS-BASED SENSORS : CLINICAL PERSPECTIVE

## PROF. HARDIK JEETENDRA PANDYA

Department of Electrical Engineering  
IISc Bangalore

## PROF. CHANDRAMANI KISHORE SINGH

Department of Electrical Engineering  
IISc Bangalore

	<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG
<b>INTENDED AUDIENCE</b> : B.E/B.Tech, M.E/M.Tech	<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>PRE-REQUISITES</b> : Basic Electronics	<b>EXAM DATE</b>	: 16 Nov 2019
<b>INDUSTRIES APPLICABLE TO</b> : Companies working in semiconductors and integrated circuits: Intel, AMD, Samsung, Texas Instruments, Analog Devices etc.		

### COURSE OUTLINE :

This course is designed with an aim of educating students in the area of microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also be able to understand how to fabricate some of those sensors. Several examples of engineering devices used in clinical research will be also covered. Class 10000 non-conventional clean room and some equipment within it will also be shown. Below are some of the course outcomes. Ability to understand microfabrication process Understand sensors used in electronics and biomedical areas Understand Clean Room (Class 1 to Class 10000) Understand Microengineering Technology Design the process flow for fabricating microheater required in gas sensors. Design the process flow for fabricating force sensors for biomedical application. Design microheater for gas sensors as per specifications. Design force sensors as per specifications. Understand fabrication of microfluidic platforms, micro-cantilevers, flexible force sensors, inter-digitated electrodes, polymer-glass bonding etc. for clinical research

### ABOUT INSTRUCTOR :

Dr. Hardik J. Pandya is a core faculty member in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is developing Advanced Microsystems and Biomedical Devices Facility for Clinical Research and Biomedical and Electronic (10-6-10-9) Engineering Systems Laboratory to carry out cutting-edge research on novel devices to solve unmet problems in biology and medicine.

Prof. Chandramani Kishore Singh is an Assistant Professor in the Department of EEE at IISc Bangalore. He has numerous publications to his credit and with high H-index and citations. He is a member of IEEE.

### COURSE PLAN :

- Week 01** : Introduction to microengineering devices and its applications
- Week 02** : Clean room, contaminants, wafer cleaning processes (DI water, RCA, metallic impurities, etc.).
- Week 03** : Introduction to the microheater, force sensors, microfluidic devices, its specifications, and applications.
- Week 04** : Masks: Types of masks, Types of Photoresists, Spin Coaters Lithography process: optical lithography, x-ray, and e-beam lithography, lift-off techniques, soft lithography, Use of resists (spin coating, positive and negative photoresists), photoresist pre-baking, exposure, and development.
- Week 05** : Etching: Isotropic/anisotropic, selectivity, wet and plasma assisted etching.
- Week 06** : Types of wafers and orientations. Techniques of metallization: PVD [(Sputtering – DC, RF and Magnetron), thermal evaporation, e-beam evaporation].
- Week 07** : Chemical Vapor Deposition: Dielectric films (Plasma Enhance Chemical Vapor Deposition (PECVD)), Atomic Layer Deposition
- Week 08** : Understanding and designing the process flow for fabricating microengineering devices. Process flow for microheater, force sensors, and microfluidic devices.
- Week 09** : Wafer dicing and bonding techniques. Microfluidic Chips
- Week 10** : Process Flow for Fabricating Flexible Force Sensors and Force Sensors on Silicon, Process Flow for Fabricating VOC sensors, Biochips
- Week 11** : Clinical Research: Problems and Solutions using Microengineering Device
- Week 12** : Visit to non-conventional Class 10000 Clean Room and discussing few equipment within.



# SENSORS AND ACTUATORS

**PROF HARDIK J PANDYA**

Department of Electrical & Electronic Engineering  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Electronics

**INTENDED AUDIENCE** : Engineering Students, Faculty from Engineering Colleges

## **COURSE OUTLINE :**

This course is designed with an aim of educating students in microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real

world. The students will also be able to understand how to fabricate some of those sensors. They will have an exposure towards how to fabricate the sensors and its application in real world and understand and also learn modern day microsensors and micro actuators, how to simulate some of those sensors and characterise before fabricating it.

## **ABOUT INSTRUCTOR :**

Dr. Hardik J. Pandya is an Assistant Professor in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is heading an Advanced Microsystems and Biomedical Devices Facility for Clinical Research as well as Biomedical and Electronic Engineering Systems Laboratory which focuses on the cutting-edge research on novel devices for solving unmet problems in biology and medicine. He is recipient of prestigious Early Career Research Award from Science and Engineering Research Board, Government of India.

## **COURSE PLAN :**

**Week 1:** Basics of Energy Transformation: Transducers, Sensors and Actuators

**Week 2:** Understanding of thin film physics: Application in MOSFET and its variants

**Week 3:** Thin Film Deposition Techniques: Chemical Vapor Deposition (APCVD, LPCVD, UHVCVD, PECVD, ALCVD, HPCVD, MOCVD)

**Week 4:** Thin Film Deposition Techniques: Physical Vapor Deposition (Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition)

**Week 5:** Basic understanding of Photolithography for patterning layer. Detailed overview of Etching methods.

**Week 6:** Understanding various gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured based gas sensors

**Week 7:** Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications

**Week 8:** Explain working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications

**Week 9:** Understanding basics of microfluidics to assist Photomask design using Clewin Software, pattern transfer techniques, PDMS moulding and degassing, device bonding techniques.

**Week 10:** Simulation, Optimization and characterization of various sensors using COMSOL Multiphysics

**Week 11:** Understanding of Sensor Interfacing with Microprocessor to build electronic system

**Week 12:** Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor based electronics systems





# CONTROL ENGINEERING

## PROF. RAMAKRISHNA PASUMARTHY

Department of Electrical Engineering  
IIT Madras

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG/PG	<b>COURSE DURATION</b>	: 12 Weeks(29 Jul'19 - 18 Oct'19)
<b>PRE-REQUISITES</b>	: Network and Circuits, Basic Engineering Mathematics	<b>EXAM DATE</b>	: 17 Nov 2019
<b>INDUSTRY SUPPORT</b>	: Any industry into Industrial Automation		

## COURSE OUTLINE

This course shall introduce the fundamentals of modeling and control of linear time invariant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems.

## ABOUT INSTRUCTOR

Prof. Ramakrishna Pasumarthi is currently an Assistant Professor at Department of Electrical Engineering, IIT Madras. He obtained my PhD in systems and control from University of Twente, The Netherlands and held post doc positions at University of Melbourne and UCLA. My interests lie in the area of modeling and control of complex physical systems. I also have interests in the area of identification and control of (cloud) computing systems and data analytics for power, traffic and cloud networks. I am also a member of the Interdisciplinary Laboratory for Data Sciences at IIT Madras.

## COURSE PLAN

- Week 1** : Mathematical Modelling of Systems
- Week 2** : Laplace Transforms, transfer functions, block diagram representation.
- Week 3** : Block diagram reduction, Time response characteristics.
- Week 4** : Introduction to stability, Routh Hurwitz stability criterion
- Week 5** : Root locus plots, stability margins.
- Week 6** : Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain.
- Week 7** : Basics of control design, the proportional, derivative and integral actions.
- Week 8** : Design using Root Locus
- Week 9** : Design using Bode plots
- Week 10** : Effects of zeros, minimum and non-minimum phase systems.
- Week 11** : Application of basic filter design to Navigation and Movement.
- Week 12** : Introduction to state space methods, Linearization of nonlinear systems.



# LINEAR SYSTEM THEORY

**PROF. RAMKRISHNA PASUMARTHY**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Linear Algebra, Differential Equations, Control Systems Engineering

**INTENDED AUDIENCE** : Graduate Students from Electrical / Mechanical/ Aerospace/ Chemical Engineering

## **COURSE OUTLINE :**

This course will provide a thorough introduction to the theory of Linear Systems with emphasis on Control related concepts. First, mathematical models describing the fundamental properties that govern the behavior of systems will be developed. We will cover time invariant, time varying, continuous and discrete time systems. This course will cover concepts of stability, controllability, observability, and design and serve as necessary foundation for further study in the area of systems and control.

## **ABOUT INSTRUCTOR :**

Ramkrishna Pasumarthi is currently an Assistant Professor at Department of Electrical Engineering, IIT Madras. He obtained PhD in systems and control from University of Twente, The Netherlands and held post doc positions at University of Melbourne and UCLA. His interests lie in the area of modeling and control of complex physical systems, identification and control of (cloud) computing systems and data analytics for power, traffic and cloud networks. He is also a member of the Interdisciplinary Laboratory for Data Sciences at IIT Madras.

## **COURSE PLAN :**

**Week 1:** Introduction to Linear systems with Examples

**Week 2:** Math Preliminaries I - Vector Spaces, Bases, Coordinate Transformation, Invariant Subspaces, Inner product, Norms

**Week 3:** Math Preliminaries II - Rank, Types of Matrices, Eigen values, Eigen vectors, Diagonalization, Matrix Factorization

**Week 4:** State Transition Matrix, Solutions to LTI Systems, Solutions to LTV Systems

**Week 5:** Equilibrium points, Linearization, Types of Linearization with Examples

**Week 6:** Stability, Types of Stability, Lyapunov Equation

**Week 7:** Controllability, Reachability, Stabilizability, Tests, Controllable and Reachable Subspaces, Grammians, Controllable Decomposition

**Week 8:** Observability, Constructibility, Detectability, Tests, Subspaces, Grammians, State Estimation, Observable Decomposition

**Week 9:** Kalman Decomposition, Pole Placement, Controller Design

**Week 10:** Observer Design, Duality, Minimal Realization

**Week 11:** Basics of Optimal Control, LQR, Ricatti Equation

**Week 12:** LMIs in Control





# ELECTRICAL MEASUREMENT AND ELECTRONIC INSTRUMENTS

**PROF. AVISHEK CHATTERJEE**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Principles of Electrical Engineering (Circuit Theory), Basic Digital and Analog Electronics

**INTENDED AUDIENCE** : Mainly Electrical/ Instrumentation Engineering; also interested students from Electronics, Physics and similar disciplines

**INDUSTRIES APPLICABLE TO** : Must for Power generation industry, Power distribution industry, Electronics industry; Also highly required for Automotive industry, Rail industry, Aerospace industry, Telecommunications industry, Oil and gas industry, Construction industry, Defense industry, Marine industry, Materials and metals industry

**COURSE OUTLINE :**

It is a core course for all UG Electrical Engineering students. The content of this course is also aligned to the syllabus for the GATE EE exam. The course has two halves:

(1) Electrical Measurements

Working principle and Dynamics of different Electro-Mechanical Instruments, Ammeter, Voltmeter, Ohmmeter, Wattmeter, Energy meter, Measurement of resistance and impedances, Bridges and potentiometers, Instrument transformers.

(2) Electronic Instruments

Differential Amplifier, Op-Amp Circuits, Analog DC and AC instruments, ADC and DAC, Digital instruments, Function Generator, Oscilloscope

**ABOUT INSTRUCTOR :**

Prof. Avishek Chatterjee received his B.E degree from Jadavpur University, Kolkata in 2009 followed by M.E and PhD From Indian Institute of Science in 2011 and 2016 respectively. He currently works in IIT Kharagpur as a faculty in the Department of Electrical Engineering. His research area is in Geometry Reconstruction

**COURSE PLAN :**

**Week 1:** Measurement Error, Accuracy and Instrument grades, Electromechanical Instruments

**Week 2:** Electromechanical instruments, (contd) Electromechanical Ammeters, voltmeters and Ohmmeters

**Week 3:** Electromechanical Wattmeter and Energy Meter

**Week 4:** Resistance Measurement, Impedance Measurement: AC Bridges

**Week 5:** Potentiometers: DC and AC

**Week 6:** Instrument Transformers: CT & PT, Magnetic Measurement

**Week 7:** Analog Instrumentation Basics

**Week 8:** Analog Instrumentation

**Week 9:** Digital Instrumentation Basics

**Week 10:** Digital Instrumentation

**Week 11:** Signal and Function Generators

**Week 12:** Oscilloscope and Electronic probes



# ANALOG COMMUNICATION

**PROF. GOUTAM DAS**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**PRE-REQUISITES** : Signals and System

**COURSE OUTLINE :**

The course will introduce the participants to the signal representation in both time and frequency domain, basic analog communication techniques like modulation theory, system design for analog modulator and demodulator, random process and noise analysis.

**ABOUT INSTRUCTOR :**

Prof. Goutam Das has obtained his B.Tech., M.Tech. and Ph.D. degrees in E&ECE from the Bengal Engineering college, Shibpore, IIT Kharagpur and University of Melbourne respectively. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 2011, in G. S. Sanyal School of Communications, where he is presently an Assistant Professor. He has over 10 years of teaching and research experience. He has more than 60 publications to his credit in international journals and conferences. His research interests include Optical and wireless Access Networks – System and protocol design and performance evaluation. He had been the TPC Chair of IEEE ANTS 2011, 2012, Editorial Board member of Springer Journal of Photonic Network Communications.

**COURSE PLAN :**

**Week 01** : Introduction to Fourier Series and Fourier Transform

**Week 02** : Energy and Power Spectral Densities

**Week 03** : Modulation Theory

**Week 04** : Amplitude Modulation – AM and DSB-SC

**Week 05** : SSB-SC and VSB

**Week 06** : Angle Modulation – FM, PM

**Week 07** : Sampling Theorem

**Week 08** : Pulse Modulation and PCM

**Week 09** : Introduction to Random Process

**Week 10** : Spectral Analysis of Random Process

**Week 11** : Characteristics of Band-pass noise

**Week 12** : Performance Analysis of AM, DSB-SC with Noise



# INTRODUCTION TO WIRELESS AND CELLULAR COMMUNICATIONS

**PROF. DAVID KOILPILLAI**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**PRE-REQUISITES** : Analog and Digital Communications, Digital Signal Processing

**INDUSTRIES APPLICABLE TO** : All wireless and cellular companies such as Qualcomm, Ericsson, Tejas, Samsung, Sasken, Intel, Texas Instruments, Motorola, Ittiam, Aruba, MoJo Networks.

## COURSE OUTLINE :

An in-depth understanding of the wireless channel and the related impairments (multipath, fading), small-scale and large-scale propagation effects, Understanding of the design of cellular systems, Detailed discussion of Multiple Access (TDMA/CDMA/OFDM), Antenna diversity, MIMO, Wireless Channel Capacity, Computer simulations of wireless systems, Exposure to current and emerging wireless and cellular systems (LTE, 802.11).

## ABOUT INSTRUCTOR :

Prof.R. David Koilpillai received the B.Tech degree in Electrical Engineering from the Indian Institute of Technology Madras and the M.S. and Ph.D. degrees in Electrical Engineering from the California Institute of Technology, Pasadena, CA. In June 2002, David joined the EE faculty of IIT Madras. He is currently the Qualcomm Institute Chair Professor in EE and Dean (Planning). During the period April 2008 – December 2009, he served as the Co-Chair of the IITM special Task Force for setting up the new IIT at Hyderabad. He also served as Head, Central Electronics Centre of IITM during 20010-11. His technical areas of expertise include cellular and broadband wireless systems, and DSP techniques for wireless communications. He is the Faculty Coordinator of the IITMSAT Student Satellite initiative. During January – July 2007, he was on sabbatical from IITM and served as the Chief Scientist, Centre of Excellence in Wireless Technology (CEWiT), a public-private R&D initiative of the Govt. of India, and was responsible for launching the national project – Broadband Wireless Consortium of India (BWCI).

## COURSE PLAN :

**Week 01** : Overview of Cellular Systems and evolution 2g/3G/4G/5G

**Week 02** : Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity

**Week 03** : Wireless propagation Part 1 - Link budget, Free-space path loss, Noise figure of receiver

**Week 04** : Wireless propagation Part II - Multipath fading, Shadowing, Fading margin, Shadowing margin,

**Week 05** : Antenna Diversity

**Week 06** : Wireless Channel Capacity

**Week 07** : MIMO

**Week 08** : CDMA Part I

**Week 09** : CDMA Part II

**Week 10** : OFDM and LTE Part I

**Week 11** : OFDM and LTE Part II

**Week 12** : Large Scale Propagation effects and Channel Models



# DIGITAL SIGNAL PROCESSING

**PROF. C. S. RAMALINGAM**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Networks and Systems

**INTENDED AUDIENCE** : UG students in ECE/EEE

**COURSE OUTLINE :**

This course will introduce you to the basics of discrete-time sequences, z-transform, frequency response of discrete-time systems, sampling, and the DFT.

**ABOUT INSTRUCTOR :**

C.S. Ramalingam obtained his BE (ECE) from the University of Madras, an M.Tech degree from IIT Kharagpur, and a Ph.D in Electrical Engineering from the Univ. of Rhode Island, Kingston, USA. He was a Member of Technical Staff at the DSPS R&D Center of Texas Instruments (Dallas, TX) from 1995—2001. Since 2001 he is with the Department of Electrical Engineering at IIT Madras, where he is currently Associate Professor. His areas of interest are Signal Processing with applications to Speech Analysis, Synthesis, and Coding.

**COURSE PLAN :**

- Week 1:** Introduction to discrete-time sequences, operations on the independent variable, elementary signals: unit step
- Week 2:** Elementary signals: Dirac delta, exponentials, similarities and differences between CT and DT sinusoids
- Week 3:** Introduction to systems and their properties, LTI systems, convolution
- Week 4:** Definition of the z-transform, region of convergence, simple examples, DTFT as a special case of the z-transform
- Week 5:** Properties of the z-transform
- Week 6:** Inverse z-transform
- Week 7:** Sequences having DTFT but no z-transform
- Week 8:** Response to suddenly applied inputs, response to  $A \cos(l_0 n + l)$ .
- Week 9:** Frequency Response of LTI systems with rational transfer function, magnitude response
- Week 10:** Phase Response
- Week 11:** Sampling
- Week 12:** Discrete Fourier Transform



# DIGITAL CIRCUITS

**PROF. SANTANU CHATTOPADHYAY**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E. / B.Tech

**PRE-REQUISITES** : Basic Electronics

**INDUSTRIES APPLICABLE TO** : Companies involved in development digital products

## COURSE OUTLINE :

Digital circuits are part of any electronic design today. This also happens to be one of the core subjects for the undergraduate students in Electronics, Electrical and Computer Engineering. It forms the basis of many of the next level courses. The proposed course on digital circuits will cover all the fundamental concepts in digital design. It will primarily focus on the prescribed GATE syllabus for Electronics and Communication Engineering (ECE) specialization. The course will start with the representations of numbers – different number systems and conversion between them, representation of integer and real numbers etc. This will be followed by combinational and sequential circuit design techniques. Data converters and semiconductor memories will be covered. Microprocessor 8085 will be discussed as a complete digital system example. Designed primarily as a single course covering the digital circuits portion of GATE syllabus, the course will also be helpful for any other aspirant willing to learn digital electronics principles comprehensively in today's perspective.

## ABOUT INSTRUCTOR :

Santanu Chattopadhyay received his PhD from Indian Institute of Technology (IIT) Kharagpur in 1996. He is currently a Professor in the Department of Electronics and Electrical Communication Engineering, IIT Kharagpur. His research interests include Digital Design, Embedded Systems, System-on-Chip (SoC) and Network-on-Chip (NoC) Design and Test, Power- and Thermal-aware Testing of VLSI Circuits and Systems. He has published more than 150 papers in reputed international journals and conferences. He has published several text and reference books in the related areas. He is a senior member of IEEE and an editorial board member of IET Circuits Devices and Systems.

## COURSE PLAN :

- Week 01** : Introduction, Number System
- Week 02** : Boolean Algebra
- Week 03** : Combinational function minimization – K Map, Boolean identities
- Week 04** : Logic Gates
- Week 05** : Arithmetic circuits, Code converters
- Week 06** : Multiplexers, Decoders, PLA
- Week 07** : Sequential Circuits – Latches and Flip-flops
- Week 08** : Counters, Shift Registers, Finite State Machines
- Week 09** : Data Converters – Sample and hold circuits, ADCs, DACs
- Week 10** : Semiconductor Memories – ROM, SRAM, DRAM
- Week 11** : Microprocessor 8085 – Part I
- Week 12** : Microprocessor 8085 – Part II



# NEURAL NETWORKS FOR SIGNAL PROCESSING – I

**PROF. SHAYAN SRINIVASA GARANI**

Department of Electronics System Engineering  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic mathematical background in probability, linear algebra, signals and systems or equivalent

**INTENDED AUDIENCE** : Graduate level, Senior UG students, Engineers and scientists of related industry

**INDUSTRIES APPLICABLE TO** : AI based, machine learning based industries

## **COURSE OUTLINE :**

This will be an introductory graduate level course in neural networks for signal processing. It would be part-I of a III part series on neural networks and learning systems that the instructor intends to introduce. The course starts with a motivation of how the human brain is inspirational to building artificial neural networks. The neural networks are viewed as directed graphs with various network topologies towards learning tasks driven by optimization techniques.

## **ABOUT INSTRUCTOR :**

Prof. Shayan Garani Srinivasa is an Assistant Professor at the Department of Electronics Systems Engineering, Indian Institute of Science. He earned his PhD from Georgia Institute of Technology. He is chairing IEEEEDSTC award committee and Photonic Detection, Optical Society of America.

## **COURSE PLAN :**

- Week 1:** Introduction, Human brain, models of a neuron, Neural communication, Neural networks as directed graphs, network architectures (feed-forward, feedback etc.), knowledge representation.
- Week 2:** Learning processes, Learning tasks, Perceptron, Perceptron convergence theorem, relationship between perceptron and Bayes classifiers, Batch perceptron algorithm
- Week 3:** Modeling through regression, Linear and logistic regression for multiple classes.
- Week 4:** Multilayer perceptron, Batch and online learning, derivation of the back propagation algorithm, XOR problem, Role of Hessian in online learning, annealing and optimal control of learning rate
- Week 5:** Approximations of functions, Cross-validation, Network pruning and complexity regularization, convolution networks, non-linear filtering
- Week 6:** Cover's theorem and Pattern separability, The interpolation problem, RBF networks, Hybrid learning procedure for RBF networks, Kernel regression and relationship to RBFs.
- Week 7:** Support vector machines, Optimal hyperplane for linear separability, Optimal hyperplane for nonseparable patterns, SVM as a kernel machine, Design of SVMs, XOR problem revisited, robustness considerations for regression
- Week 8:** SVMs contd. Optimal solution of the linear regression problem, Representer theorem and related discussions. Introduction to regularization theory
- Week 9:** Hadamard's condition for well-posedness, Tikhonov regularization, Regularization networks, generalized RBF networks, Estimation of regularization parameter etc.
- Week 10:** L1 regularization basics, algorithms and extensions
- Week 11:** Principal component Analysis: Hebbian based PCA, Kernel based PCA, Kernel Hebbian algorithm
- Week 12:** Deep multi-layer perceptrons, Deep autoencoders and stacked denoising auto-encoders.





# MICROELECTRONICS: DEVICES TO CIRCUITS

**PROF.SUDEB DASGUPTA**

Department of Electronics & Communication Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Core\_Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Students of Computer science & Electrical Engineering

**PRE-REQUISITES** : First course on linear circuit analysis, A basic course on Semiconductor Devices and Digital Electronics. A course on Computer Organization will be also helpful (though not strictly required).

**INDUSTRIES APPLICABLE TO** : Cadence; Synopsys; ST Microelectronics; NXP Semiconductors; Semiconductor Complex Limited; Design House in general

## **COURSE OUTLINE :**

This course aligns with the core courses in Electronics Circuits taught to undergraduates in Electrical and Computer Engineering. The objective of this course is to develop the ability to analyse and design electronic circuits both analog and digital, discrete and integrated. The course starts with the basics of the device most seldom encountered in mixed designs and then go on to do circuit analysis in the later parts.

## **ABOUT INSTRUCTOR :**

Prof. S. Dasgupta is presently working as an Associate Professor, in Microelectronics and VLSI Group of the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He received his PhD degree in Electronics Engineering from Institute of Technology-Banaras Hindu University (currently IIT-BHU), Varanasi in 2000.

## **COURSE PLAN :**

**Week 1** : Bipolar Junction Transistor

**Week 2** : MOS Transistor Basics

**Week 3** : CMOS Inverter Basics

**Week 4** : Biasing of MOS Amplifier and its behavior

**Week 5** : Multistage and Differential Amplifier

**Week 6** : s-domain analysis, Transfer function, Poles and Zeros, High Frequency Response of CS Configuration, Differential Amplifier, Cascade Connection and its Operation

**Week 7**: General Feedback structure and properties of negative feedback, Basic Feedback and CE Amplifier, Frequency Response of CC and SF Configuration, Frequency Response of the Differential Amplifier, Cascade Connection and its Operation

**Week 8** : Operational Amplifier

**Week 9** : Butterworth and Chebyshev Filters, First and Second Order Filter Functions, Switched Capacitor based filters, Single-Amplifier Biquadratic Filters, Second Order LCR Resonator.

**Week 10** : Combinational Logic Design-I,II,III & IV

**Week 11** : Sequential Logic Design

**Week 12** : Clock Strategies for Sequential Design



# DIGITAL IMAGE PROCESSING

**PROF. PRABIR KUMAR BISWAS**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : BE/ME/MS/PhD

**PRE-REQUISITES** : Concepts of Digital Signal Processing

**INDUSTRIES APPLICABLE TO** : Defense labs like DRDO, Space ISRO, TCS

## COURSE OUTLINE :

Digital image processing deals with processing of images which are digital in nature. Study of the subject is motivated by three major applications. The first application is in improvement of pictorial information for human perception i.e. enhancing the quality of the image so that the image will have a better look. The second is for autonomous machine applications which have wider applications in industries, particularly for quality control in assembly automation and many similar applications. This course will introduce various image processing techniques, algorithms and their applications.

## ABOUT INSTRUCTOR :

Dr. Prabir Kumar Biswas completed his B.Tech(Hons), M.Tech and Ph.D from the Department of Electronics and Electrical Communication Engineering, IIT Kharagpur, India in the year 1985, 1989 and 1991 respectively. From 1985 to 1987 he was with Bharat Electronics Ltd. Ghaziabad as a deputy engineer. Since 1991 he has been working as a faculty member in the department of Electronics and Electrical Communication Engineering, IIT Kharagpur, where he is currently holding the position of Professor and Head of the Department. Prof. Biswas visited University of Kaiserslautern, Germany under the Alexander von Humboldt Research Fellowship during March 2002 to February 2003. Prof. Biswas has more than a hundred research publications in international and national journals and conferences and has filed seven international patents. His areas of interest are image processing, pattern recognition, computer vision, video compression, parallel and distributed processing and computer networks. He is a senior member of IEEE and was the chairman of the IEEE Kharagpur Section, 2008.

## COURSE PLAN :

**Week 01** : Introduction and signal digitization

**Week 02** : Pixel relationship

**Week 03** : Camera models & imaging geometry

**Week 04** : Image interpolation

**Week 05** : Image transformation

**Week 06** : Image enhancement I

**Week 07** : Image enhancement II

**Week 08** : Image enhancement III

**Week 09** : Image restoration I

**Week 10** : Image restoration II & Image registration

**Week 11** : Colour image processing

**Week 12** : Image segmentation, Morphological image processing, Object representation, description and recognition



# PATTERN RECOGNITION AND APPLICATION

**PROF. PRABIR KUMAR BISWAS**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 -18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic knowledge of - Probability, random variables, Digital modulation, BPSK, QPSK etc

**COURSE OUTLINE :**

The course has been designed to be offered as an elective to final year undergraduate students mainly from Electrical Sciences background. The course syllabus assumes basic knowledge of Signal Processing, Probability Theory and Graph Theory. The course will also be of interest to researchers working in the areas of Machine Vision, Speech Recognition, Speaker Identification, Process Identification etc. The course covers feature extraction techniques and representation of patterns in feature space. Measure of similarity between two patterns. Statistical, nonparametric and neural network techniques for pattern recognition have been discussed in this course. Techniques for recognition of time varying patterns have also been covered. Numerous examples from machine vision, speech recognition and movement recognition have been discussed as applications. Unsupervised classification or clustering techniques have also been addressed in this course. Analytical aspects have been adequately stressed so that on completion of the course the students can apply the concepts learnt in real life problems.

**ABOUT INSTRUCTOR :**

Prof. Prabir Kumar Biswas is professor and head of the department of Electronics & Electrical Communication Engineering IIT Kharagpur. His research areas are Image Processing, Computer Vision, Automated Visual Inspection, Multimedia Network, Pattern Recognition and Sensor Network. He had received Humboldt Fellow award in 2002. He is a senior member Institute of Electrical and Electronics Engineers, USA.

**COURSE PLAN :**

**Week 1** : Introduction

**Week 2** : Statistical Pattern Recognition

**Week 3** : Dimensionality Problem

**Week 4** : Nonparametric Pattern Classification

**Week 5&6** : Linear Discriminant Functions

**Week 7&8** : Neural Network Classifier

**Week 9&10** : Time Varying Pattern Recognition

**Week 11&12** : Unsupervised Classification



# MICROWAVE THEORY AND TECHNIQUES

**PROF. GIRISH KUMAR**

Department of Electrical Engineering  
IIT Bombay

**TYPE OF COURSE** : Rerun | Elective | UG/P/G

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, Ph.D

**PRE-REQUISITES** : Electromagnetic Waves

**INDUSTRIES APPLICABLE TO** : Telecom industry, defense industry and space organization

## COURSE OUTLINE :

The course will be broadly focusing on analysis, design and development of microwave circuits and systems. The course will cover introduction to Microwaves, Microwave transmission modes, Transmission lines, Impedance Matching, Microwave Network Analysis, Directional Coupler, Power Divider, Microwave Filters, Microwave Attenuator, RF switches and phase shifters, Microwave Amplifiers, Low Noise Amplifier, Microwave Mixers and Oscillators. Microwave Antennas, Microwave Measurements, Microwave Systems, Effect of Microwaves on human body, RF MEMS, Microwave Imaging, etc.

## ABOUT INSTRUCTOR :

Girish Kumar received the Ph.D. degree in Electrical Engineering from Indian Institute of Technology (IIT) Kanpur, India, in 1983. From 1983 to 1985, he was a Research Associate with the Electrical Engineering Department, University of Manitoba, Winnipeg, Canada. From 1985 to 1991, he was an Assistant Professor with the Electrical Engineering Department, University of North Dakota, Grand Forks, ND, USA. Since 1991, he is with IIT Bombay, India, where he is currently a Professor in the Electrical Engineering Department. He has authored more than 300 papers in the international and national journals and conference proceedings. He is an author of three books and filed seven patents. His research interests include microstrip antennas and arrays, broadband antennas, microwave integrated circuits and systems.

## COURSE PLAN :

**Week 01** : Introduction to Microwaves: History and Applications, Effect of Microwaves on human body

**Week 02** : Microwave Transmission Modes, Waveguides, Transmission Lines

**Week 03** : Smith Chart, Impedance Matching, ABCD and S-Parameters

**Week 04** : Power dividers, Combiners, Couplers

**Week 05** : Microwave Filters

**Week 06** : Microwave Diodes and Attenuators, RF Switches, Phase Shifters

**Week 07** : Microwave Transistors, Amplifiers and LNA

**Week 08** : Power Amplifiers and Microwave Tubes

**Week 09** : Microwave Oscillators and Mixers

**Week 10** : Antennas – Fundamentals, Dipole, Monopole, Arrays, Microstrip, Horn, Helical, Yagi-Uda, Log-Periodic and Reflector Antennas

**Week 11** : RF MEMS, Microwave Measurements, Microwave Systems and Imaging

**Week 12** : Software Session and Lab Demonstration



# PRINCIPLES AND TECHNIQUES OF MODERN RADAR SYSTEMS

**PROF. AMITABHA BHATTACHARYA**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Knowledge of Electromagnetic Theory and Microwave Engineering is required. Following NPTEL courses are suggested: (a) Electromagnetic Theory (b) Basic Tools in Microwave Engineering (c) Basic Building Blocks of Microwave Engineering (d) Analysis and Design Principles of Microwave Antennas

**INTENDED AUDIENCE** : BE/B.Tech Electronics Engineering/Electronics and Communication Engineering/ ME/M.Tech/MS students belonging to RF and Microwave Engineering, PhD fellows having research area of Radar system design

**INDUSTRIES APPLICABLE TO** : Radar Industry, Space Industry, Avionics industry, Defense Industry, Internal Security Industry, Mining industry, Geo-exploration Industry.

## **COURSE OUTLINE :**

The course "Principles and Techniques of Modern Radar Systems" covers a broad spectrum of the radar system design and analysis, starting with the basic concepts of microwave radar principles. The modern trend of close sensing of targets with ground penetrating radar is next introduced along with the topic of radar tomography to give the course students a thrill of various modern civil, industrial and mining applications of radar technology. This trend of radar technology evolution from defence applications to civilian applications is emphasized at the end of the course.

## **ABOUT INSTRUCTOR :**

Prof. Amitabha Bhattacharya received his B.Tech, (E&ECE) Degree from IIT Kharagpur in 1986, M.E. E&CE from Jadavpur University in 1994 and PhD (E. & ECE) from IIT Kharagpur in 1998. He started his professional career in 1986 by joining as Junior Research Engineer in an ISRO-sponsored Research Project at IIT Kharagpur and continued thereafter as a Senior Research Assistant in a DRDO sponsored Research Project till 1991. In 1997, he joined SAMEER, Mumbai and then Defence Lab, Jodhpur as a Research Scientist.

## **COURSE PLAN :**

**Week 1:** Basic Principles: Radar Equation, Radar Cross section

**Week 2:** CW Radar, FMCW Radar

**Week 3:** Pulsed Radar Principles

**Week 4:** Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar,

**Week 5:** Tracking Radar, Angular resolution, Monopulse Technique

**Week 6:** Detection Theory: Match Filtering, Radar Ambiguity Function

**Week 7:** Imaging Radar: Resolution Concept, Pulse Compression

**Week 8:** Synthetic Aperture Processing, ISAR Imaging

**Week 9:** Probability of False Alarm and Detection, Modified Radar Range Equation with Swerling Models

**Week 10:** Ground Penetrating Radar for close sensing

**Week 11:** Radar Tomography and Radar based Microwave Imaging

**Week 12:** Emerging and Modern Applications of Radar Principles



# COMPUTATIONAL ELECTROMAGNETICS

**PROF. UDAY KHANKHOJE**

Department of Electrical Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Engineering Electromagnetics

**INTENDED AUDIENCE** : UG and PG students

**INDUSTRIES APPLICABLE TO** : ISRO, DRDO

## COURSE OUTLINE :

This course on Computational Electromagnetics is targetted at senior undergraduate students and beginning graduate students who have taken a first course in Engineering Electromagnetics. The course covers the mathematical formulation of the main methods currently in use by the community, namely: Integral Equations Methods (and their solution by the Method of Moments), the Finite Element Method, and the Finite Difference Time Domain method. These methods are illustrated by their use in solving scattering problems and antenna radiation/impedance calculation problems. Additional topics include introduction to inverse problems, calculating the mutual coupling between antennas, finding the electromagnetic modes of a waveguide, and techniques to hybridize the Finite Element Method with the Integral Equation Method. Programming issues faced in the implementation of these methods will also be highlighted.

## ABOUT INSTRUCTOR :

Prof. Uday K Khankhoje, completed his BTech in EE from IIT Bombay in 2001-05 and MS, PhD in EE (minors in Physics, Applied Physics) from Caltech (2005-10). He completed his Postdoc at Jet Propulsion Laboratory (NASA/Caltech) from 2011-12 and in University of Southern California from 2012-13. He was an Assistant Professor in Electrical Engineering at IIT Delhi from 2013-16 and he is currently an Assistant Professor, Department of Electrical Engineering (EE) Indian Institute of Technology Madras.

## COURSE PLAN :

**Week 1:** Advanced concepts in electromagnetics: uniqueness theorem, volume/surface equivalence theorems. Introduction to integral equations methods (IEM) by using the Huygen's principle and the extinction theorem.

**Week 2:** Introduction to Green's functions in one and two dimensions

**Week 3:** Solving surface integral equations using the method of moments, how to deal with singularities, and use of quadrature rules

**Week 4:** Solving volume integral equations using the Method of moments

**Week 5:** Introduction to the Finite Element Method (FEM), basis functions in 1 and 2 dimensions

**Week 6:** FEM formulations in 1 and 2 dimensions

**Week 7:** Introduction to Finite Difference Time Domain methods (FDTD): Yee cells, update equations, stability

**Week 8:** FDTD - Accuracy Analysis, Dispersion, Material specifications and Dispersive media

**Week 9:** FDTD - Boundary conditions and their implementation

**Week 10:** Applications of computational electromagnetics (CEM): Antenna problems

**Week 11:** Applications of CEM: Phased array and Wireless System problems

**Week 12:** Applications of CEM: Inverse Scattering problems





# ELECTRICAL MACHINES - I

**PROF. TAPAS KUMAR BHATTACHARYA**

Department of Electrical Engineering

IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Electrical Technology: Knowledge of elementary calculus

**INTENDED AUDIENCE** : Electrical Engineering, Mechanical and Mining Engineering

**INDUSTRIES APPLICABLE TO** : BHEL, CESC, NTPC, WBPDC

## **COURSE OUTLINE :**

Transformer and D.C rotating machine will be the main topics to be discussed in this course. Three phase transformer connection & vector group. Parallel operation of transformers. Autotransformer. Basic constructional features of D.C machine. Elementary lap and wave winding used in armature. Emf and torque equations of D.C. machine – generator and motor mode. Armature reaction and its effect. Compensating winding. Shunt, series and compound machines. Generator characteristics. Motor characteristics. Efficiency, Basic tests.

## **ABOUT INSTRUCTOR :**

Tapas Kumar Bhattacharya has over thirty years of teaching experience at IIT Kharagpur. His research interest is in the field of electrical machines and special electrical machines.

## **COURSE PLAN :**

**Week 1:** Single phase Ideal transformer and basic equations. Its equivalent circuit.

**Week 2:** Core loss: Eddy current and hysteresis loss

**Week 3:** Taking Leakage flux, winding resistances and core loss in the equivalent circuit of the transformer.

**Week 4:** Exact and approximate equivalent circuit. Phasor diagram. Regulation & efficiency.

**Week 5:** Open circuit and short circuit tests. Estimation of equivalent circuit parameters.

**Week 6:** Three phase transformer and various connections with vector groups.

**Week 7:** DC machine constructional features and basic idea of its operation. Armature winding, commutator segments and brushes.

**Week 8:** Lap and wave windings and number of parallel paths in armature circuit. Emf equation.

**Week 9:** Torque equation. Separately excited and shunt generator characteristics.

**Week 10:** Armature reaction and its ill effects. How to nullify the effects of armature reaction.

**Week 11:** Shunt, series and compound motor characteristic.

**Week 12:** Starting, speed control and braking of DC motor. Testing.



# POWER SYSTEM ANALYSIS

**PROF. DEBAPRIYA DAS**

Department of Electrical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**INDUSTRIES APPLICABLE TO** : Power Grid - NTPC - NHEC - DVC and State Electricity Boards.

## COURSE OUTLINE :

This course is mainly for undergraduate third-year Electrical Engineering students, which will introduce and explain the fundamental concepts in the field of electrical power system engineering. The basic concepts of per unit system will be introduced along with their applications in circuit applications. Transmission line parameters, their calculations, and the modeling will be introduced. Basic load flow algorithms will be covered in details along with short-circuit analysis and the method of symmetrical components. Unbalanced fault analysis and basic power system stability analysis will also be covered in these lecture series. By the end of the course, the students should be able to gather high-quality knowledge of electrical power system components, its operation strategies, and stability analysis.

## ABOUT INSTRUCTOR :

Debapriya Das obtained his B.E. degree from Calcutta University ( B.E. College ( Presently known as IEST ), Shibpur, Howrah, WB ), M.Tech. from I.I.T. Kharagpur and Ph.D. from IIT Delhi. He has nearly thirty years of experience in teaching and research. For more information, one can visit his IIT Kharagpur website as well as his personal website [www.ddas.co.in/](http://www.ddas.co.in/). One can also visit the website <https://scholar.google.co.in/citations?user=yZj2uFYAAAAJ>.

## COURSE PLAN :

- Week 01** : Structure Of Power System and Few Other Aspects
- Week 02** : Resistance, Inductance, and Capacitance of Transmission Lines
- Week 03** : Power System Components and Per Unit System
- Week 04** : Characteristics and Performance of Transmission Lines
- Week 05** : Load Flow Analysis
- Week 06** : Load Flow Analysis (Contd.)
- Week 07** : Optimal System Operation
- Week 08** : Optimal System Operation (Contd.)
- Week 09** : Symmetrical Fault
- Week 10** : Symmetrical Components
- Week 11** : Unbalanced Fault Analysis
- Week 12** : Power System Stability



# FIBER-OPTIC COMMUNICATION SYSTEMS AND TECHNIQUES

**PROF. K. PRADEEP KUMAR**

Department of Electrical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BE/B.Tech

**PRE-REQUISITES** : Fundamentals of Electromagnetic theory, Principles of Communication Systems, Programming in Matlab

**INDUSTRIES APPLICABLE TO** : Sterlite Technologies, Infinera, Comsol India, Matlab, Texas Instruments, Defense labs etc will be interested

**COURSE OUTLINE :**

Recent years have seen an exponential increase in demand for large bandwidth and high data rate applications. This is fuelled by rapid advances in fiber-optic communications which includes introduction of digital signal processing (DSP) algorithms combined with coherent detection. A thorough grounding in optical fibers and fiber-optic communications is necessary to communication engineers to address future needs of high data rate communications. Fiber-Optic Communication Systems and Techniques provides solid background in wide ranging topics of fiber-optics. The topics covered include modes of optical fibers, impairments in optical fiber channel, lasers and photodiodes, optical amplifiers, WDM components, and digital fiber-optic communications. Several latest advances in DSP for fiber-optic communications is emphasized.

**ABOUT INSTRUCTOR :**

Dr. K. Pradeep Kumar obtained his PhD from the Department of Electrical Engineering, IIT Madras working on Quantum Key Distribution in 2009. He has since been at the Department of Electrical Engineering, IIT Kanpur. His research interests include Quantum key distribution, signal processing for coherent optical communications, optical signal processing using nonlinear fibers, and fiber-optic modeling. He has published more than 50 papers in peer-reviewed journals and conferences.

**COURSE PLAN :**

**Week 01** : Electromagnetic nature of light, Uniform plane waves, Boundary conditions

**Week 02** : Reflection and transmission of waves at a boundary, Total internal reflection, Ray theory of dielectric slab waveguides, and optical fibers

**Week 03** : Modal analysis of slab waveguides

**Week 04** : Modal analysis of optical fibers (step and graded index), linearly polarized modes

**Week 05** : Attenuation and dispersion in optical fibers, Concepts of spontaneous and stimulated emission of light

**Week 06** : Optical sources: Lasers and LEDs

**Week 07** : Optical amplifiers, Photodiodes

**Week 08** : Noise in photodetectors, WDM optical Components

**Week 09** : Analog and digital optical communications, Direct detection receivers

**Week 10** : Coherent detection, Noises, Comparison of direct and coherent detection

**Week 11** : DSP algorithms for coherent optical communications

**Week 12** : Multiplexing techniques in fiber-optic communications



# MICROWAVE ENGINEERING

**PROF. RATNAJIT BHATTACHARJEE**

Department of Electrical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic course of Electromagnetic Theory

**INTENDED AUDIENCE** : B. Tech/BE (Third/Fourth year ECE) students

**INDUSTRIES APPLICABLE TO** : DRDO, ISRO, BEL, SAMEER and other companies working in the area of RF and Microwave

**COURSE OUTLINE :**

This course intends to provide a foundation for microwave engineering to the undergraduate students. Rigorous treatment of the fundamentals of microwave engineering will be provided. Design of different passive and some active microwave circuits/subsystems will be covered in detail. This course will also provide an overview of application of microwave in communication and other areas.

**ABOUT INSTRUCTOR :**

Prof. Ratnajit Bhattacharjee received his B.E. in Electronics and Telecommunication Engineering from Guwahati University, M.Tech in Microwave Engineering from IIT Kharagpur and Ph.D from Jadavpur University, Kolkata. Presently, he is a Professor in the Department of Electronics and Electrical Engineering, IIT Guwahati. His research interest includes Wireless communication, Wireless networks, Microstrip antennas, Microwave Engineering and Electromagnetics. Eleven research students have completed their PhD under his supervision. He has co-authored about one hundred and forty research papers and has developed a web course on Electromagnetic Theory under the NPTEL project. He is also involved with the on-going mission project on Virtual Labs as coordinator of EE discipline laboratories and Institute coordinator for IIT Guwahati.

**COURSE PLAN :**

**Week 1:** Introduction to Microwave Engineering and Transmission line theory

**Week 2:** Rectangular and Circular waveguides

**Week 3:** Microwave Networks and Scattering Matrix

**Week 4:** Impedance Matching

**Week 5:** Microwave Resonators

**Week 6:** Power divider, directional couplers and filters

**Week 7:** Microwave Semiconductor Devices

**Week 8:** Microwave Amplifiers and Oscillators

**Week 9:** Microwave Tubes

**Week 10:** Ferrite devices

**Week 11:** Introduction to Microwave Integrated Circuits (MIC)

**Week 12:** Microwave Communication Systems and other application areas



# ELECTRICAL MACHINES

**Prof. G. BHUVANESWARI**

Department of Electrical Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Electrical Engineering, Circuit theory

**INTENDED AUDIENCE** : UG students and instructors

**INDUSTRIES APPLICABLE TO** : Machines manufacturing and drives manufacturing industries like Kirloskar, ABB and Siemens

## **COURSE OUTLINE :**

The course introduces Electrical Machines - namely Transformers, DC and AC rotating machines, which are, arguably, the most important components of energy and power conversion industry. Transformers, being static, are the easiest of electrical machines and hence they will be dealt with initially after introducing magnetic circuit fundamentals. DC and AC machines will be discussed after understanding the process of electromechanical energy conversion through a magnetic field. The efficiency, voltage regulation and characteristics of these machines will be discussed while they are functioning as generators. Further, their speed-torque characteristics, starting, braking, speed control and efficiency will be discussed while they function as motors. Every topic will include their applications in various power industries as well.

## **ABOUT INSTRUCTOR :**

Prof. Bhuvaneswari has been working as a faculty member in the Department of Electrical Engineering IIT Delhi since 1997. She completed her University and obtained PhD from IIT Madras. She worked as a lecturer in College of Engineering, Madras after which she was working for the electric utility company ComEd in Chicago, IL, USA before joining as a faculty member in IIT Delhi. She has more than 150 international and National journal and conference papers to her credit. She is Fellow of IEEE-USA, IET-UK, IETE, IE(I) and a life member of ISTE. Her areas of interest are power electronics, electrical machines, drives, power quality, power conditioning and renewable energy.

## **COURSE PLAN :**

**Week 1** : Introduction to Electrical machines

**Week 2** : Magnetic circuits and flux calculations

**Week 3** : AC circuits & Magnetic Circuits

**Week 4** : Transformers

**Week 5** : Single-phase and Three-phase transformers

**Week 6** : Electromagnetic energy conversion principles

**Week 7** : DC machines: Generators and motors

**Week 8** : 3-phase induction machines

**Week 9** : Single-phase induction motor

**Week 10**: Problems on DC Generators and motors

**Week 11**: Single-phase induction motor

**Week 12**: Three-phase Synchronous Machine



# **HUMANITIES & SOCIAL SCIENCES**





# HUMANITIES & SOCIAL SCIENCES

## 04 weeks

01. Body language: Key to professional Success
02. Artistic Exploration in Scientific Research And Technology
03. Population Studies
04. Inclusion and Technology Design
05. Water, Society and Sustainability
06. Psychology of Everyday
07. The Victorian Gothic Short Story
08. Cognition, Transformation and Lives
09. Gender Justice and Workplace Security
10. Visual Perception and Art: A Survey Across the Cultures
11. Patent Drafting For Beginners

## 08 weeks

01. Technical english for engineers
02. Interpersonal Skills
03. Developing Soft Skills and Personality
04. Ethics in Engineering Practice
05. Energy Economics And Policy
06. The Psychology Of Language
07. Introduction to Japanese Language and Culture
08. Intermediate Level of Spoken Sanskrit
09. Disability Studies: an introduction
10. Development Research Methods
11. Folk And Minor Art In India
12. Consumer Psychology
13. Positive Psychology

## 12 weeks

01. Soft skills
02. Appreciating Linguistics: A typological approach
03. Applied Linguistics
04. History of English Language and Literature
05. Indian Fiction in English
06. Short Fiction in Indian Literature
07. German - II
08. German-I
09. Text, Textuality and Digital Media
10. Introduction to Film studies
11. Patent Law For Engineers And Scientists



# BODY LANGUAGE: KEY TO PROFESSIONAL SUCCESS

**PROF. RASHMI GAUR**

Department of Humanities and Social Sciences  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**COURSE OUTLINE :**

Body language plays a vital role in all formal contexts. The expanding trend of articulating views through vibrant participation in group discussions, power point presentations, team based tasks, brain storming and interviews, has made a good command over Body Language a mandatory skill. Whereas technical literacy is essential, it is a confident command over body language which gives an edge in today competitive arena. In all professional interactions, your body language is the only window to your attitudes and feelings; and therefore it is always as important as your answers. The aim of this course is to impart sensitivity and precision to students understanding of body language so that in professional settings they can regulate their body language can successfully learn to control their hesitation, anxiety and nervousness to come across as a more confident individual in all formal assessment situations.

**ABOUT INSTRUCTOR :**

Professor Rashmi Gaur teaches courses of Communication, Culture, Gender Studies and Media (Film and Literature) at IIT Roorkee. In her career, spanning three decades, she has guided about 12 Ph.D. theses, published four books, more than ninety research papers in national and international journals, besides participating in many conferences in India and abroad. She also runs consultancy projects in related areas and formed strong inter cultural networks through international collaborations. She is also a member of several academic bodies. At present she is working in the area of Media, Digital Humanities and Professional Communication.

**COURSE PLAN :**

**Week 1:** Defining Body Language, Scope and Relevance, Changing Contours, Classification, Defining Proxemics, Four Zones, Behavioral Connotations, Space and Designs, Haptics and its Role, Behavioral Significance

**Week 2:** Shaking Hands and other tactile behavior. Cultural Variations, Occulesics, Right and Left Brain Associations, Different Types of Eye Contact, Individual and Group situations, Facial Expressions, Smiles and Nods, Head Tilts and Inclines

**Week 3:** Facial Expressions, Cultural Interface, Kinesics: Types and Contexts, Negative and Positive Gestures, Hand Movements and Steepling, Understanding Finger Movements, Fidgeting and Ticks

**Week 4:** Paralanguage and Voice Modulations, Chronemics, Chromatics, Cultural and Gender Based aspects, Stereotypes, Body Language: Online Presence and Video Interviews



# ARTISTIC EXPLORATION IN SCIENTIFIC RESEARCH AND TECHNOLOGY

**PROF. BITASTA DAS**

Department of Humanities and Social Sciences  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Interest in Scientific Concepts and creativity

**INTENDED AUDIENCE** : Any stream Under Graduate

**INDUSTRIES APPLICABLE TO** : Folk Art

**COURSE OUTLINE :**

Human-nature interaction exudes various outcomes. One of them is folk arts. Folklore, among all the human sciences, is probably one of the rare fields of inquiry that transcends disciplinary boundaries tying all expressive forms together. It encompasses not just the formal and standardized forms but also the rudimentary and fundamental expressive modes. Folklore is a significant tool to arrive at credible nuances about what it means to be “human” and about human expressive behaviour. In a country like India where majority of the population resides in rural, technologically untouched societies, it is the folk lexicon that gives expression to their worldview. The two domains of knowledge—Science and Art are seemingly different. While the objective of Science is to arrive at absolute truth, for Arts it is aesthetic expressions. This course brings together these two distant domains of knowledge and explores the aesthetics of science through Indian folk art.

**ABOUT INSTRUCTOR :**

Dr. Bitasta Das is presently an Instructor in Undergraduate Programme at Indian Institute Science, Bangalore in the Humanities discipline. She teaches “Ethnographic Methods”, “People and Nature” and a course titled “Mapping India through the Folk Arts”. She has doctoral degree in Cultural Studies from Manipal University and she is a gold medallist from Tezpur University, Assam. Art and Science is an area of work introduced by her at IISc where the students work in the interface of art and science to produce Arte-Facts; songs, dance, play and Painting that has scientific research and technology as its subject. She has many research papers and four books to her credit.

**COURSE PLAN :**

**Week 1:** Science and Art - emergence of the two domains

**Week 2:** Folk art: Theory and perspectives; Understanding the diverse Indian folk art

**Week 3:** Science and Indian folk art: Facilitating a dialogue

**Week 4:** Exploring science through folk arts; Learning to create



# POPULATION STUDIES

**PROF. A. K. SHARMA**

Department of Humanities and Social Sciences  
IIT Kanpur

**TYPE OF COURSE** : New | Core | PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Students of MA in Population Studies, Those opting population studies as an optional paper in sociology, economics, geography etc, IAS/civil services aspirants

**COURSE OUTLINE :**

In social sciences there is huge demand for population studies. At present the subject is taught mostly as an optional paper in different departments such as Sociology, Economics, Geography, Psychology. A few universities and IIPS also offer diploma and masters course in the subject. There is a demand for modular courses among the Administrators, Market research workers, Media communication, and NGO workers. The aim of the course is to equip them with knowledge usually imparted in diploma and masters courses. Thus the course will serve a base for higher degrees such as Ph.D. Aspirants for civil service exams are also expected to benefit from this.

**ABOUT INSTRUCTOR :**

Prof. A.K Sharma is a Professor of Sociology, HSS Department, IIT Kanpur. He has guided about two dozen Ph.D students, several Postdoctoral Fellows, and one M.Tech student. He has taught courses in Statistics, Population, Research methods, sociological theories and sociology.

**COURSE PLAN :****Week 1:** Introduction to population studies

- Population geography,
- Population, ecology population and environment and quality of life
- Population dynamics

**Week 2:** Population growth and development

- Population policies and planning

**Week 3:** Population and family welfare

- Techniques of population analysis
- Population and society

**Week 4:** Statistical techniques in population studies,

- Population growth
- Women Population concepts
- Aging



# INCLUSION AND TECHNOLOGY DESIGN

**PROF. BIDISHA CHAUDHURI**  
**PROF. AMIT PRAKASH**  
IIT Madras

**TYPE OF COURSE** : New | Elective | PG  
**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)  
**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Anybody with a Bachelor's degree in any discipline

**INDUSTRIES APPLICABLE TO** : Companies/organizations engaged in designing digital products for diverse social groups • Companies/organizations interested in leveraging digital technologies to complement their existing delivery channels

## **COURSE OUTLINE :**

There is increasing evidence to suggest that meaningful access to ICTs and capabilities required for their effective use are ensconced in myriad interactions between individuals' skills, social positions and their larger network of social relations. Hence, when we think of an inclusive [digital] society, we need to focus on these issues as important factors shaping people's engagement with ICTs. This course presents a brief conceptual and practical toolkit for combining the technical and social support required for achieving greater inclusion in the design of ICTs. Towards this end, we will look at three axes through which exclusion usually takes place, namely, class, disability and gender. The aim of the course is to highlight the ways in which technologies can become exclusive, how it could impact different segments of the society and how we can think of alternative design principles that will make our ICTs more inclusive.

## **ABOUT INSTRUCTOR :**

Prof. Bidisha Chaudhuri is an Assistant Professor at the International Institute of Information Technology Bangalore (IIITB). She has completed her PhD from the South Asia Institute at the Heidelberg University, Germany. Her research interest includes e-Governance, Public Policy reform, Gender and Development, South Asian politics, Information Communication Technology (ICT) for Development. She teaches undergraduate and graduate courses on social theories and relationship between technology and society.

Prof. Amit Prakash is an Associate Professor at the International Institute of Information Technology Bangalore (IIITB). At IIITB, he is also the Convenor of the Centre for IT and Public Policy and is in the core team of the E-Health Research Centre

## **COURSE PLAN :**

**Week 1:** Introduction: The political nature of technology designs

**Week 2:** Missing Women in Tech: Why lack of female technologists matters for technology design and development? Gender and Technology: Challenges and Concerns ICTs and Gender: Field Concerns and Project Management Critical for Technology Design

**Week 3:** Accessibility Fundamentals I: An Introduction to the Research Agenda Accessibility Fundamentals II: Disabilities, Guidelines, and Laws Designing an Assistive Technology Ecosystem: STEM Education for Visually Impaired Students

**Week 4:** Inclusion in designing ICT for Development projects: Who [should] matter? Digital labour, platforms, and the future of work Conclusion



# WATER, SOCIETY AND SUSTAINABILITY

**PROF. JENIA MUKHERJEE**

Department of Humanities and Social Sciences  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core/elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE:** B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc

**INDUSTRIES APPLICABLE TO** : Bengal National Chamber of Commerce and Industry, Govt. bodies who deal with water.

## COURSE OUTLINE :

The global water scenario is beset by multiple challenges: water availability, severe inequity to water access and entitlements across social and spatial lines, frequent floods and droughts, disputes over corporate control of limited water resources, etc. The world appears to be on track to halve the number of people without access to safe clean water. However, in the urban Global South, this success masks regional and local inequalities and a process of urbanization without infrastructure, which is particularly acute in the growing peripheries of existing cities. Interestingly enough, lessons can be learnt from small-scale community water conservation practices and localized needs-driven initiatives. Within this context, it is important to understand and address water beyond the physical and technical attributes and explore the complex and cyclical processes through which water shapes, and, is in turn shaped by society. The course is located at the intersections across water, technology, science and society towards sustainable future. It combines fundamental theoretical, methodological approaches and empirical case studies to introduce and familiarize students with water-society relationship: the contemporary challenges and prospective potentials.

## ABOUT INSTRUCTOR :

Prof. Jenia Mukherjee is Assistant Professor at the Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur. Her research interest spans across environmental humanities, water political ecology, urban ecology and development studies. In 2013, she was awarded the World Social Science Fellowship by the International Social Science Council. In 2010 and 2015 she received the Department of Foreign Affairs and Trade (DFAT), Government of Australia sponsored Australian Leadership Awards Fellowship (ALAF) for her research on riverine island communities. She had conducted and organized several workshops, conferences and seminars. She had recently organized an AICTE course on Combining hydrology and hydrosocial: Towards comprehensive understanding of river systems at IIT Kharagpur (October 2017). She had published three books (2014, 2018), several articles and book chapters in peer-reviewed journals and edited volumes.

## COURSE PLAN :

- Week 01** : Theme: Introduction: Contexts and frameworks L1: Water-society relationship towards sustainable future L2: Theoretical framework 1: Sociohydrology L3: Theoretical framework 2: Hydrosocial L4: Hydraulic techniques, technological choices and power dynamics L5: 'Small is beautiful: Conserving water, empowering communities
- Week 02** : Theme: Managing water: Statist control, transnational interventions L1: Modern hydrology L2: Floods, dams and 'development' L3: 'Colonial hydrology': Case study India (Part 1) L4: 'Colonial hydrology': Case study India (Part 2) L5: Integrated Water Resource Management: Mainstream and critical perspectives
- Week 03** : Theme: Water and cities L1: Contemporary urbanization and water needs L2: Urban utilities: WATSAN arrangements L3: Lessons from political ecology and environmental history L4: Water justice in third world peri-urban spaces: Case studies from Asia, Africa and Latin America (Part 1) L5: Water justice in third world peri-urban spaces: Case studies from Asia, Africa and Latin America (Part 2)
- Week 04** : Theme: Water conservation techniques and practices L1: Lessons from traditional water harvesting mechanisms L2: Community water conservation practices in Ancient India (Part 1) L3: Community water conservation practices in Ancient India (Part 2) L4: Participatory water management in contemporary India: Challenges and potentials L5: Combining policy-driven and needs-driven initiatives towards water sustainability.





# PSYCHOLOGY OF EVERYDAY

**PROF. BRAJ BHUSHAN AND DR. ALOK BAJPAI**

Department of Humanities and Social Sciences  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | Both  
**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)  
**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Perusing UG/PG in Psychology, Psychiatry, Psychiatric Social Work, Psychiatric Nursing, etc.

**INTENDED AUDIENCE** : Anyone interested in mental health issues

**INDUSTRIES APPLICABLE TO** : Institutions offering MA/MSc/MPhil in clinical/ guidance &counseling/mental health programmes

## COURSE OUTLINE :

This course picks-up threads from the basic observed behavior in everyday life and enters into a dialogue facilitating self-reflection and thus better self-understanding. The emphasis is on what a common man observes and how the knowledge of psychology and psychiatry can be applied to it for better clarity.

## ABOUT INSTRUCTOR :

Professor Braj Bhushan is a Professor of psychology at IIT Kanpur.  
Dr. Alok Bajpai is a Consultant Psychiatrist at Kanpur.

## COURSE PLAN :

- Week 1:** Introduction to clinical psychology Introduction to psychiatry Understanding behaviour- I  
Understanding behaviour- II Revisiting normal-abnormal dilemma- I
- Week 2:** Revisiting normal-abnormal dilemma- II Revisiting normal-abnormal dilemma- III Revisiting  
normal-abnormal dilemma- IV Issues confronting the young adults- I Issues confronting the  
young adults- II
- Week 3:** Issues confronting the young adults- III Issues confronting the young adults- IV Mental health  
issues of adults- I Mental health issues of adults- II Mental health issues of adults- III
- Week 4:** Mental health issues of adults- IV Mental health issues of child & adolescents- I Mental health  
issues of child & adolescents - II Mental health issues of child & adolescents - III Mental health  
issues of child & adolescents - IV



# THE VICTORIAN GOTHIC SHORT STORY

**PROF. DIVYA A**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : UG, PG students of English Literature

**INDUSTRIES APPLICABLE TO** : British Council, American Embassy

**COURSE OUTLINE :**

The course offers a specialized study of the Victorian Short Story in relation to the Gothic mode. It will introduce students to the form as it was practised in Great Britain by great masters of literature such as Charles Dickens, Rudyard Kipling, Oscar Wilde and H.G.Wells. This course highlights the fact that the Gothic short story was an important and flourishing literary genre in the Victorian period.

**ABOUT INSTRUCTOR :**

Divya A is an Assistant Professor in English Literature in the Indian Institute of Technology Madras, India. Her research interests primarily revolve around explorations in the fields of gender, domesticity, spatiality, urbanism, and the interplay between the visual and the literary arts. After obtaining her Master of Studies degree in Early Modern English Literature from the University of Oxford, Divya completed her PhD in Nineteenth-Century English Fiction at Nanyang Technological University. She has published on Charles Dickens, Elizabeth Gaskell, Wilkie Collins, and the Pre-Raphaelites. Her current research project traces and maps the British colonial visual culture of Nineteenth-Century India.

**COURSE PLAN :**

**Week 1:** Charles Dickens, The Haunted Signal Man (1866)

**Week 2:** Rudyard Kipling, My Own True Ghost Story (1888)

**Week 3:** Oscar Wilde, The Happy Prince (1888)

**Week 4:** H.G.Wells, The Red Room (1896)



# COGNITION, TRANSFORMATION AND LIVES

**PROF. ALOK BAJPAI**

Psychiatrist  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG  
**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, Ph.D

**INDUSTRIES APPLICABLE TO** : Motivational and Self-help programmes

**COURSE OUTLINE :**

This course addresses anyone who is interested in change, not the temporary change, but transformation at a deeper, sustained level; whether individual or collective. The course is structured to provide a basic knowledge of Psychology and Neuroscience before using a narrative biography of Mahatma Gandhi to elucidate the process of transformation. It does not look at Mahatma Gandhi's politics rather at the Man who left behind a model of transformation. We posit it in a scientific analysis here.

**ABOUT INSTRUCTOR :**

Prof. Alok Bajpai has been trained in Psychiatry at National Institute of Mental health and NeuroSciences (NIMHANS) Bangalore. He did his DPM, MD and is currently practicing at Kanpur and is also the Psychiatrist with Counselling cell, IIT Kanpur. His research interest are in Physics of Brain, Sleep and EEG.

**COURSE PLAN :**

**Week 01** : Why Do people do what they do?

**Week 02** : Where is the mind?

**Week 03** : Understanding Transformation

**Week 04** : Gandhi's process of transformation.



# GENDER JUSTICE AND WORKPLACE SECURITY

**PROF. DIPA DUBE**

Department of Humanities and Social Sciences  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech

**INDUSTRIES APPLICABLE TO** : Some aspects of this course is of key interest to companies since they are statutorily required to set up Internal Complaints Committee on Sexual Harassment and enumerate internal procedures for the same.

## COURSE OUTLINE :

The issue of gender justice has been a matter of discussion and deliberation, both at the international and national levels. With the increased participation of women in all walks of life, particularly at the workplace and the breaking of hitherto social, political and religious gender barriers, the issue has assumed significance and become subject-matter of debate at all levels including law. Today, women are donning multiple roles, apart from being a homemaker- they are working as top executives in MNCs, working as legislators in State and Central legislatures, working as educators in the education sector, etc. While the changed societal matrix & perception and economic globalization have made way for the increased participation of women, the concern over the free play of discriminatory attitudes and prejudicial mindsets often pose challenges to women and targets of multi-facet retaliations and disincentives. The incident of Nirbhaya in the Capital of the Nation not only exhibits how such treatment is basically an anathema to the concept of gender justice but also exposes the barbaric mindset annihilating the values of basic civilization. The days of yore when women were treated as fragile, feeble, dependent and subordinate to men, should be a matter of history.

## ABOUT INSTRUCTOR :

Prof. Dipa Dube has been pursuing her career as an academic for over a decade. Having completed her LL.M. and Ph.D from the Universities of Pune and Calcutta, Dr. Dube has been involved in teaching courses in Criminal Laws, Criminology, Penology, Evidence etc. in reputed Institutes of India such as NUJS, Kolkata and NLU Jodhpur. Presently, she is working as an Associate Professor at the Rajiv Gandhi School of Intellectual Property Law, IIT Kharagpur. She has many books and articles to her credit. She has attended several National and International Conferences and delivered lectures on invitation at various national institutions including State Judicial Academy. She has also undertaken research projects in diverse areas of criminal law, disability, gender justice etc. funded by Government agencies.

## COURSE PLAN :

**Week 01** : Introduction to Gender Justice- Notion and Significance

**Week 02** : International and Constitutional Perspectives on Gender Equality

**Week 03** : Protection of Women at Workplace

**Week 04** : Gender Violence- Within and Beyond



# VISUAL PERCEPTION AND ART: A SURVEY ACROSS THE CULTURES

**PROF. SOUMIK NANDY MAJUMDAR**

Department of History of Art  
Visva Bharati University

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BFA, MFA (Fine Arts), B.Des, M.Des., B.Arch, M.Arch, UG and PG Courses on Cultural Anthropology, Social Sciences, Film & Animation

**INDUSTRIES APPLICABLE TO** : Universities and Academic Institutions that teach and research in Visual Arts & Cultural Anthropology; Museums and Art Galleries that deal with visual arts.

**COURSE OUTLINE :**

The central concern of this course is to explore the complex and dynamic relationships between our visual perception and art in the context of specific visual cultures. As far as the various forms of art-object are concerned within the context of specific visual culture, visual perception varies in the most dynamic and complex ways. This course offers a survey across the global culture to study this variety of relationships and how visual perception operates as a creative process affecting deeply the concepts and styles of art. This survey will also provide us with vital clues to understand why visual artists across the globe perceive visual phenomenon so differently from each other.

**ABOUT INSTRUCTOR :**

Prof. Soumik Nandy Majumdar is an Assistant Professor at Visva Bharati University, Santiniketan in the department of History of Art, Kala Bhavana (The Institute of Fine Arts & Crafts). Prof. Majumdar has taught as a Visiting Faculty at IIT- Kanpur, in the discipline of Fine Arts, under the Department of Humanities and Social Sciences. He completed his BFA and MFA in History of Art from Santiniketan and M.S.University, Baroda respectively. He is involved in teaching art history, conducting courses on art-appreciation, art criticism, art curating and researching on art - education.

**COURSE PLAN :**

**Week 01** : Introduction to Visual Perception

**Week 02** : Visual Perception and Visual Communication

**Week 03** : Visual Perception and Visual Culture

**Week 04** : Visual Perception and Modern Art

# PATENT DRAFTING FOR BEGINNERS

**PROF. FEROZ ALI**

Chair Professor on intellectual property rights  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRY SUPPORT** : Law Firms, LPOs, knowledge-based industries etc

**INTENDED AUDIENCE** : Anyone interested in patent drafting

**COURSE OUTLINE :**

Patent specifications — the documents which encompass the patent right in a technological invention - are techno-legal documents created at the interface of science and law. Unlike technical writing, patent law requires drafting patent specifications to satisfy certain requirements. This course is designed to enable beginners without any prior knowledge on patent drafting to draft patent specifications on their own. The course will cover the fundamental principles of patent drafting and discuss in detail the concepts in patent law in the context of patent drafting.

**ABOUT INSTRUCTOR :**

Prof. Feroz Ali, is the Chair Professor on Intellectual Property Rights (IPR) at the Indian Institute of Technology (IIT) Madras. He teaches intellectual property laws and business laws. He is the author of three books on patent law. He is a practicing advocate at the Madras High Court. He litigates and counsels in intellectual property law, corporate law and competition law but his primary focus has remained in patent law. He has appeared before the Supreme Court, the High Courts, Intellectual Property Appellate Board and the Patent Offices.

**COURSE PLAN :**

**Week 1** : Invention as a solution to an unsolved Problem

**Week 2** : Drafting a Claim

**Week 3** : Types and Arrangement of Claims

**Week 4** : Structure of the Patent Specification





# TECHNICAL ENGLISH FOR ENGINEERS

**PROF. AYSHA IQBAL**

Department of Humanities & Social Sciences  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**COURSE OUTLINE :**

The course covers all the areas of grammar necessary for the undergraduate students of engineering sciences. This includes topics such as reading/writing/listening comprehension, note taking, summarizing, report writing, along with elements of grammar and vocabulary. The course is designed for self-study, where participants will be required to solve regular quizzes and assignments, and can also be used as an add-on to classroom teaching.

**ABOUT INSTRUCTOR :**

Prof. Aysha Iqbal Viswamohan is Professor in the Department of Humanities & Social Sciences , IIT Madras. She has an M.Phil in English language teaching and a Ph.D in Drama. She has published widely in the areas of language, popular culture and literature.

**COURSE PLAN :**

**Week 1** : Listening, Listening/Reading Comprehension

**Week 2** : Dictation; Notemaking

**Week 3** : Speaking; Using words in context

**Week 4** : Use of formal expressions and usages

**Week 5** : Formal presentations (organizing data and slide preparation)

**Week 6** : Reading; Skimming through the text; Scanning

**Week 7** : Writing ; Grammar; Introduction to elements of academic writing

**Week 8** : Report Writing; Resume writing; Project Proposal writing



# INTERPERSONAL SKILLS

**PROF. SMITA JHA**

Department of Humanities and Social Sciences  
IIT Roorkee

**TYPE OF COURSE** : New | Core\_Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Under graduate and post graduate engineering students and post graduate science students

**INDUSTRIES APPLICABLE TO** : Almost all corporate sector employee will value this course including sales professionals, business leaders and educators. This course is useful for students as well as for housewives.

**COURSE OUTLINE :**

The proposed course is a program to enhance personality to deal with the various problems of a professional world. Soft skills are becoming increasingly vital to employers as it has become very competitive to survive in a business world. Be it team spirit, communication skills or being a quick-thinker, expressing and demonstrating the right soft skills can make hopeful applicants stand out from the crowd. This course will also focus on pronunciation so as to make one's speech impressive. To excel in a job one surely needs a repertoire of technical skills. This course has been designed to meet all the requirements.

**ABOUT INSTRUCTOR :**

Prof. Smita Jha is currently working as faculty of English language and literature in the Department of Humanities & Social Sciences, Indian Institute of Technology, Roorkee. She has done M.A. in English (Gold Medalist) from Bihar University, Bihar. She has done Post graduate diploma in teaching English from CIEFL, Hyderabad. Prof. Smita Jha has more than 23 years of teaching experience both at UG and PG level. She has developed course on Neurolinguistics for the first year B.Tech students, She is running Linguistics as elective for the 3rd and the 4th year B.Tech students. She has published more than 50 papers in refereed journals. She has also written books on divers topics like nativization of English prose, partition literature etc. Her research areas are Linguistics, Indian writing in English, World Literature, Contemporary Literary Theory, ELT. She has supervised seven research scholars on various aspects of literature.

**COURSE PLAN :**

**Week 1** : Introduction to Interpersonal skills with pronunciation and communicative skills

**Week 2** : Introduction to Body language as part of communicative skills

**Week 3** : Introduction to group dynamics and group effectiveness and leadership

**Week 4** : Various steps to give a successful oral presentation

**Week 5** : Time Management with Negotiation

**Week 6** : Creativity and Problem Solving Skills

**Week 7** : Stage Freight & Death by PowerPoint

**Week 8** : Making Decision & Emotional Intelligence with Group Discussion



# DEVELOPING SOFT SKILLS AND PERSONALITY

**PROF. T. RAVICHANDRAN**

Department of Humanities and Social Sciences  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, B.Com/M.Com, MBBS, Ph.D

**INDUSTRIES APPLICABLE TO** : All industries/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

## COURSE OUTLINE :

The course aims to cause a basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills.

## ABOUT INSTRUCTOR :

Prof. T. RAVICHANDRAN is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally.

## COURSE PLAN :

- Week 01** : Introduction: A New Approach To Learning, Planning And Goal-Setting, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, Aiming For Excellence: Developing Potential And Self-Actualisation, Need Achievement And Spiritual Intelligence.
- Week 02** : Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Two Solutions, Types of Conflicts: Becoming A Conflict Resolution Expert, Types of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best out of Stress.
- Week 03** : Habits: Guiding Principles, Identifying Good And Bad Habits, Habit Cycle; Breaking Bad Habits, Using The Zeigarnik Effect For Productivity And Personal Growth, Forming Habits of Success.
- Week 04** : Communication: Significance Of Listening, Active Listening, Barriers To Active Listening; Telephone Communication: Basic Telephone Skills, Advanced Telephone Skills, Essential Telephone Skills .
- Week 05** : Technology And Communication: Technological Personality?, Mobile Personality?, E-Mail Principles, How Not To Send E-Mails!, Netiquette, E-Mail Etiquette.
- Week 06** : Communication Skills: Effective Communication, Arising Out Of Sender/Receiver's Personality; Barriers To Communication: Interpersonal Transactions, Miscommunication; Non-Verbal Communication: Pre-Thinking Assessment-1 & 2.
- Week 07** : Nonverbal Communication: Introduction And Importance, Issues And Types, Basics And Universals, Interpreting Non-Verbal Cues; Body Language: For Interviews, For Group Discussions.
- Week 08** : Presentation Skills: Overcoming Fear, Becoming A Professional, The Role Of Body Language, Using Visuals, Reading Skills: Effective Reading, Human Relations: Developing Trust And Integrity.



# ETHICS IN ENGINEERING PRACTICE

**PROF. SUSMITA MUKHOPADHAYAY**

Department of Human Resource Management  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Any interested student

**PREREQUISITES** : Basic understanding of business management

**INDUSTRIES APPLICABLE TO** : Being ethical is an integral part of being a good engineer. So this course will have strong industry support.

**COURSE OUTLINE :**

Engineering as a profession is meant to serve the public by strictly adhering to codes of conduct and placing paramount the health, safety and welfare of public. However it raises few conflicting questions like : who is the public? Does it include future generation? Who decides what is best for public? Do engineers have managerial and technical responsibilities? What is the acceptable risk? Do Engineers have responsibilities towards the environment also? Engineering ethics is the study of moral issues and decisions confronting individuals and organizations engaged in engineering and the study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity. To prepare students for their professional responsibilities as Engineers. To help them recognize and think through ethically significant problem situations that are common in Engineering and to evaluate the existing ethical standards for ENGINEERING Practice.

**ABOUT INSTRUCTOR :**

Prof. Susmita Mukhopadhyay Associate Professor, VGSOM (Ph.D., Calcutta University, Fellow ISI, Kolkata) Susmita Mukhopadhyay's areas of specialization include Human Resource Management and Industrial Psychology, Business Values and Ethics, and Organizational Behaviour. A gold medalist in M.Sc., she is the recipient of the Young Scientist Award and Search of Excellence Award. She was selected for the Microfinance Researchers Alliance Fellow Program Centre for microfinance, Institute of Financial Management and Research, Chennai, in 2009. ing on art - education.

**COURSE PLAN :**

**Week 01** : Introduction to Ethical Reasoning and Engineer Ethics

**Week 02** : Professional Practice in Engineering

**Week 03** : Ethics as Design - Doing Justice to Moral Problems

**Week 04** : Central Professional Responsibilities of Engineers

**Week 05** : Computers, Software, and Digital Information

**Week 06** : Rights and Responsibilities Regarding Intellectual Property

**Week 07** : Workplace Rights and Responsibilities

**Week 08** : Responsibility for the Environment



# ENERGY ECONOMICS AND POLICY

**PROF. SHYAMASREE DASGUPTA**

Department of Humanities and Social Sciences  
IIT Mandi

**TYPE OF COURSE:** New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Any foundational course in Economics

**INTENDED AUDIENCE** : Primarily the graduate students working in the area of energy economics and energy policy domain. This course will also be useful for general audience

**INDUSTRIES APPLICABLE TO** : Power Sector; Energy consulting firms; Renewable Energy production units, Policy makers

## COURSE OUTLINE :

The course deals with understanding energy as a scarce resource, various aspects of energy demand and supply with a focus to policies that are in place to promote renewable energy supply and finally, a much needed discussion on interaction between energy, environment and climate change. The course aims at broadening the vision of students while making any energy related decision as a technology developer, energy manager, entrepreneur, policy maker, researcher in future or simply for personal energy use in day to day activities.

## ABOUT INSTRUCTOR :

Prof. Shyamasree Dasgupta is an Assistant Professor at the School of Humanities and Social Sciences in Indian Institute of Technology Mandi. She is an economist by training. Her teaching and research interest remains in the area of energy, environment, climate change and sustainable development. She obtained Ph.D and M.Phil in Economics from Jadavpur University, Kolkata, India with SYLFF Fellowship. She is a member of several active academic/research networks including International Association of Energy Economics, Indian Society for Ecological Economics, The Indian Econometric Society etc. She is a contributing author in the Industry Chapter of IPCC AR 5.

## COURSE PLAN :

**Week 1:** Energy as a Scarce Resource; Classification, Measurement and Accounting of energy resources

**Week 2:** Energy Demand-Part I- Analyzing past, present and future demand

**Week 3:** Energy Demand-Part II - Demand Side Management and policies

**Week 4:** Energy Demand – Part III - Behavioral issues and energy policies

**Week 5:** Energy Supply- Part I – Economics of non-renewable energy supply

**Week 6:** Energy Supply- Part II- Economics and policies to promote renewable energy supply

**Week 7:** Energy Market

**Week 8:** Energy, Environment and Climate change



# THE PSYCHOLOGY OF LANGUAGE

**PROF.NAVEEN KASHYAP**

Department of Humanities and Social Sciences  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Any one can learn from this course

**COURSE OUTLINE :**

The very basic form of exchanging information between two living beings is termed as communication. A highly developed form of communication is language, which is used mostly by human beings. The present course will introduce the concept of language and the psychology behind the learning and using of language

**ABOUT INSTRUCTOR :**

Naveen Kashyap, Ph.D is as Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advance cognitive process and research methodology to UG and PG students of Guwahati for the past 10 years.

**COURSE PLAN :**

**Week 1:** Communication and Language

**Week 2:** The science of language

**Week 3:** Speech Perception

**Week 4:** Speech Production

**Week 5:** Words

**Week 6:** Sentence structure, Comprehending sentences, Producing sentences, Syntactic rules

**Week 7:** Discourse Conversation, Narratives and references

**Week 8:** Reading and Writing, Cognitive processes in reading and writing





## INTERMEDIATE LEVEL OF SPOKEN SANSKRIT

**PROF. ANURADHA CHOUDRY**

Department of Humanities and Social Sciences  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Knowledge of Sanskrit OR those who have completed the NPTEL course on Introduction to Basic Spoken Sanskrit

**INTENDED AUDIENCE** : This is a language course and therefore it would be relevant for anyone interested

### **COURSE OUTLINE :**

The course gives students a more elaborate foundation of Sanskrit as a living language. It will introduce them to further grammatical structures that will facilitate their understanding of simple texts as well as allow them to use it in daily life. It also seeks to give provide them with a deeper appreciation of the beauty of the different aspects of this language from its sounds to its rich content so that they feel enthused enough to delve further into it.

### **ABOUT INSTRUCTOR :**

Prof. Anuradha Choudry is an Assistant Professor at the Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur. She has an interdisciplinary background in Sanskrit, Yoga, Indian Psychology and is well-versed in various languages. In 2007, she was awarded the Erasmus Mundus Scholarship of the European Union for a MLit in Crossways in European Humanities. She has been a Visiting Faculty for Sanskrit in Ghent University, Belgium, and other Institutions and works closely as an Instructor for Yoga Psychology and Sanskrit and mantras for several organizations worldwide including the European Union of Yoga and the Irish Yoga Association among others. She also had conducted and organized several workshops, conferences and seminars in India and abroad. Her publications include two books on Happiness - Indian Perspectives (2017) and Perspectives on Indian Psychology (2013), several articles and a few book chapters.

### **COURSE PLAN :**

**Week 1:** Introduction: Some Unique characteristics of Sanskrit - Revision of the main features of Part 1 Introduction to Basic Spoken Sanskrit

**Week 2:** Introduction of different declensions in the plural and tenses – 1

**Week 3:** Introduction of different declensions in the plural and tenses – 2

**Week 4:** Practice with various verbs in different moods and tenses, Summary of the Sentence Structures using the plural with different questions

**Week 5:** Introduction of a few more words ending with consonants and their declensions- An Alternative Conjugation of verbs

**Week 6:** Introduction to their different declensions in singular, dual and plural - New verb forms -

**Week 7:** Introduction to Sandhi - Vowel with vowel / Vowel with consonant / Consonant with consonant / Aspirant with vowel or consonant -

**Week 8:** Practice with a variety of word endings, various verbs in different moods and tenses, Summary of the Sentence structures using the plural with different questions



# DISABILITY STUDIES: AN INTRODUCTION

**PROF. HEMACHANDRAN KARAH**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students currently pursuing any degree in Sciences and Humanities, Rehabilitation professionals and Students of special education

**COURSE OUTLINE :**

This is a broad outline on the emerging field of disability studies. Disability studies is an interdisciplinary field cutting across disciplines such as Literature, Political Theory, and Assistive Technology.

**ABOUT INSTRUCTOR :**

Prof. Hemachandran Karah teaches English Literature at the Humanities and Social Sciences Department of IIT Madras. He is interested in researching on themes such as disability, health, the language question, literary criticism, and musicology.

**COURSE PLAN :**

**Week 1:** Introduction Disability Definition: An Evolving Phenomenon, Medical Model of Disability, Social Model of Disability: Part 1&2 Stigma: A Universal Phenomenon, Stigma and Disability

**Week 2:** Key Concepts:, Ableism Part 1&2 Disability Activism, Models of Disability Activism, Dependency, Interdependency

**Week 3:** Key Concepts: Blindness, Blindness as metaphor, Eugenics, Disability Pride, Disability Resilience, Disability Passing

**Week 4:** Disabilities, Ideas and Disciplines: Assistive Technology: An interview with Prof. Madhusudan Rao, Disability and Ethnography: An Interview with Prof. James Staple

**Week 5:** Disabilities, Ideas and Disciplines: Schizophrenia: A Personal Account – An interview with Reshma Valliappan, Autism and the Indian Family: An interview with Dr. Shubhangi Vaidhya

**Week 6:** Disabilities, Ideas and Disciplines: Dyslexia and the Modern University: An Interview with Prof Tanya Titchkosky, Gender and Disability: Interviews with Prof. Anita Ghai and Prof. Nandini Ghosh

**Week 7:** Disabilities, Ideas and Disciplines: The Normal and its End: An interview with Prof. Lenard Davis, Literary Disability Studies: An Interview with Dr. Shilpa Anand, What is Deaf Culture? An Interview with Dr. Michele Friedner,

**Week 8:** Literature, Disability and Health: Disability and Life Writing, Disability and Metaphor, Narrative Medicine, Conclusion



# DEVELOPMENT RESEARCH METHODS

**PROF. RAJASHREE BEDAMATTA**

Department of Humanities and Social Sciences  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : This course is meant for postgraduate students from any discipline who are interested in taking up research in the field of social sciences, with particular focus on the Development Sector. Professionals working in the development sector, or those pursuing Rural Management or Rural Development Courses will also benefit.

## **COURSE OUTLINE :**

This course will provide training in some methodological approaches in Development studies and Development research that will equip the students into applying them in their dissertations or project evaluations. Applied and practice oriented issues in development research methods will be taken up by focusing on the differences in qualitative, quantitative and mixed-methods research. Anyone who is interested in development issues and undertaking development research is encouraged to enroll.

## **ABOUT INSTRUCTOR :**

Prof. Rajashree Bedamatta is currently a Professor in the Department of Humanities and Social Sciences at the Indian Institute of Technology, Guwahati. She completed her PhD from the Social Sciences Division of Indian Statistical Institute. Her thesis focused on food and employment - based social security programmes and their contribution to household level security. Over a period of time, She has developed a keen interest in inter-disciplinary research bordering on the domain of Development Studies and is interested in the socio-economic and policy-oriented studies pertaining to food, education, health, and agrarian markets, within the discipline of Economics.

## **COURSE PLAN :**

**Week 1&2:** Different types of Development Studies: forms of studies and typical research questions; development, research-development work continuum

**Week 3&4:** Development Research Methods: Ethics and Values; Understanding the 'field' and the 'fieldworker'; qualitative development research methods (interviews, focus groups, participatory methods and approaches, diaries and case studies)

**Week 5&6:** Research methods and possible combinations: quantitative methods; mixed methods; interdisciplinary perspectives; problem analysis in logical framework approach

**Week 7&8:** Selected development issues and approaches: evolving approaches in poverty evaluation; gender analysis and approaches to gender mainstreaming; challenges of implementing rights based approaches; social capital assessments



# FOLK AND MINOR ART IN INDIA

**PROF. SHATARUPA THAKURTA ROY**

Department of Humanities and Social Sciences  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Any College / University with Humanities Programme

## COURSE OUTLINE

Indian folk artistry is uniquely recognized all over the world not only for richness of aesthetics but also as indicators of age-old habitual belief. They comprise of tacit knowledge that is protected by passing on through generations. Having said that one must also consider the folk artists as creative individuals with adequate freedom of expression to keep the tradition alive and going. In India, the mainstream academic style of art synergized with the principle of vernacular art and culture to boost 'Nationalistic' idea as well as 'Modernism' since pre-colonial era. (The course traces the journey of an array of indigenous art styles from traditional to contemporary and comments on sustainability of culture through preservation, conservation and paradigm shift.)

## ABOUT INSTRUCTOR

Prof. Shatarupa Thakurta Roy is presently an Assistant Professor jointly with the Department of Humanities and Social Sciences and Design Programme, Indian Institute of Technology Kanpur, India. She has developed and taught several courses in Art and Design. Current areas of research and teaching are History of Art, Art Appreciation and Criticism and Design Theory. She is also a practicing artist with several national and international exhibitions to her credit.

## COURSE PLAN

**Week 1:** Changing definition of Folk and Minor Art; Timeline and Regions: General Mapping; Traditional Roots: Elements and Principles; Timelessness : Primitive Connection; Evolution in Purpose: Ritualistic to Propagative; Contemporary Practice

**Week 2:** Classification and Connections: Traditional Roots; Available literary recourses; Mythical Associations  
Idea of Nationalism in the Context of Folk art; Idea of Modernism In the context of Folk Art; Relevance of the Art Practice

**Week 3:** Contextualization and Decontextualization; Concept of Communication for Social Purpose; Aesthetic Perspective; Secularity and Religious Plurality; Ethnographic perspective on the study of Folk Art and Culture; About the Exponents who brought the culture under the limelight

**Week 4:** Contextualization and Decontextualization; School of Art in Madhubani Painting; Art as a Feminine Preserve vs the Male painters of Madhubani; Yamapata, Pytkar and other art practice of Jharkhand Yamapata by the Jadopatias Sohari Painters and their Art; Patachitra of Bengal and Odisha

**Week 5:** Continuum of the Practice: Ancient Centres and Contemporary; Case study 1 Stylistic Variety in Bengal; Case study 2 Stylistic Variety in Odisha; Case study 3 Stylistic Variety in Andhra Pradesh; Exponents and their Contributions; Hypothesis on Possible Stylistic influences

**Week 6:** Characteristics of Contemporary Collection; Thematic Analysis; Iconic Analysis; Semiotic Analysis; Effect of narratives: Qualitative Evaluation; Individual Expression in Contemporary Art

**Week 7:** Cultural Condition: Colonial and Post colonial Ideologies; Social Formation during Preindependence; New Aesthetics: early Prints and Battala Prints; Artist Block Makers and Hybrid Aesthetics of Urban Folk Art; Kalighat Painting to Haripura Posters: A synergy; Jamini Roy: Accommodating Vernacular Idiom in Academic Practice

**Week 8:** Coexistence and Collaborations with Mainstream Art; Strategies for Future and Sustainability: Vision and Revision; Alternative Context: place of folk art in Contemporary Lifestyle; Ancient literary sources and canonization: Scholarly Comments; Need of Paradigm Shift; Conclusion



# POSITIVE PSYCHOLOGY

**PROF. KAMLESH SINGH**

Department of Humanities and Social Sciences  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**COURSE OUTLINE :**

This course focuses on 'Positive Psychology' (PP) which is a relatively new branch of Psychology that aims to understand, test, discover and promote the factors that allow individuals and communities to thrive. PP is based upon 3 primary concerns: Positive emotions, Positive individual traits, and Positive institutions. This course will introduce the learners to these fundamental aspects of PP, apart from highlighting some of the core PP concepts including – Happiness, Flow, Mindfulness, Optimism, Resilience, Emotional Intelligence, Spirituality and Self-Related concepts (Self-efficacy, Self-esteem, Ideal-self and Real-self, Self-regulation) etc. This course will facilitate to understand positive aspects of human behavior.

**ABOUT INSTRUCTOR :**

Dr. Kamlesh Singh is an Associate Professor of Psychology in the Department of Humanities & Social Sciences, IIT Delhi. Her primary areas of research interest include Positive Psychology and its applications, Psychometrics, and Community Psychology. She has to her credit 85 papers in peer-reviewed National and International Journals, 14 book chapters, and 3 books. Apart from her ongoing teaching and research projects in Positive Psychology, she is also Member, Council of Advisors, International Positive Psychology Association (IPPA). Furthermore, she is the Secretary of National Positive Psychology Association (India).

**COURSE PLAN :**

**Week 1:** Introduction to Positive Psychology

**Week 2:** Research Methods

**Week 3:** Character Strengths and Virtues

**Week 4:** Happiness & Well-Being

**Week 5:** Positive Emotional States and Processes

**Week 6:** Hope, Optimism, Self and related concepts & Resilience

**Week 7:** Flow, Mindfulness, and Spirituality

**Week 8:** Recent Trends and Directions in Positive Psychology



# CONSUMER PSYCHOLOGY

**PROF. NAVEEN KASHYAP**

Department of Psychology  
IIT Guwahati

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Anyone can learn

**COURSE OUTLINE :**

Human beings have basic needs that they fulfill by making transactions in the market. Transactions mostly in the form of monetary exchange for goods and services are very basic for the survival of the human race. The present course is designed to study how consumers behave on the market and what the consequences of various behavior patterns. Additionally, the present course also looks at various psychological factors that shape the behavior and actions of the consumer in the global market.

**ABOUT INSTRUCTOR :**

Prof. Naveen Kashyap, Ph.D is an Associate Professor of Psychology at the Indian Institute of Technology Guwahati. His research interests are sleep and human cognitive processes. Dr Kashyap has been teaching courses like cognitive psychology, introduction to psychology, consumer psychology, advanced cognitive process and research methodology to UG and PG students of IITG for the past 10 years.

**COURSE PLAN :**

**Week 1:** Introduction to Consumer Psychology

**Week 2:** Overview of foundation of consumer behavior.

**Week 3 :** Consumer Decision Making

**Week 4 :** Purchase process and consumption; Consumer learning and brand loyalty

**Week 5 :** Low involvement decision making; Situational influences.

**Week 6 :** The Individual Consumer; Consumer perceptions; Consumer information processing and acquisition

**Week 7 :** Attitudes; Attitude reinforcement and change

**Week 8 :** Marketing Communications.





## SOFT SKILLS

**PROF. BINOD MISHRA**

Professor of English  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BE/B.Sc/B.A, ME, M.Sc./M.A, Ph.D

**PRE-REQUISITES** : Basic knowledge of reading and writing English.

**INDUSTRIES APPLICABLE TO** : Can be useful to all major companies, such as L&T, BHEL, NBCC, NTPC, WIPRO, INFOSYS, and other organizations where HR has a crucial role.

### COURSE OUTLINE :

Soft Skills, a buzz word today has attracted the attention of students, professionals and entrepreneurs all over the world. Employability, being the major concern today, every individual aims at getting coveted jobs. Employability today is commensurate with proving multiple skills in varied situations in a fast changing world. Hence, everyone aspiring for jobs today has to prove one's mettle in various situations where one requires to be armed with different skills, which, collectively come under Soft Skills. One may be armed with good competence of one's subject but one cannot compete with his peer groups unless one has the potential of performance. Performance can be ensured with the demonstration of certain abilities that can help a professional communicate, corroborate, convince, evaluate and look into the continuing as well as the upcoming trends of the corporate world from time to time.

### ABOUT INSTRUCTOR :

Prof. Binod Mishra, Associate Professor of English at IIT Roorkee, Uttarakhand, has a teaching experience of 21 years in different reputed colleges and universities. He has taught courses like Technical Communication Skills, Soft Skills, Language Skills, Modern Drama and Diasporic Literature etc. A Ph.D on the works of Mulk Raj Anand, Mishra has to his credit 20 books (15 edited and 05 authored) on various aspects of English language and literature. A life member of several literary associations, Dr. Mishra is on the editorial advisory board of several reputed journals, BoS member of several universities and two times elected Editor-in-Chief of Indian Journal of English Studies, one of the oldest journals of English language and literature.

### COURSE PLAN :

- Week 01** : Introduction to Soft Skills, Aspects of Soft Skills, Effective Communication Skills, Classification of Communication, Personality Development .
- Week 02** : Positive Thinking, Telephonic Communication Skills, Communicating Without Words, Paralanguage.
- Week 03** : Proxemics, Haptics: The Language of Touch, Meta-communication, Listening Skills, Types of Listening.
- Week 04** : Negotiation Skills, Culture as Communication, Organizational Communication.
- Week 05** : Communication Breakdown, Advanced Writing Skills, Principles of Business Writing, Types of Business Writing.
- Week 06** : Business Writing, Business Letters, Business Letters: Format and Style, Types of Business Letter.
- Week 07** : Writing Reports, Types of Report, Strategies for Report Writing, Evaluation and Organization of Data.
- Week 08** : Structure of Report, Report Style, Group Communication Skills.
- Week 09** : Leadership Skills, Group Discussion, Group Discussion, Meeting Management, Adaptability & Work Ethics.
- Week 10** : Advanced Speaking Skills, Oral Presentation, Speeches & Debates, Combating Nervousness, Patterns & Methods of Presentation, Oral Presentation: Planning & Preparation.
- Week 11** : Making Effective Presentations, Speeches for Various Occasions, Interviews, Planning & Preparing (Part I): Effective Resume, Planning & Preparing (Part II): Effective Resume .
- Week 12** : Drafting an Effective Resume, Facing Job Interviews, Emotional Intelligence & Critical Thinking, Applied Grammar.



# APPRECIATING LINGUISTICS: A TYPOLOGICAL APPROACH

**PROF. ANINDITA SAHOO**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Any bachelor degree

## **COURSE OUTLINE :**

This course appreciates linguistics as an academic discipline that focuses on the understanding of what natural language is and what systematicity of language comparison deals with. Following the typological approach, this course investigates both the structure (form) and usage (function) of language. Because of its focus on the issue of language typology, this course deals with the languages of the world in terms of the grammatical features they have in common.

## **ABOUT INSTRUCTOR :**

Prof. Anindita Sahoo obtained her PhD from the Indian Institute of Technology Delhi. Her PhD thesis analyzes passive constructions in South Asian languages such as Odia, Kharia and Malayalam. Her primary research interests are in Linguistic Typology and Syntax. Her recent publications focus on the typology and grammaticalization of passive and copula constructions. She is also interested in language and communication studies from an acquisition and cognitive processing perspective.

## **COURSE PLAN :**

**Week 1:** Linguistics: Some Fundamental Concepts

**Week 2:** What is Language Typology: Form and Function

**Week 3:** Lexical Typology

**Week 4:** Morphological Typology

**Week 5:** Syntactic Typology

**Week 6:** Phonological Typology

**Week 7:** Semantic Typology

**Week 8:** Pragmatic Aspects of Language Typology

**Week 9:** Typology and Language Change

**Week 10:** Language Universals and Linguistic Typology

**Week 11:** Language Universals and Linguistic Typology (Contd.)

**Week 12:** Drafting Typological Profile of an unfamiliar language with the help of Reference Grammar



# APPLIED LINGUISTICS

**PROF. RAJESH KUMAR**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : BA, MA, B El Ed, B.Ed. PhD

**COURSE OUTLINE :**

Language is an essential part of all that we do. It defines us as humans. This course deals with the applications of theoretical tools in understanding languages and out come of the analyses of theoretical tools. We aim to have delivered the applications of the fundamental ideas of language to the fields such as language teaching and learning, cognitive science, education, and language disorder and disabilities.

**ABOUT INSTRUCTOR :**

Prof. Rajesh Kumar teaches linguistics in the Department of Humanities and Social Sciences at the IIT Madras in Chennai.

**COURSE PLAN :**

**Week 01** : Introduction to Applied Linguistics

**Week 02** : Language Acquisition

**Week 03** : Sounds

**Week 04** : Words

**Week 05** : Sentences Part One

**Week 06** : Sentence Part Two

**Week 07** : Application Part One

**Week 08** : Application Part Two

**Week 09** : Application Part Three - Language Teaching

**Week 10** : Application Four - Language and Disability

**Week 11** : Application Five - Language and Computers

**Week 12** : Application Six - Language and Education



# HISTORY OF ENGLISH LANGUAGE AND LITERATURE

**PROF. MERIN SIMI RAJ**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.A, M.A

**PRE-REQUISITES** : No formal pre-requisites. However, a familiarity with and an interest in English literary studies would be much appreciated. Industry that will recognize this course. The course is best suited for the academic fraternity.

**COURSE OUTLINE :**

This course is a chronological survey of the major forces and voices that have contributed to the development of an English literary tradition. It intends to cover the literary ground from the Old English Period till the mid twentieth century focusing on the emergence, evolution and progress of English language and literature through different ages and periods. The course will showcase major literary moments, movements and events in the context of the social, political, religious and economic changes that shaped England and its history from the 5th century BC onwards. The objective of the course is to enable a critical understanding of the intellectual history of England and to equip the learners to analyse literary products within particular socio-historical contexts.

**ABOUT INSTRUCTOR :**

Prof. Merin Simi Raj teaches in the Dept. of Humanities and Social Sciences at IIT Madras. Her teaching and research interests include literary historiography, Literary Criticism, Indian writing in English, Postcolonial literature and Narratives of marginality.

**COURSE PLAN :**

- Week 01** : Introduction and Old English Period
- Week 02** : Middle English Period and Renaissance
- Week 03** : English Renaissance and Elizabethan Period
- Week 04** : The Age of Shakespeare
- Week 05** : The Restoration Age to Enlightenment
- Week 06** : Augustan Age
- Week 07** : The Romantic Age
- Week 08** : The Age of Wordsworth and Romantic poetry
- Week 09** : The Victorian Age
- Week 10** : The Rise of the Novel
- Week 11** : The Age of Modernism
- Week 12** : The Age of Postmodernism



# INTRODUCTION TO JAPANESE LANGUAGE AND CULTURE

**PROF. VATSALA MISRA**

Department of Human Resource Management  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG/PG 12 weeks

**COURSE DURATION** : (29 Jul'19 - 16 Nov'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Any interested student

**COURSE OUTLINE :**

Japanese Language has been taught as part of the Foreign Language Programme at IIT Kanpur since July 1995. With increasing technical and economic ties between India and Japan, more Japanese companies are doing business in India and vice versa. This gives rise to the urgent need for more Indians to learn at least the rudiments of Japanese for their professional advancement. This course has been designed with the above background and keeping in mind the requirements of Level's 4 & 5 of the 'Japanese Language Proficiency Test', held by Japan Foundation. It focuses on conversational skills and basic training in sentence construction, simple situational conversation, grammatical knowledge and elements of Kanji (Chinese pictograms), and the kana (Katakana and Hiragana) scripts.

**ABOUT INSTRUCTOR :**

Prof. Vatsala Misra is a Professor in Humanities and Social Sciences at IIT Kanpur. She has published in different areas. In this course, the focus is on conversational skills, basic training in sentence constructions and grammatical knowledge.

**COURSE PLAN :**

**Week 1:** Kana scripts

**Week 2:** Chinese characters

**Week 3:** Grammar

**Week 4:** Vocabulary

**Week 5:** Situational conversations and practice drills

**Week 6:** Introduction to the history of Japan and its cultural Aspects

**Week 7:** Video and audio-clips for listening practice

**Week 8:** Daily Japanese Expressions and idioms

**Week 9:** Potential form of verbs; Some proverbs and expressions

**Week 10:** Expressing intent or purpose; Examples from Japanese way of life

**Week 11:** Permission and seeking approval; Basic Kanji

**Week 12:** Filling out simple forms; Conditional form of verbs; Kanji



# INDIAN FICTION IN ENGLISH

**PROF. MERIN SIMI RAJ**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE**

: Rerun | Core | PG

**COURSE DURATION**

: 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE**

: 17 Nov 2019

**INTENDED AUDIENCE** : M.E/M.Tech, M.S, M.Sc, PhD

**COURSE OUTLINE :**

The course intends to provide a comprehensive understanding of fiction written in English in India since its emergence in the 19th century and to introduce the learners to the literary ground covered in major literary histories, anthologies and critical discussions from the 1960s onwards. Apart from a chronological survey, the course will focus on the historical and literary origins of the genre, its political and economic underpinnings, the debates and controversies within the field and the crisis in contemporary literary studies. The objective of the course is also to expose the students to questions of nation, secularism, caste, gender, region and identity inherent in the writings. To enable a more nuanced engagement selected novels will be read and analysed within current critical frameworks such as postcolonialism, feminism, caste studies, historiography studies etc. the new trends in writing and publishing are also discussed in order to give a perspective of the genre in the present century. The pedagogy will include lectures, discussions and presentations by students. The locus of the course will be on peer learning and also on developing the skills for critical enquiry and academic research. The students are expected to read the prescribed novels and critical material.

**ABOUT INSTRUCTOR :**

Prof. Merin Simi Raj teaches in the Dept. of Humanities and Social Sciences at IIT Madras. Her teaching and research interests include literary historiography, Literary Criticism, Indian writing in English, Postcolonial literature and Narratives of marginality.

**COURSE PLAN :**

- Week 01** : Introduction, background and literary history - From Srinivasa Iyengar, M.K.Naik and Arvind Krishna Mehrotra - Questions of language, legitimacy and nationalism - Regional writing vs. writing in English.
- Week 02** : Early novels of the 19th century - Discussions based on Meenakshi Mukherjee's works - the genealogy of Indian novel - Indulekha - Rajmohan's Wife .
- Week 03** : 'Gandhi Novels' of the 1930s-1940s and beyond - From Priyamvada Gopal and Rumina Sethi - Kanthapura - Waiting for the Mahatma .
- Week 04** : Novels of the 1950s and 1960s - dominant themes and traditions – Post-independence writing - Heat and Dust - The Strange Case of Billy Biswas.
- Week 05** : Women and Indian Fiction in English - The question of gender, feminist concerns, the idea of 'home' - Cry, the Peacock - Nayantara Sehgal .
- Week 06** : Post-1980s and Rushdie: Writing the Postcolonial Nation - Midnight's Children - The Shadow Lines.
- Week 07** : Post-1980s and Rushdie: Writing the Postcolonial Nation - Ice Candy Man - The Hungry Tide - Riot.
- Week 08** : The region vs. the nation in Indian Fiction in English - Bombay in IE fiction - Writings from the North East - Tamsila Ao's short stories - "The Remains of the Feast" by Gita Hariharan.
- Week 09** : Caste in Indian Fiction in English - Untouchable - The God of Small Things - A Fine Balance.
- Week 10** : The global market, Booker events and literary canon - The 'Stefanian' writers - Arvind Adiga and Kiran Desai .
- Week 11** : Indian fiction in English in the contemporary.
- Week 12** : 'Other' writings.





# SHORT FICTION IN INDIAN LITERATURE

**PROF. DIVYA A**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, Ph.D.

**INDUSTRIES APPLICABLE TO** : British Council ,American and other Embassies in India

## COURSE OUTLINE :

This course involves the study and analysis of fiction in English from different regions of India. The course will draw upon both short and long fiction. Students will be required to develop an understanding of both 19th century as well as contemporary Indian fiction. The objective of the course is to use literature as a point of entry into the nature of Indian identity and the Indian way of life.

## ABOUT INSTRUCTOR :

Prof. Divya A is an Assistant Professor in English Literature in the Indian Institute of Technology Madras, India. Divya's research interests primarily revolve around explorations in the fields of gender, domesticity, spatiality, urbanism, and the interplay between the visual and the literary arts. After obtaining her Master of Studies degree in Early Modern English Literature from the University of Oxford, Divya completed her PhD in Nineteenth- Century English Fiction at Nanyang Technological University. She has published on Charles Dickens, Elizabeth Gaskell, Wilkie Collins, and the Pre-Raphaelites. Her current research project traces and maps the British colonial visual culture of Nineteenth Century India.

## COURSE PLAN :

**Week 1** : Sivasankaran Pillai "In the Flood"

**Week 2** : Kamala Das "Summer Vacation"

**Week 3** : Rabindranath Tagore "Cabulliwallah"

**Week 4** : Khushwant Singh "Karma"

**Week 5** : Sundara Ramaswamy "Reflowering"

**Week 6** : Premchand "The Chess Players"

**Week 7** : Premchand "The Shroud"

**Week 8** : Ambai, "A Kitchen in the Corner of the House"

**Week 9** : Mulk Raj Anand "The Price of Bananas"

**Week 10** : Ruskin Bond "The Blue Umbrella"

**Week 11** : R.K. Narayan "A Horse and Two Goats"

**Week 12** : Anita Desai "Games at Twilight"



## GERMAN II

**PROF. MILIND BRAHME**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : German I

**INTENDED AUDIENCE** : Anyone interested in learning elementary German

**INDUSTRIES APPLICABLE TO** : Companies / Organisations / Individuals having business / work with Germany, Austria and/or Switzerland

**COURSE OUTLINE :**

German II builds upon German I to help the learner acquire the A level of competence (A1+A2) as per the European Common Language Framework. It is meant to broaden and deepen the learner's understanding of German grammatical structures, further enrich vocabulary to cover all aspects of daily living, and to develop a basic understanding of the German cultural space. Serious learners should be able to get a comprehensive understanding of basic German grammar, and build a good enough vocabulary to be able to articulate themselves in any given daily life situation, and about basic themes of personal interest.

**ABOUT INSTRUCTOR :**

Prof. Milind Brahme has an MA, M Phil and a PhD in German Language and Literature from the Centre of German Studies, JNU. He has been a faculty of IIT Madras since 2003, and has more than 25 years of experience of teaching German Language and Literature in diverse situations and contexts.

**COURSE PLAN :**

**Week 1:** Cooking and cuisine, eating habits, expressing feelings Grammar clauses with because, reflexive verbs, possessive articles with dative

**Week 2:** School and after, subjects, school types Grammar past tense of modal verbs, changing prepositions position and movement

**Week 3:** Media in daily life, film Grammar comparative and superlative, clauses with that

**Week 4:** Festivals and events, invitations and responses Grammar clauses with if, adjective declension

**Week 5&6:** Professions, Work, train travel Grammar Adjective declension, the verb werden

**Week 7:** Learning, presentations, Exams Grammar: Subjunctive, Genitive

**Week 8:** Sports, Fans Grammar: Clauses, Verbs with dative and accusative

**Week 9:** Living, shifting, conflicts at home, pets Grammar : Subjunctive, als and wenn

**Week 10:** Music, Describing pictures Grammar Interrogative what kind of, Indefinite Pronouns, Relative Clauses

**Week 11:** Time Grammar subjunctive, verbs with prepositions, W questions with prepositions

**Week 12:** Festivals, Stereotypes Grammar: Clauses, Relative Clauses



# GERMAN I

**PROF. MILIND BRAHME**

Department of Humanities and Social Sciences  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Anyone interested in learning elementary German

**INDUSTRIES APPLICABLE TO** : Companies / Organisations / Individuals having business / work with Germany, Austria and/or Switzerland

**COURSE OUTLINE :**

German I is meant to be an introduction to the German language and a basic orientation towards Germany (and to some extent Austria and Switzerland). Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of Germany as a cultural space are the overall objectives of the course. Serious learners should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

**ABOUT INSTRUCTOR :**

Prof. Milind Brahme has an MA, M Phil and a PhD in German Language and Literature from the Centre of German Studies, JNU. He has been a faculty of IIT Madras since 2003, and has more than 25 years of experience of teaching German Language and Literature in diverse situations and contexts.

**COURSE PLAN :**

**Week 1:** Themes: Introducing oneself and others; Grammar: W questions, Personal Pronouns, Simple Sentence, Verb Conjugation

**Week 2:** Themes: Hobbies, The Week, Numbers, The Alphabet, Months, Seasons / Grammar : Articles , plural, the verbs to have and to be

**Week 3:** Theme: In the city / Naming places and buildings, means of transport, basic directions / Grammar : Definite and Indefinite articles negation - kein and nicht imperative

**Week 4:** Themes: food, drink, family / groceries and meals / Grammar : the accusative

**Week 5:** Theme: Everyday life, telling time, making appointments / Grammar : prepositions am, um, von.bis modal verbs, possessive articles

**Week 6:** Leisure activity, celebrations / Grammar: separable verbs, the accusative, past tense of to have and to be

**Week 7:** Contacts, writing letters / Grammar: dative

**Week 8:** My apartment, rooms, furniture, colours / Grammar: changing prepositions

**Week 9:** Professions / Grammar : perfect tense

**Week 10:** Clothes / Grammar: perfect tense and dative

**Week 11:** Health and the body / Grammar: The Imperative and Modal verbs

**Week 12:** Holiday and Weather



# TEXT, TEXTUALITY AND DIGITAL MEDIA

**PROF. ARJUN GHOSH**

Department of Humanities and Social Sciences  
IIT Delhi

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Undergraduates: Those interested in studying the history of the book and the onset of digital media

**COURSE OUTLINE :**

The emergence of digital means of communication and representation is transforming the way human beings assimilate and engage with knowledge. To understand this process, this course will help to understand the evolution of language, narratives and representation through the history of technologies of communication – oral, written, print and the digital. It will explore concepts of Copyright, Censorship, Authorship, Nation Formation. Students would engage in debates surrounding Blogging, Facebook, Google, Twitter, Instagram, Video games, Wikipedia and other forms of Electronic texts. Students who have already completed a Literature course are likely to benefit from the experience.

**ABOUT INSTRUCTOR :**

Prof. Arjun works on the Politics of performance and Mobilisation, Copyright and Intellectual property, New media and the Internet. He was formerly a Fellow at the Indian Institute of Advanced Study, Shimla and currently teaches at IIT Delhi. He is the author of *A History of the Jana Natya Manch: Plays For the People* (Sage, 2012) and *Freedom from Profit: Eschewing Copyright in Resistance Art* (IIAS, 2014) and an annotated translation of *Nabanna* (Rupa, 2018).

**COURSE PLAN :**

**Week 1:** Understanding Media

**Week 2:** Writing as Technology

**Week 3:** Seeing as writing

**Week 4:** Discovery of Printing

**Week 5:** History of the book

**Week 6:** Print and Nationalism

**Week 7:** Origins of Copyright

**Week 8:** Television and society

**Week 9:** Electronic Literature

**Week 10:** Future of the Book

**Week 11:** Digital Media and the Mind

**Week 12:** Social Media and Search Engines



# INTRODUCTION TO FILM STUDIES

**PROF. AYSHA IQBAL VISWAMOHAN**

Department of Human Resource Management  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 16 Nov 2019

**PREREQUISITES** : Students are expected to be aware of some of the important international cinematic trends, movements and genres as well as filmmakers.

**COURSE OUTLINE :**

The objective of this course is to enable students to understand the language of cinema and to help them recognize significant film movements and theories as well as filmmakers who have shaped the course of world cinema, along with a reading of key cinematic texts.

**ABOUT INSTRUCTOR :**

Prof. Aysha Iqbal Viswamohan is professor of film studies, drama and popular culture in the Department of Humanities and Social Sciences, IIT Madras. Among her several books are Behind the Scenes: Contemporary Bollywood Directors(ed.) Sage: New Delhi, 2017, Post-liberalization Indian Novels in English: Global Reception & Politics of Award London: ANTHEM, 2013. Her books on communication include English for Technical Communication, and English for Nurses and English for the Hotel Industry

**COURSE PLAN :**

**Week 1** : Course Overview ; Cinema & Semiotics ; Cinema & Semiotics Seven (1995); Plot in Cinema ; Conflict as a plot element ; Character as a plot element

**Week 2** : Editing in Cinema ; Montage Jump-cut ; Realism in Cinema ; Colour : Theory & Practice ; Intertextuality Casablanca (1942) ,The Matrix (1999)

**Week 3** : Cinema & Modernism :The Lumiere Brothers ,George Melies, Carl Dreyer , Charlie Chaplin ,Buster Keaton ; Cinema and Modernism :F.W. Murnau , Fritz Lang, Jean Cocteau ,Max Ophuls ;

**Week 4**: The French Masters: Jean Renoir , Robert Bresson , What is a canon? ; Canonical Text : Citizen Kane (1940) , The Godfather (1972/1974)

**Week 5**: The Academy Awards : Case study : My Left Foot (1989) and Daniel Day-Lewis , Method Acting ; Classic Hollywood : The Hay's Code ,The Studio Years , Major film makers , Major film makers ( George Stevens, WilliamWyler, BillyWilder, Elia Kazan, George Cukor ) Melodrama , Major film makers , Melodrama: Cinema of Douglas Sirk

**Week 6**: German Expressionism Film noir : Case study: Otto Preminger's Laura (1944) Neo-noir ; Case study: Martin Scorsese's Taxi Driver (1976)

**Week 7**: Stars as Icons , Case study: The Stardom of James Dean Fandoms ; Cinema and the Counter culture Movement : The Beat Generation ,Woodstock Nation Easy Rider (1968)

**Week 8**: Italian cinema : Italian Neo-Realism ,Italian Masters ; Japanese Cinema : Major Filmmakers , Major Trends ; Auteur Theory in the USA : Andrew Sarris , Alfred Hitchcock

**Week 9**: Auteur Theory in the USA : Alfred Hitchcock as an Auteur Casestudy: Rope (1948) , New Hollywood ,Major filmmakers Major texts , Major filmmakers , Major texts ;The French Connection (1971) - Case study : opening sequence of Mean Streets(1973)

**Week 10**: Newhollywood: Major filmmakers,Major texts , The End of the New Hollywood , George Lucas and Steven Spielberg New Hollywood Auteur: Woody Allen Case study: Manhattan (1979 )

**Week 11**: Cinema and Genres : Dudley Andrews Rick Altman , Gangster as a Genre , Genre Blending and Genre Bending ,Quentin Tarantino's films ; Postmodernism and Cinema : Key Theorists, Linda Hutcheon ,Ihab Hasan , Fredric Jameson , Case study: Face /off (1997), The self-conscious cinema, Natural Born Killers Wag the Dog

**Week 12**: The Western :The Westerns of Sam Peckinpah ,The Myth of the American West , No Country for Old Men (2007) , There Will be Blood (2007)

# PATENT LAW FOR ENGINEERS AND SCIENTISTS

**PROF. FERAZ ALI**

Chair Professor on intellectual property rights  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Background degree in Science or Technology is preferable. Students who enroll for this course may also benefit from the course "Patent Drafting for Beginners"

**COURSE OUTLINE :**

The course shall give an in-depth understanding of patent law to engineers and scientists. This course will help person with a science background to understand the fundamentals of patent law, know the requirements of patentability, learn how to read and interpret patent specifications, analyze patent office procedures and court cases and develop the basic understanding for drafting a patent specification. This course will cover the syllabus of Paper 1 of the Patent Agent Examination conducted by the Intellectual Property Office, Government of India.

**ABOUT INSTRUCTOR :**

Prof. Feroz Ali is the Chair Professor on Intellectual Property Rights (IPR) at the Indian Institute of Technology (IIT) Madras. He teaches intellectual property laws and business laws. He is the author of three books on patent law. He is a practicing advocate at the Madras High Court. He litigates and counsels in intellectual property law, corporate law and competition law but his primary focus has remained in patent law.

**COURSE PLAN :**

**Week 1:** Introduction to the Indian Patent System; Patent Laws as Concepts; Understanding the Patents Act, 1970; Understanding the Patents Rules, 2003; Preliminary Sections; Preliminary Rules; What's New in the Patents (Amendment) Rules, 2016; Easy way to read the Patents Act and Rules

**Week 2:** Patentability of Inventions; Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Person Skilled in the Art

**Week 3:** Patent Specification; Provisional and Complete Specifications; Structure of a Patent Specification—Title, Abstract, Description, Claims, etc.; Reading a Patent Specification—Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting.

**Week 4:** Patent Prosecution: Patent Applications ; Patent Application—Who Can Apply, True and First Inventor, How to Make a Patent Application, What to include in a Patent Application, Types of Patent Applications, Patents of Addition, Dating of Application;

**Week 5:** Patent Prosecution: Publication and Examination - I; Publication of Application; Request for Examination; Examination of Application—First Examination Report

Week 6: Patent Prosecution: Publication and Examination – II

Expedited Examination of Application; Search for Anticipation—Procedure, Withdrawal of Application; Consideration of Report of Examiner

**Week 7:** Patent Prosecution: Powers of Controller; Powers of Controller—Examination Stage, Consideration of report by examiner, Refuse or Amend Applications, Division of Applications, Dating of Application, Anticipation, Potential Infringement; Putting Applications in Order; Amendments during Prosecution

**Week 8:** Patent Prosecution: Opposition; Pre-grant opposition; Post-grant opposition; Wrongful obtaining of invention; Mention of Inventor; Opposition in General.

**Week 9:** Patent Prosecution: Practice at the Patent Office- I; Secrecy Provisions; Grant of Patents; Rights Conferred by Grant; Rights of Co-Owners; Term of Patent; Restoration of Lapsed Patents;

**Week 10:** Patent Office and Patent Prosecution; Surrender; Revocation—Grounds for Revocation; Register of Patents, Patent Office and its Establishment; Patent Agents; Use and Acquisition by Government; Penalties.

**Week 11:** Compulsory Licensing; Compulsory Licensing—Working of Patents, Grounds for Grant of Compulsory License, Revocation; Patent Licensing;

**Week 12:** Patent Enforcement, International Arrangements and Other Miscellaneous Provisions; Intellectual Property Appellate Board; Declaratory Suits, Infringement Suits; International Application—Convention Application, PCT Application, Application Designating India, Multiple Priorities; PCT Timeline; Fees—Application, In Relation to Grant of Patents; Timelines—Application, Examination, Publication etc.





# MANAGEMENT



# MANAGEMENT

## 04 weeks

01. Leadership
02. Cost Accounting
03. Decision-Making Under Uncertainty
04. Business Analytics & Data Mining Modeling Using R Part II
05. Design Thinking - A Primer

## 08 weeks

01. Project Management
02. Marketing research and analysis
03. Practitioners Course In Descriptive, Predictive & Prescriptive Analytics
04. Corporate Social Responsibility
05. The Ethical Corporation
06. Financial Accounting
07. Decision making using financial accounting
08. Economics of Health and Health Care
09. Innovation, Business Models and Entrepreneurship
10. Marketing Management-I
11. Knowledge Management
12. Toyota Production System
13. Educational Leadership
14. Intellectual Property Rights and Competition Law
15. Patent Search for Engineers and Lawyers
16. Business Analytics & Text Mining Modeling Using Python

## 12 weeks

01. Project management for managers
02. Training Of Trainers
03. Management Accounting
04. Financial Derivatives & Risk Management
05. Working Capital Management
06. Data Analysis & Decision Making - III
07. Human Resource Development
08. Performance and Reward Management
09. E-Business



# LEADERSHIP

## PROF. KALYAN CHAKRAVARTI

Department of Management  
IIT Kharagpur

## PROF. TUHEENA MUKHERJEE

Vinod Gupta School of Management  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**INTENDED AUDIENCE** : Both UG and PG course

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

### COURSE OUTLINE :

The concept of leadership has been employed within different context and at different levels of analysis e.g. self-leadership, small-group leadership, organizational leadership and national leadership. The primary purpose of this course is to serve as a catalyst for the students of leadership's thinking and dialogue about leaders and the process of leadership.

### ABOUT INSTRUCTOR :

Prof. Kalyan Chakravarti is an alumnus of IIT Kharagpur, in electrical engineering, in the graduating class of 1963. Thereafter, he received his business management training from IIM Ahmedabad and the Harvard Business School. He has over three decades of corporate experience in prestigious companies – English Electric, Larsen & Toubro and Cable Corporation of India, and a decade of experience in IIT Kharagpur as Dean and Professor of the Vinod Gupta School of Management. In academic life he has taught a wide range of courses – human behaviour, human resources, values and ethics, strategic management and leadership. His current area of interest is change management and organisation development.

Prof. Tuheena Mukherjee's core competency lies in handling issues of emotions in organizations, high performance work systems, and cross-cultural issues in business. Prof. Mukherjee is an industrial psychologist and a certified MBTI Trainer, one of the widely used psychometric assessment tools for training and consultancy world over and used as best practices for organizations world-wide. Prof. Mukherjee uses multiple pedagogic techniques like experimentation and psychometric assessments for training personnel. In corporate life he has a wide range of experience in marketing, manufacturing, human resources, industrial relations, projects, administration and corporate affairs, rising from assistant manager, to executive director and a member of the Board

### COURSE PLAN :

**Week 01** : Introduction to Leadership: Functions; Leadership Roles: Leaders Vs Managers: Theories

**Week 02** : Leadership Styles: Effective Vs Successful Managers; Leadership Styles: Adaptation - Studies / Case: "From Sindhi to Siddhi" (Part - I) Leadership Behaviour: Emergence: Leadership and Trust; Case: "From Sindhi to Siddhi (Part-II)" / Transformation Leadership.

**Week 03** : Leadership Skills: Leadership and Management; Case: The DVC story - A First Person Account Leadership in Action - (Part - I) Competencies and Skills of Leaders: Issues in Organizational Leadership; Case: The DVC Story - A First Person Account, Leadership in Action Part – II.

**Week 04** : Self Regulating - The Key to Institution Building, Framework of institution Building; Case: "Rai Bahadur Mohan Singh Oberoi" (Part - I), Issues in Institution Building; Case: Rai Bahadur Mohan Singh Oberoi (Part-II)



# COST ACCOUNTING

**PROF. VARADRAJ BAPAT**

Department of Management  
IIT Bombay

**TYPE OF COURSE** : New | Core/Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students, Employees, Entrepreneurs

**INDUSTRIES APPLICABLE TO** : Large number of Companies

**COURSE OUTLINE :**

This course discusses the basic concepts of cost accounting and control. The course is designed to help the participants to become intelligent users of cost information for Computing cost of Product/ Process/ Project/ Activity, Controlling and Managing the cost, Decision making like pricing, Make or buy, Profit Planning, Planning and Budgeting.

**ABOUT INSTRUCTOR :**

Prof. Varadraj Bapat has consulting and teaching experience of 25 years in Accounting, Audit and Finance. He has obtained professional qualifications in Chartered Accountancy, Cost Accountancy, and Information System Audit before obtaining PHD from IIT, Bombay. He has authored 6 books and published many research papers in high impact international journals. He has done numerous research projects. He is member of Board of Governors for IIT Guwahati and NIT Manipur. He has been member of NAAC Peer team and MHRD Autonomy team.

**COURSE PLAN :**

**Week 1:** Introduction and Scope of Cost Accounting

Cost classification

Accounting for Direct Costs

Accounting for Indirect Costs, Overhead costs

**Week 2:** Overhead costs, Activity Based Costing Methods

Marginal Costing

BEP and CVP Analysis

**Week 3:** BEP and CVP Analysis cases

Decision making cases

**Week 4:** Budgeting cases Standard Costing and

Variance Analysis Standard Costing cases



# DECISION-MAKING UNDER UNCERTAINTY

**PROF. N. GAUTAM**

Department of Management  
Texas A&M University

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Undergraduate course in Probability (including topics on random variables and expected value); Calculus and Algebra

**INDUSTRIES APPLICABLE TO** : Most industries would find this useful (examples in course are in retail, supply chain and hospitality)

**COURSE OUTLINE :**

We are often faced with situations where we need to make decisions that have implications for personal and institutional goals. When there is uncertainty involved, we could either go with our gut feeling or take an analytical approach by characterizing the uncertainty, defining an objective, and evaluating the risk/payoffs of choices. This course is about the latter and is presented through the usage of example problem instances.

**ABOUT INSTRUCTOR :**

Prof. Gautam is a Professor of Industrial and Systems Engineering at Texas A&M University and has a courtesy appointment in Electrical and Computer Engineering. He received his B. Tech. in Mechanical Engineering at IIT Madras followed by an M.S. and Ph.D in Operations Research from the University of North Carolina at Chapel Hill. Since 1997 he has taught courses in Applied Probability, Stochastic Systems, Queueing Models, decision-making, operations research, and statistics while being on the faculty panel at Pennsylvania State University and Texas A&M University.

**COURSE PLAN :**

**Week 1:** Background and Introduction: Risk, Uncertainty and Variability; Probability, Random Variables and Expectation; Optimization Criteria; Types of decisions

**Week 2:** One-time decisions: Secretary problem; Utility function; Decision trees; TV game shows; Monte Hall problem; Project evaluation

**Week 3:** Repeated decisions: News vendor problem; Buffering to manage uncertainty; Safety stock for inventory; Route planning; Exploration vs. exploitation

**Week 4:** Sequential adaptive decision-making: Strategic and Operational; Stochastic Programming; Simpson's Paradox; Markov decision process



# BUSINESS ANALYTICS AND DATA MINING MODELING USING R - (PART-2)

**PROF. GAURAV DIXIT**

Department of Management studies  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG/ PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRY SUPPORT** : Big Data companies, Analytics & Consultancy companies, Companies with Analytics Division

**PRE REQUISITES** : Basic Statistics Knowledge

**COURSE OUTLINE :**

Objective of this course is to impart knowledge on use of data mining techniques for deriving business intelligence to achieve organizational goals. Use of R statistical computing are included to build, assess, and compare models based on real datasets and cases with an easy-to-follow learning curve.

**ABOUT INSTRUCTOR :**

Prof. Gaurav Dixit is an Assistant Professor in the Department of Management Studies at the Indian Institute of Technology Roorkee. He earned his doctoral degree from the Indian Institute of Management Indore and an engineering degree from Indian Institute of Technology (BHU) Varanasi. Previously, he worked in Hewlett-Packard (HP) as software engineer, and Sharda Group of Institutions as project manager on deputation.

**COURSE PLAN**

**Week 1** : Unsupervised Learning Methods : Association Rules

**Week 2** : Unsupervised Learning Methods : Cluster Analysis

**Week 3** : Time Series Forecasting: Understanding Time Series and Regression-Based Forecasting Methods

**Week 4** : Time Series Forecasting: Smoothing Methods and Conclusion





# DESIGN THINKING - A PRIMER

**PROF. BALA RAMADURAI**

Department of Management  
IIT Madras

**PROF. ASHWIN MAHALINGAM**

Department of Management  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG

**INTENDED AUDIENCE** : General

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRY SUPPORT** : Many industries and institute recognize the need for design thinking - e.g., ICT, manufacturing, sales, marketing

**COURSE OUTLINE :**

The course titled Innovation, Business Models and Entrepreneurship, is designed to give an in-depth understanding on various aspects of innovation, creativity, evolving business models, incubation and entrepreneurship. The course also includes sessions on blue ocean strategy and technology incubation which are proving as game changer in today's competitive scenario. Course also deals with role of IPR and IP management in innovation management. The course is a blend of theory and practice therefore this course does not require any prerequisite and will be useful to understand innovation and its applications in different spheres of development and growth.

**ABOUT INSTRUCTOR :**

Prof. Bala Ramadurai is an independent innovation consultant and professor. He has 3 patents to his credit and 10+ publications in international research journals. He co-founded TRIZ Innovation India (<http://trizindia.org>) and is an Adjunct Professor at Symbiosis Institute of Business Management, India. He has a PhD from Arizona State University, USA, and a B.Tech from IIT Madras, India.

Prof. Ashwin Mahalingam joined the faculty in the Building Technology and Construction Management division of the Civil engineering department at IIT-Madras in 2006. Ashwin received his B.Tech in Civil engineering from IIT-Madras and then proceeded to Stanford University for a Masters in Construction Engineering and Management.

**COURSE PLAN :**

**Week 01** : Introduction to Design Thinking

**Week 02** : Empathize Phase: Customer Journey Mapping

**Week 03** : Analyze Phase: 5-Whys and How might we...

**Week 04** : Phase: Ideation: Free Brainstorming & Make/Test Phase: Prototype



# PROJECT MANAGEMENT

**PROF. RAGHU NANDAN SENGUPTA**

Department of Industrial Management engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E, M.E, M.Sc, Ph.D

**PRE-REQUISITES** : Basic Probability & Statistics Basic Operations  
Research

**INDUSTRIES APPLICABLE TO** : Manufacturing Industry, Chemical Industry, Steel Industry, Cement Industry,  
Service Industry, Industry with well developed SCM, etc.

## COURSE OUTLINE

With the concept of managing Big Projects under costs and time constraints, it is imperative, that people working in manufacturing/process/service industry have a very good understanding of the general and advanced concepts of Project Management. It is with this motivation that this course is designed, to meet the demand in the market from, UG to PG students coming from a variety of fields, be it Engineering or Management. "His research work has been published in journals like Metrika, European Journal of Operational Research, Sequential Analysis, Computational Statistics & Data Analysis, Communications in Statistics: Simulation & Computation, Quantitative Finance, etc. At Indian Institute of Technology Kanpur, INDIA he is a Professor in the Industrial & Management Engineering department and teaches courses like Probability & Statistics, Stochastic Processes & their Applications, Management Decision Analysis, Financial Risk Management, etc. He is also the recipient of IUSSTF Fellowship 2008 and visited Operations Research & Financial Engineering department at Princeton University, USA, ERASMUS MUNDUS Fellowship 2011 to Warsaw University, POLAND, EU-NAMASTE Fellowship 2015 to IST, University of Lisboa, PORTUGAL, DAAD Fellowship 2015 to TU Dresden, GERMANY."

## ABOUT INSTRUCTOR

Prof. Raghu Nandan Sengupta completed his Bachelors of Engineering in Mechanical Engineering from Birla Institute of Technology Mesra, Ranchi INDIA and his FPM (PhD) from Indian Institute of Management Calcutta, INDIA with specialization in Operations Management. His research interests are in Sequential Analysis, Statistical & Mathematical Reliability, Optimization and its use in Financial Optimization.

## COURSE PLAN

**Week 1** : Project Management, Concepts and Definitions; Project Management Cycle

**Week 2** : Risk associated with Projects Decision; Tree Modeling

**Week 3** : Cost Evaluation Techniques in Project Management; GANNT Chart and Precedence Diagrams

**Week 4** : PER, CPM; Project Life Cycles

**Week 5** : Concepts of Scheduling; GERT

**Week 6** : Q-GERT; Critical Chain and Theory of Constraints

**Week 7** : Activity Network Diagram; Resource requirement, Resource constraints, Crashing of Jobs

**Week 8** : Project Control Techniques; Earned Value Project



# MARKETING RESEARCH AND ANALYSIS

**PROF. J.K. NAYAK**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, PhD, MBA

**INDUSTRIES APPLICABLE TO** : All Industries both in Public and Private space, academic institutions and Research organizations

## COURSE OUTLINE :

Marketing research is involved with the linking of the manufacturers, intermediaries and the customers through information. It helps in identifying the recent trends in habits and behaviours of consumers through a research process. Some of the key applications of this study is to create a better product, decide the right price, distribution system and the promotional mechanism to attract customers and make a difference within the competition. It uses research tools in understanding the customer and segmenting the market. Some of the research tools are qualitative and quantitative in nature as well. Some of the frequently used techniques are like focus group study, TAT, projective techniques, regression analysis, factor and cluster analysis, discriminant analysis, structural equation modeling, multidimensional scaling and conjoint analysis etc. and other multivariate techniques.

## ABOUT INSTRUCTOR :

Dr. Jogendra Kumar Nayak is the Assistant Professor in Marketing in the Department of Management Studies, Indian Institute of Technology Roorkee. He is a Ph.D. degree holder from Indian Institute of Technology Kharagpur. He teaches marketing research in both spring and autumn semesters in IIT Roorkee. Alongwith it, he also teaches industrial marketing. He has publications in most of the publishing houses such as Elsevier, Emerald, Sage and Taylor and Francis. His major research areas are in Industrial Marketing, Consumer Behaviour, and Tourism Management. He regularly conducts workshop titled "Data Analysis for Research and Publication" which is attended by participants from educational institutes, Govt. organisations and industry as well.

## COURSE PLAN :

**Week 01** : Introduction to Marketing Research, Defining Research Problem, Developing, Research Approach, Research Design, Qualitative Research.

**Week 02** : Qualitative Research, Projective Technique, Case Study, Descriptive Research, Design, Primary & Secondary Data, Research Error, Measurement & Scaling.

**Week 03** : Scale Development, Questionnaire & Form Design, Causal Research, Experimental Design & Sampling.

**Week 04** : Sampling, Hypothesis Development, Type I & Type II Errors, Data Preparation, Hypothesis Testing.

**Week 05** : Hypothesis Testing, Cross Tabulation, Correlation & Regression, Factor Analysis.

**Week 06** : Factor Analysis, SEM & CFA, Cluster Analysis.

**Week 07** : Cluster Analysis, Discriminant Analysis, Researching Rural Market, International Marketing Research.

**Week 08** : Ethics, Report Preparation, Multi Dimensional Scaling, Conjoint Analysis.



# PRACTITIONERS' COURSE IN DESCRIPTIVE, PREDICTIVE AND PRESCRIPTIVE ANALYTICS

## PROF. DEEPU PHILIP

Department and Design Programme  
IIT Kanpur

## PROF. AMANDEEP SINGH

Department of Industrial and Production Engineering  
NIT, Jalandhar

**TYPE OF COURSE** : Rerun | Elective | UG/PG  
**INTENDED AUDIENCE** : The student should have completed  
fivesemesters of UG Engineering  
or Science program.

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INDUSTRY SUPPORT** : Analytics companies – Mu Sigma, Cisco, EXL analytics, KPMG, Ernst & Young, etc.; Financial  
companies - CapitalOne, SBI Cap, ICICI, Amex, etc.; Banking sector – SBI, UBI, Reserve Bank, HDFC,  
HSBC, Canara Bank, Yes Bank, etc.

## COURSE OUTLINE

Data analytics is a demanding field and industry is looking for potential employees who are having a practitioners approach to data analytics. This course is aimed at providing exposure to various tools and techniques along with relevant exposure to appropriate problems so that the know-how and do-how aspect of analytics, which is required by industry can be fulfilled. The course also aims at introducing various applications with the involvement of real-life practitioners so that appropriate exposure to audience who intend to build a career in this area is possible.

## ABOUT INSTRUCTOR

Prof. Deepu Philip is a faculty of Industrial & Management Engg. Department and Design Programme of IIT Kanpur. He works in the area of Production and Operations, Systems Simulation, Product Life Cycle Management, Unmanned Aerial Systems, and Systems Engineering. He holds bachelor degree in Industrial Engineering with his doctorate in Industrial & Management Engineering from MSU Bozeman. He has both academic and industrial experience with leading organizations of the world. ( He has experience in designing and implementing complex system of systems in different fields including defense, aviation, fertilizer, strategic chemical plants, transportation, banking, automation, health care, energy, and communication.)

Prof. Amandeep Singh Oberoi is working as Assistant Professor in the Department of Industrial and Production Engineering Department, National Institute of Technology, Jalandhar, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has over eight years of industrial and academic experience. (His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metallurgy. He has travelled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international refereed journals.)

## COURSE PLAN

- Week 1** : Introduction to analytics; Differentiating descriptive, predictive, and prescriptive analytics, data mining vs data analytics
- Week 2** : Industrial problem solving process; Decision needs and analytics, stakeholders and analytics, SWOT analysis
- Week 3** : Model and modeling process, modeling pitfalls, good modelers, decision models and business expectations,
- Week 4** : Different types of models – overview of context diagrams, mathematical models, network models, control systems models, workflow models, capability models
- Week 5** : Data and its types, phases of data analysis, hypothesis and data Scales, relations, similarity and dissimilarity measures, sampling process, types of sampling, sampling strategies, error mitigation
- Week 6** : Visualization of numeric data, visualization of non-numeric data, tools available for visualizations  
Hypothesis testing, pairwise comparisons, t-test, ANOVA, Wilcoxon signed-rank test, Kruskal-Wallis test, A/B testing
- Week 7** : Data infrastructure, analytics and BI, data sources, data warehouse, data stewardship, meta data management  
Data and forecasting, super-forecasting, S-curve (lifecycle), moving average, exponential smoothing, error in forecasting  
Linear correlation, correlation and causality, spearman's rank correlation, Linear regression, logistic regression, robust regression
- Week 8** : Hierarchical clustering (Euclidean & Manhattan), k-means clustering, Nearest neighbor, decision trees  
Basics, customer lifetime value, customer probability model, Net promoter score, survival analysis  
Product lifecycle analysis, Ansoff's matrix, competitive map, Fundamentals of simulation, simulation types, Monte-Carlo simulation



# CORPORATE SOCIAL RESPONSIBILITY

**PROF. ARADHNA MALIK**

Department of Management  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/ PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, PhD, MBA

**INDUSTRIES APPLICABLE TO** : All corporate organizations

**COURSE OUTLINE :**

The course introduces participants to the field of Corporate Social Responsibility. The course begins with a discussion on the history of CSR activities, and moves through planning, implementation, evaluation and development of the CSR cycle in profit making organizations. The course concludes with a discussion on how the field of CSR is likely to develop in future.

**ABOUT INSTRUCTOR :**

Prof. Aradhna Malik earned her Masters in Child Development from Punjab University, Chandigarh, India and PhD from University of Denver, USA. She has been serving Indian Institute of Technology Kharagpur as faculty in the School of Management since 2008. She teaches intercultural communication, business ethics and organizational behavior to Undergraduate, Masters and Doctoral level students. Her research and academic interests include, ageing, orality, human technology interaction, intercultural communication, communication disorders, management of public health and neuro linguistic programming (NLP).

**COURSE PLAN :**

**Week 01** : Introduction to CSR: What and Why of CSR.

**Week 02** : Emergence of CSR: History and current scenario.

**Week 03** : Stakeholders: Organization, Government, Society and Regulatory Environments.

**Week 04** : Planning and Implementing CSR activities.

**Week 05** : Evaluating and developing CSR activities.

**Week 06** : Corporate Governance.

**Week 07** : CSR and Sustainability.

**Week 08** : Future Directions.



# THE ETHICAL CORPORATION

**PROF. CHHANDA CHAKRABORTI**

Department of Management  
IIT Kharagpur

**TYPE OF COURSE** : New | Core\_Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Management, Humanities and Social Science, Entrepreneurship, Students from any discipline with interest in contemporary ways of doing business, business professionals, HR Professionals, Business consultancy professionals

**INDUSTRIES APPLICABLE TO** : Tata Group, Wipro Group, Tech Mahindra, ITC Group, Infosys, etc.

**COURSE OUTLINE :**

This foundational course will enable learners understand that 'business as usual' is no longer a viable option in the global business scenario. What is required instead is 'Ethical Corporation'. This course explains how to take a purposeful business to the next level by infusing ethical considerations in the various functional areas of business, to use leading current paradigms in current business scenario, and the established traditions of ethical theories, to drive the discussion why being an ethical corporation is of paramount importance today.

**ABOUT INSTRUCTOR :**

Chhanda Chakraborti (Ph.D, University of Utah, USA, M.A., University of Washington, USA, M.A., Jadavpur University, India) is a Professor of Philosophy in Department of Humanities and Social Sciences, IIT Kharagpur. She has taught MBM students at Vinod Gupta School of Management (VGSOM), IIT Kharagpur for years, as well as Masters in Human Resource Management (MHRM) students, IIT Kharagpur. Under her guidance, several students have done their Ph.D on Corporate Social Responsibility and relevant topics in Ethics. She has developed and taught 8 courses for IIT Kharagpur, which includes Business Ethics course, Business, Society and Ethics course, and Corporate Social Responsibility Course.

**COURSE PLAN :**

**Week 1:** Ethical Corporation: What, why, and how?

**Week 2:** Action guidance: Principles of Normative Ethical theories, Foundations of New Global Paradigms, Citizenship culture, stakeholder engagement

**Week 3:** Managing ethics within the corporation : Formally and Informally

**Week 4:** Virtue of Trustworthiness : Corporate Governance

**Week 5:** Investing in Human Relationships: Employees

**Week 6:** The Responsible Corporation: Natural Environment

**Week 7:** The involved, conversational corporation: Consumers and larger society

**Week 8:** Ethical competition, and keeping supply chain clean and clear





# FINANCIAL ACCOUNTING

**PROF. VARADRAJ BAPAT**

Department of Management  
IIT Bombay

**TYPE OF COURSE** : New | Core/Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students, Employees, Entrepreneurs

**INDUSTRIES APPLICABLE TO** : Large number of Companies

## **COURSE OUTLINE :**

This course discusses the basic concepts of financial accounting and reporting. The viewpoint is that of readers of financial reports rather than the accountants who prepare them.

This course is designed with the following objectives:

- (i) Help the participants to become intelligent users of accounting information
- (a) Understand the basic accounting and financial terminology.
- (b) Understand how events affect firm value
- (c) Understand how financial transactions are recorded.
- (d) Make the participants' comfortable looking through financial statements
- (ii) Develop the ability in participants' to use financial statements to assess a company's performance

## **ABOUT INSTRUCTOR :**

Prof. Varadraj Bapat has consulting and teaching experience of 25 years in Accounting, Audit and Finance. He has obtained professional qualifications in Chartered Accountancy, Cost Accountancy, and Information System Audit before obtaining PHD from IIT, Bombay. He has authored 6 books and published many research papers in high impact international journals. He has done numerous research projects. He is member of Board of Governors for IIT Guwahati and NIT Manipur. He has been member of NAAC Peer team and MHRD Autonomy team.

## **COURSE PLAN :**

**Week 1:** Introduction and Scope of Accounting, Financial Statements, Balance Sheet1& 2 Profit and Loss Account

**Week 2:** Profit and Loss Account(contd), Depreciation 1& 2, Inventory, Valuation1&2,

**Week 3:** Cash Flow Statement1&2, GAAP, AS, IFRS, Recording of Financial Transactions1&2

**Week 4:** Creative Accounting, Window Dressing, Corporate Governance, Global Models in Corporate, Governance, Evolution of Accounting

**Week 5:** Preparation of Balance Sheet 1&2, Balance Sheet Ratios, Preparation of PL account1&2

**Week 6:** Income Statement Ratios, Balance sheet and income statement1&2, Preparation of Cash Flow Statement1&2

**Week 7:** Preparation of Cash Flow Statement3, Cash Flow Ratios, Financial Statement Analysis1&2 Liquidity Ratios

**Week 8:** Leverage Ratios, Profitability Ratios, Return Ratios, Turnover ratios, Recap



# DECISION MAKING USING FINANCIAL ACCOUNTING

**PROF. G ARUN KUMAR**

Department of Management  
IIT Madras

**TYPE OF COURSE** : New | Core | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Graduate

**INTENDED AUDIENCE** : Generic at the PG level

## **COURSE OUTLINE :**

This course aims at developing skills to understand, evaluate and use financial information in business decision making. The course will introduce participants to develop an understanding of the important tools and techniques used in analyzing financial information.

## **ABOUT INSTRUCTOR :**

Prof. G. Arun Kumar is a Professor at the Department of Management Studies, IIT Madras. He does research in the area of finance with specific focus on Corporate Valuation, Corporate Governance, and Development Finance. He has co-authored two books: one on "Management Accounting" with Prof. Robert Kaplan of Harvard Business School and Prof. Atkinson of University of Waterloo and another on "Public perception of security" which encompasses food and health security. He has worked on many development projects related to emerging economies pertaining to financial inclusion, migration and remittances, state and non-state justice systems, etc.

## **COURSE PLAN :**

**Week 1:** Conceptual Basis of Financial Accounting

**Week 2:** Concepts and Interactions of Financial Statements

**Week 3:** Financial Statements: Balance sheet

**Week 4:** Financial Statements: Income Statement

**Week 5:** Accounting Records and Systems Credit and debit Journal and Ledger

**Week 6:** Financial Statements: Cash flow Statement

**Week 7:** Financial Statement Analysis Reading financial statements Financial Ratios

**Week 8:** Accounting Fraud and Governance



# ECONOMICS OF HEALTH AND HEALTH CARE

**PROF. ANGAN SENGUPTA**

Dept. of Management, Amrita Vishwa Vidyapeetham  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.E, M.Tech

**INDUSTRIES APPLICABLE TO** : Public Health Organizations, Hospitals, Allied Healthcare Providers, Pharmaceutical companies, NGO.

## COURSE OUTLINE :

When I was doing my doctoral research in the area of Health Economics several people asked me "What does this Economics in Healthcare mean?" Health economics or Economics of Healthcare is a discipline of economics which is concerned with the association between health status and the related resources assessing the value, behavior, efficiency and effectiveness of various stakeholders in the production and consumption of healthcare. Health Economics has not been studied well in India or in many other developing countries, unlike the developed economies.

## ABOUT INSTRUCTOR :

Dr. Angan Sengupta is an Assistant Professor with the Dept. of Management, Amrita Vishwa Vidyapeetham, Bangalore campus. He has done his PhD in the area of Health Economics and Policy from Maastricht University, The Netherlands. He has post-graduation degrees in Economics from Calcutta University and in Population Studies from International Institute for Population Sciences (IIPS), Mumbai. He has garnered corporate experience working with A.C. Nielsen ORG-MARG, while his research and teaching experience includes various institutes and organizations like, International Institute for Applied Systems Analysis (IIASA), Austria, Indian Institute of Management, Bangalore, Institute of Health Management Research, Bangalore. Dr. Sengupta has worked on various large scale implementation and M&E surveys. Dr. Angan is a recipient of ICSSR doctoral fellowship as well as UGC NET-Junior Research Fellowship. He also earned a fellowship from TIFAC, Ministry of Science and Technology, Govt. of India to conduct a research as a Young Summer Scientist in IIASA, Austria. He has presented research papers in several national and international conferences and public seminars and also published scientific papers in highly reputed national and international journals. His research interests include Population and Health Economics, Economics of Ecology and Natural Resources, Statistics, Demography, and Epidemiology.

## COURSE PLAN :

**Week 01** : Introduction, Consumer Behaviour, Demand and Supply.

**Week 02** : Elasticity of demand and supply, Theory of Production.

**Week 03** : Theories of Cost and Grossman's Demand for Healthcare.

**Week 04** : Market Imperfections, Healthcare Financing.

**Week 05** : Health Insurance.

**Week 06** : Impact Evaluation, Social Determinants of Health.

**Week 07** : Economic Externalities, Public and Private Goods.

**Week 08** : Population, Health and Development.



# INNOVATION, BUSINESS MODELS AND ENTREPRENEURSHIP

**PROF. RAJAT AGRAWAL**

Department of Management  
IIT Roorkee

**PROF. VINAY SHARMA**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**INTENDED AUDIENCE** : B.E, B.Tech, M.E, M.Tech

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INDUSTRY SUPPORT** : All leading companies in area of R & D, technology and business incubators, start-ups, innovation Management.

**COURSE OUTLINE :**

The course titled Innovation, Business Models and Entrepreneurship, is designed to give an in-depth understanding on various aspects of innovation, creativity, evolving business models, incubation and entrepreneurship. The course also includes sessions on blue ocean strategy and technology incubation which are proving as game changer in today's competitive scenario. Course also deals with role of IPR and IP management in innovation management. The course is a blend of theory and practice therefore this course does not require any prerequisite and will be useful to understand innovation and its applications in different spheres of development and growth.

**ABOUT INSTRUCTOR :**

Prof. Rajat Agrawal is a member of faculty (Associate Professor) at Department of Management Studies, Indian Institute of Technology Roorkee, Roorkee. He is also associate faculty member at Center of Excellence for Disaster Mitigation and Management and Center of Excellence for Transportation Management, IIT Roorkee. He administers various initiatives of IIT Roorkee in the field of IPR, incubation and entrepreneurship in different capacities. He initiated incubation centre at IIT Roorkee. He is also IPR Chair Coordinator at IIT Roorkee. Dr. Rajat is a visiting fellow to Copenhagen Business School, Copenhagen, Denmark.

Prof. Vinay Sharma has around 25 years of Experience, in the areas of Marketing, Rural Marketing, International Marketing, Business Opportunity Development, Market Development, Brand Development; IT enabled Services, Spiritual Orientation for Market Prosperity Development and Teaching for past twelve years. One of his recent PhD projects wherein he guided an IFS officer for developing a forest bioresidue briquetting machine to develop a value chain for household energy generation for the forest users of North-West-Himalayan region is in the phase of implementation.

**COURSE PLAN :**

- Week 01** : Analyzing the Current Business Scenario, Innovation and Creativity - An Introduction, Innovation in Current Environment, Types of Innovation, School of Innovation.
- Week 02** : Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent Vs Convergent Thinking, Levers of Idea Management.
- Week 03** : Experimentation in Innovation Management, Idea Championship, Participation for Innovation, Co-creation for Innovation, Prototyping to Incubation.
- Week 04** : What is a Business Model, Who is an Entrepreneur, Social Entrepreneurship, Blue Ocean Strategy-I, Blue Ocean Strategy-II.
- Week 05** : Marketing of Innovation, Technology Innovation Process, Technological Innovation Management Planning, Technological Innovation Management Strategies, Technology Forecasting.
- Week 06** : Sustainability Innovation and Entrepreneurship, Types of Sustainable Entrepreneurship, Conditions for Sustaining Innovation, SME strategic involvement in sustainable development, Exploration of business models for material efficiency services.
- Week 07** : Management of Innovation, creation of IPR, Management of Innovation, creation of IPR, Types of IPR, Patents in India, Copyrights and other important IP.
- Week 08** : Business Models and value proposition, Business Model Failure: Reasons and Remedies, Incubators : Business Vs Technology, Managing Investor for Innovation, Future markets and Innovation needs for India.



# MARKETING MANAGEMENT - I

**PROF. SHASHI SHEKHAR MISHRA**

Department of Industrial and Management Engineering  
IIT Kanpur

**PROF. JAYANTA CHATTERJEE**

Department of Industrial and Management Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | PG

**INTENDED AUDIENCE** : Any one can learn

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : FMCG, Automotive, Chemical, Pharmaceutical, Engineering and Service Industries

**COURSE OUTLINE :**

This is part-I of a course on Marketing Management. The objective of the course is to introduce the participants to principles and practices, theoretical building blocks of marketing, its role as an organizational engine and the evolving marketing process of today. At the end of the course, a participant will be able to understand and manage the core marketing management function.

**ABOUT INSTRUCTOR :**

Prof. Jayanta Chatterjee is Senior Professor of Marketing, Strategy and Innovation in the Department of Industrial and Management Engineering at IIT Kanpur. An Electrical Engineering graduate from Jadavpur University, M.Tech and PhD from IIT Delhi, Prof. Chatterjee has fifteen years of Management teaching experience in India and abroad and 30 years of hands on management experience in different countries.

Dr. Shashi Shekhar Mishra is currently working as Assistant Professor in the Department of Industrial and Management Engineering at Indian Institute of Technology Kanpur since December 2011. Dr. Mishra has received his PhD (Marketing) from Indian Institute of Management, Lucknow. He holds an Engineering degree in chemical technology from H.B.T.I. Kanpur, and has worked for three years in petrochemical and automobile industry before joining the doctoral program at IIM Lucknow.

**COURSE PLAN :**

- Week 01** : Introduction to Marketing: Defining Marketing, Core concepts in Marketing, Evolution of Marketing, Marketing Planning Process, Contemporary Issues and Practices.
- Week 02** : Scanning the Business Environment: The value chain, Core Competencies, Strategic Planning Process, PESTEL, SWOT Analysis.
- Week 03** : Marketing Information System and Marketing Research: Role of Marketing Information, System in Managerial Decision Making Process, Components of Marketing Information systems.
- Week 04** : The Marketing Research Process: An overview, Defining the Management Decision Problem and Marketing Research Problem, Framing Research Objectives and developing the research plan, Exploratory vs. Conclusive Research.
- Week 05** : Consumer Behavior: Consumer Behavior, What Influences Consumer Behavior, Key Psychological Processes, The Buying Decision Process: The Five Stage Model, Other Theories of Consumer Decision Making
- Week 06** : Industrial Buyer Behavior: Concept of Buying Center, Industrial buying process model, Influence of Economic and Behavioral Factors, Influence of Procurement Organization, Role of Negotiation Process.
- Week 07** : Generic Marketing Strategies: Defining Market Segmentation, Bases of segmentation
- Week 08** : Generic Marketing Strategies: Evaluation and Targeting Market Segments, Brand Positioning and Differentiation.



# KNOWLEDGE MANAGEMENT

**PROF. KBL. SRIVASTAVA**

Department of Humanities and Social Sciences  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.E/M.Tech, M.S, M.Sc, PhD, MBA/MBA(HR

**INDUSTRIES APPLICABLE TO** : IT Companies/ R&D Companies/ Pharma Companies/ Manufacturing and Services sector

## COURSE OUTLINE :

The objective of this course is to prepare students to understand the current theories, practices, tools and techniques in knowledge management (KM) to deal with the challenges with the organization and management of knowledge. This course addresses contemporary issues in managing knowledge, intellectual capital and other intangible assets by discussing the fundamental concepts of knowledge and its creation, acquisition, representation, dissemination, use and re-use, the role and use of knowledge in organizations and institutions, KM systems and its application in knowledge generation and transfer, and in the representation, organization, and exchange of knowledge, knowledge codification and system development, its testing, KM tools and portals, and finally ethical, managerial and legal issues in knowledge management.

## ABOUT INSTRUCTOR :

Prof. KBL. Srivastava is Professor, Department of Humanities and Social Sciences and Joint Professor in Vinod Gupta School Management, and specializes in the area of Human Resource Management and Development and Organizational Behaviour at Indian Institute of Technology, Kharagpur. He holds a first class Master's degree in Psychology from Gorakhpur University and Ph.D. from Indian Institute of Technology, Kanpur, and has around 25 years of teaching, research, and training experience. He has taught earlier at BITS Pilani, and T A Pai Management Institute, Manipal, and also served as visiting faculty in XLRI, Jamshedpur (2002), and Asian Institute of Technology, Bangkok (2005), and UNU Tokyo (2013).

## COURSE PLAN :

**Week 01** : Introducing the concept of KM: Why KM, KM system life cycle, and aligning KM and business strategy.

**Week 02** : KM Cycle: Knowledge creation, capturing tacit knowledge, Types of knowledge and its implications for KM.

**Week 03** : Knowledge codification and system development: codification, system testing and deployment, Knowledge transfer and knowledge sharing- the role of culture and structure.

**Week 04** : KM system: Analysis design and development: Knowledge infrastructure, Knowledge audit, and knowledge team.

**Week 05** : KM system : Analysis design and development: Analysis, design and development of KM system.

**Week 06** : KM tools and Portals: inferences from data, data mining and knowledge portals.

**Week 07** : Evaluation of KM effectiveness: Tools and metrics, Ethical, legal and managerial issues.

**Week 08** : KM experiences from Indian companies, KM innovation and Learning organization, The future of KM.





# TOYOTA PRODUCTION SYSTEM

**PROF. RAJAT AGRAWAL**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Production and Operations Management

**INTENDED AUDIENCE** : Industry people who wants to use “operations” for competitive advantage, Students doing research in operations management, Students doing Masters and Bachelors degrees in area of operations management, Industrial engineering etc, Professionals who are interested in knowing the best practices in operations.

**INDUSTRIES APPLICABLE TO** : This course will be highly useful for manufacturing organizations. Particularly companies such as Hero, Maruti, BHEL, Rockman, Bajaj, Tata etc.

**COURSE OUTLINE :**

Manufacturing is one of the important activity for wealth generation. Countries like China, Thailand, Vietnam etc are creating an enabling environment for developing these nations as major industrial ones. Therefore, there is an increasing interest in manufacturing activities. Toyota car company at Japan is a very interesting case study to learn many things to make manufacturing competitive. Toyota consistently raises the bar for manufacturing, product development, and process excellence. The result is an amazing business success story: steadily taking market share from price cutting competitors, earning far more profit than any other automaker, and winning the praise of business leaders worldwide. The proposed course will discuss various aspects of Toyota's approach and will also focus to achieve sustainability through excellence in operations.

**ABOUT INSTRUCTOR :**

Prof. Rajat Agrawal is a member of faculty (Associate Professor) at Department of Management Studies, Indian Institute of Technology, Roorkee. He is also associate faculty member at Center of Excellence for Disaster Mitigation and Management and Center of Excellence for Transportation Management, IIT Roorkee. He administers various initiatives of IIT Roorkee in the field of IPR, incubation and entrepreneurship in different capacities. He initiated incubation centre at IIT Roorkee. He is cocordinator of Design innovation centre at IIT Roorkee.

**COURSE PLAN :**

**Week 1:** Manufacturing output , Operations Systems , Operations Strategy , The Toyota Way: Using operational Excellence as a strategic weapon , The Heart of the Toyota Production System: Eliminating Waste

**Week 2:** The 14 Principles of the Toyota Way: An executive summary of the culture behind TPS, Toyota Way in action, Long Term Philosophy, Create continuous process flow Pull system to avoid over production

**Week 3:** Levelling Workload (Heijunka) , Getting quality right the first time , Standardization of the task , Use of Visual Control , Use of reliable technology

**Week 4:** Role of Leaders in Manufacturing Philosophy, Develop Exceptional Teams , Challenge and respect extended networks , See yourself to understand the situation Developing decisions with consensus

**Week 5:** Become a learning organization, Continuous Improvement , Using the Toyota Way to transform technical and service organizations , Lean Manufacturing, Lean, Agile and Sustainable Manufacturing

**Week 6:** Flexible Manufacturing System , Benchmarkin , Business Excellence Awards, Kanban Approach in manufacturing , Kanban Calculations

**Week 7:** The Significance of Lead Time , Techniques to reduce Lead Time , Cultural issues in Lean , Overview of Lean implementation, Takt Time, Spaghetti Diagram and Value, Stream Mapping

**Week 8:** A critical and comparative analysis of various philosophies , Planning and Goals: Hoshin-Kanri Planning, Constraint Management, Assessment Tools , Lean House



## EDUCATIONAL LEADERSHIP

**PROF. ATASI MOHANTY**

Department of Industrial and Systems Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/ PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.A.in Education/ M.Ed, PG Course, Elective Course

**PRE-REQUISITES** : Graduation

**INDUSTRIES APPLICABLE TO** : All Educational Institutes & Educational Professionals

### COURSE OUTLINE :

In the context of Global, Multicultural & Virtual work environments domain knowledge alone is not a sufficient guarantee for professional success. Since long we have been talking about organizational leadership or corporate leadership. In fact leadership is an adjective mostly attached to the growth of industry. Rarely do we realize the importance of leadership in educational institutions. This course is designed to help the teaching/Academic professionals to understand how educational leadership can transform and enhance the effectiveness of educational institutions. This course intends to focus on academic community and to encourage individual members to develop various skills, competencies, abilities to enhance their leadership skills. It will also help them to develop awareness into their self-motivation, reflective practices, critical thinking and positive plans of actions for enhancing their leadership impact and institutional effectiveness. This course is aimed to mobilize human resources of education sector, educational administration and prospective teachers.

### ABOUT INSTRUCTOR :

Prof. Atasi Mohanty has done her Ph.D. in Educational Psychology from Centre of Advanced Study in Psychology, Utkal University, Bhubaneswar, India. She has also earned her M.Phil. degrees both in Education and Psychology. Prior to joining Centre for Educational Technology, IIT Kharagpur, she was teaching in Visva-Bharati university, Santiniketan. Her area/s of teaching and research interest/s are Educational Psychology, Teacher Education, Mental Health & Human Resource Development. She has also organized Workshops/Seminar/Short Term Courses on Professional Development and Educational Leadership.

### COURSE PLAN :

**Week 01** : Educational Management & Leadership: Issues & challenges

**Week 02** : Professional Development & the Reflective Practitioner

**Week 03** : Professional Ethics & Values in Teaching

**Week 04** : Key Challenges for Educational Leaders: Grooming Capable & Authentic Educational Leaders

**Week 05** : Emotional Intelligence & Educational Leadership

**Week 06** : Leadership for Managing Diversity & Inclusion in Education

**Week 07** : Educational Leadership in a changing World : 21st Century Challenges

**Week 08** : Innovative Pedagogy ,Technology & Turnaround Leadership : The Stakeholders' Perspectives



# INTELLECTUAL PROPERTY RIGHTS AND COMPETITION LAW

**Prof . K. D. RAJU**  
**Prof. NIHARIKA BHATTACHARYA**  
IIT Kharagpur

**TYPE OF COURSE** : New I Elective I UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students from Law, Management and business studies and Technical background can benefit from the program

## **COURSE OUTLINE :**

In the ever evolving technology driven society, the recent conflict between the domain of IPRs and competition law pertains to the exercise of rights in IPR affecting competition law. Therefore, in the light of the above intricacies and problems the course aims to discuss the general principles and laws related to Intellectual Property Right and Competition law, The course also provides an overview of the application and operation of both the laws in different jurisdictions and tries to simplify the overlapping domain of IP and Competition Law.

## **ABOUT INSTRUCTOR :**

Prof. Raju K.D is presently Professor at Rajiv Gandhi School of Intellectual Property Law, Indian Institute of Technology, Kharagpur. His research career began with M.Phil studies at Jawaharlal Nehru University, New Delhi on International Law and further his doctoral studies at JNU.

Prof. Niharika Sahoo Bhattacharya is currently working as an Assistant Professor in Rajiv Gandhi School of Intellectual Property Law, IIT Kharagpur. She has done her doctoral studies in the interdisciplinary area of IPR and biomedicines from IIT Kharagpur. Her broad research interest is to analyze and understand the complexities between scientific innovations, their protection and commercialization. Her other research interest are IP issues in pharmaceuticals, IP and competition law, and Plant variety Protection.

## **COURSE PLAN :**

**Week 1:** Function of IPR. Public good, Incentive theory, different forms of IPR

**Week 2:** Introduction to competition Law, Anti-competitive agreements, Abuse of dominance, Regulation of combinations,

**Week 3:** The relationship and Interaction between IPR and competition law

**Week 4:** The economics of US Antitrust law, IP and competition issues, Technology transfer agreements

**Week 5:** The EU experience with IP and Competition Law

**Week 6:** Market allocation, Horizontal agreements, Vertical agreements, licensing issues

**Week 7:** Indian Competition Act and IPR protection

**Week 8:** Anticompetitive agreement and abuse of dominance in IPR protection, IPR issues in merger and acquisition; Harmonization of IP protection and competition Law in India



# PATENT SEARCH FOR ENGINEERS AND LAWYERS

**PROF. M. PADMAVATI**  
**PROF. SHREYA MATILAL**  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE:** Masters in IP Law, PG Diploma in IP Law  
**INDUSTRIES APPLICABLE TO** : All technical industries, law firms

## **COURSE OUTLINE :**

Patents are legal documents which provide the basis of an invention and the extent to which rights are covered in relation to an invention. Understanding technology trends, gaining an insight into lead technologies, forming a part of literature search before embarking on R&D, determining patentability of an invention, freedom to operate searches before product entry into market are some of the predominant reasons for patent search. The course will help the students/participants to develop skills to conduct patent search and analysis, to develop practical insights into specific types of patent search and to enable understanding of the techno-legal aspects of patent search and analysis

## **ABOUT INSTRUCTOR :**

Prof. M. Padmavati is a Professor at the Rajiv Gandhi School of IP Law. She expertises in Intellectual Property and Commercialization of recombinant and herbal drugs and Drug Regulation, Biodiversity Law. She is the Course Coordinator of the KIRAN-IPR Program at IIT Kharagpur for training women scientists in IPR, patent search.

Prof. S. Matilal, started practising at the Bar of the High Court at Calcutta and Supreme Court of India. He got CALI Excellence for the Future Awarded (Awarded by Centre for Computer Assisted Legal Instruction, Chicago, U.S.A.) for his research work on pharmaceutical data exclusivity. He received Microsoft Outstanding Young Faculty Award in 2009 (Awarded by Microsoft Corporation, U.S.A.) for conducting research on the Application of the DOE in Software Patents.

## **COURSE PLAN :**

**Week 1:** Inventions and Patent Eligibility

**Week 2:** How to read a patent document - Patent Anatomy

**Week 3:** Public search databases - Differences between public search and subscribed database search

**Week 4:** Types of Patent search - I

**Week 5:** Types of Patent search - II

**Week 6:** Analysis of Patent Search

**Week 7:** Patent landscape analysis

**Week 8:** Value of Patent Search and analysis



# BUSINESS ANALYTICS & TEXT MINING MODELING USING PYTHON

**PROF. GAURAV DIXIT**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : UG & PG engineering students: All branches, MBA students, Professionals working in or aspiring for Business Analyst, Data Analyst, Data Scientist, and Data Engineer roles.

**INDUSTRIES APPLICABLE TO** : Big Data companies, Analytics & Consultancy companies, Companies with Analytics Division.

**COURSE OUTLINE :**

Objective of this course is to impart knowledge on use of text mining techniques for deriving business intelligence to achieve organizational goals. Use of Python based software platform to build, assess, and compare models based on real datasets and cases with an easy-to-follow learning curve.

**ABOUT INSTRUCTOR :**

Dr. Gaurav Dixit is an Assistant Professor in the Department of Management Studies at the Indian Institute of Technology Roorkee. He earned his doctoral degree from the Indian Institute of Management Indore and an engineering degree from Indian Institute of Technology (BHU) Varanasi. Previously, he worked in Hewlett-Packard (HP) as software engineer, and Sharda Group of Institutions as project manager on deputation. Gaurav's research focuses on information technology (IT) strategy, electronic commerce, electronic waste, data mining, text mining, and big data analytics and provides insights on business and social value of IT. His research has appeared in quality journals & conferences, including Resources, Conservation and Recycling, Journal of Global Information Technology Management, Sustainable Production and Consumption, Journal of Information Technology Management, ICIS conference, DIGITS conference, India Finance Conference.

**COURSE PLAN :**

**Week 1:** Introductory overview of Text Mining

**Week 2:** Python

**Week 3:** Python for Analytics

**Week 4:** Data Preparation

**Week 5:** Predictive Models for Text

**Week 6:** Retrieval and Clustering of Documents

**Week 7:** Information Extraction

**Week 8:** Conclusion



# PROJECT MANAGEMENT FOR MANAGERS

**PROF. MUKESH KUMAR BARUA**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, PhD

**COURSE OUTLINE :**

Project management is an essential skill-set for many careers and in many contexts in our lives. Project Management is an ideal starting point if you need to manage projects at work or at home, while not necessarily being a formally trained project manager. It is also suitable if you are considering undertaking a project in the near future and are seeking to learn and apply essential project management knowledge and skills.

**ABOUT INSTRUCTOR :**

Dr. M. K. Barua is an Associate Professor at Department of Management Studies, Indian Institute of Technology Roorkee. He is also seconded faculty Asian Institute of Technology (AIT) Bangkok and Defense Engineering College, FDRE's Metals and Engineering Corporation, Ethiopia. Also he is visiting faculty at IIM Sirmaur and IIM Rohtak. His research interest includes Operations management, project management and supply chain management. He has published more than 100 research papers in international journals of repute

**COURSE PLAN :**

**Week 01** : Project Management Fundamentals

**Week 02** : Project life cycle analysis

**Week 03** : Project selection methods

**Week 04** : Capital budgeting techniques

**Week 05** : Risk management

**Week 06** : Risk and technical analysis

**Week 07** : HRM issues in project management

**Week 08** : PERT and CPM

**Week 09** : Probability models in networks

**Week 10** : Crashing of networks

**Week 11** : Cost management and cost control

**Week 12** : Quality and procurement management





# TRAINING OF TRAINERS

**PROF.SANTOSH RANGNEKAR**

Department of Management

IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : MBA/ Industry/ Faculty/Ph D Students

**INDUSTRIES APPLICABLE TO** : Applicable to all Industries

## **COURSE OUTLINE :**

Today Knowledge Management is responsible for new organization structures. Communication and work group technology create virtual organizations and electronic communities. Members of the organization are connected through networks that extend worldwide, allowing people to communicate easily. The challenge for us is to understand the changes and accommodate them at proper requirement. This challenge can be met by understanding creation, storage and distribution of knowledge.

## **ABOUT INSTRUCTOR :**

Prof. S.Rangnekar is presently a faculty in IIT Roorkee. He has conducted more than 100 MDP's for Middle and Senior level Executives of Everest Group, Ambuja Cement, Godrej Industries, Power Finance Corporation, Damodar Valley Corporation, Rajasthan Rajya Vidyut Prasaran Nigam Limited, etc.

## **COURSE PLAN :**

**Week 1:** Introduction Of Training

**Week 2:** Training Techniques and Methods

**Week 3:** Designing Business Game, Drafting questionnaire and making Scale

**Week 4:** Use of Psychometric test, Analysis of Data based on scale

**Week 5:** Discussion and interpretation of data analysis results

**Week 6:** Effective Demonstration of Training

**Week 7:** Personality of Trainer , Developing Trainers Practices

**Week 8:** Trainer & Trainee Relationship ,Effective learning

**Week 9:** The measurement of Learning

**Week 10:** Training for building organizational Culture, Cost Benefit Analysis of Training

**Week 11:** Future Training Methods, Role of Technology in Training

**Week 12:** Training Prospects and Challenges.



# MANAGEMENT ACCOUNTING

**PROF. ANIL K. SHARMA**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : New | Core | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : M.Com, MBA, MFC, CA, ICWA, CS, Working professionals in the area of finance

**INDUSTRIES APPLICABLE TO** : All companies would value this course

## **COURSE OUTLINE :**

Management accounting is a subject of recent origin which has facilitated the managerial decision making more effectively and efficiently. The tools & techniques of management accounting are very useful for strategic managerial decisions facilitating cost control, profit maximization, organizational planning and control. Innovative costing techniques like ABC and responsibility accounting help the business organizations to sustain in a competitive global scenario and expand their product lines and markets. Management control systems help the businesses to use their scarce resources efficiently and effectively and contribute in the maximization of the firm value.

## **ABOUT INSTRUCTOR :**

Dr. Anil K. Sharma an Associate Professor in the Department of Management Studies, IIT Roorkee. He had completed M.Com, M. Phil and PhD in Financial Management from Punjab University Chandigarh. He has been working at IIT Roorkee for the past 16 years and has 22 years teaching experience in total. His area of interest is research in finance and accounting. He has published more than 100 research papers in International and National refereed journals and refereed conferences. He has been awarded best paper award for his paper presented in an international conference in Thailand. He is the chief editor of two International Journals and editorial board member for three International Journals and reviewer to more than twenty International and national Journals.

## **COURSE PLAN :**

**Week 1** : Management accounting

**Week 2** : Preparation of cost sheet, Treatment of stock in cost sheet, Budgeting as tool of Management Accounting - Uses & applications, Different types of Budget - Master budget, Flexible budget & cash budget

**Week 3** : Master Budget

**Week 4** : Master Budget - Case studies, Flexible Budget - Concept, rationale, Uses & applications of Management Accounting - Uses & applications, Different types of Budget - Master budget, Flexible budget & cash budget

**Week 5** : Flexible Budget

**Week 6** : Variance analysis

**Week 7** : Variance analysis - a case study, Marginal Costing - Meaning and rationale, Tools & techniques of Marginal Costing

**Week 8** : Applications of marginal costing in management decision making

**Week 9** : Marginal costing - a case study, Activity based costing (ABC) Concept, Methods/Techniques of ABC, ABC in Manufacturing industry.

**Week 10** : ABC in service industry.

**Week 11** : Management Control system - Tools & Techniques.

**Week 12** : Responsibility accounting : Concept & Rationale, Responsibility centers, Goal congruence managerial efforts and motivation; Controllability and measurement of financial performance, Responsibility accounting in service, Government and non-profit organizations.



# FINANCIAL DERIVATIVES & RISK MANAGEMENT

**PROF. J P SINGH**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basics of finance, Senior school mathematics (algebra, calculus & probability).

**INTENDED AUDIENCE** : The audience would comprise of those desirous of get acquainted with the intricacies of derivatives pricing, their strategizing and their applications as hedging instruments and also, appreciating the nuances that have led to the origin and extensive development of this field of knowledge.

**INDUSTRIES APPLICABLE TO** : Banks, Stock & commodity exchanges, stock & commodity Portfolio managers, Investment bankers, Market regulators etc.

**COURSE OUTLINE :**

Traditional courses on derivatives can be classified almost exclusively into those: (i) that provide a comprehensive coverage of the underlying mathematical models using stochastic calculus and develop the subject as an extension of probabilistic mathematics e.g. mathematical finance and (ii) that cover the theme purely at a superficial level focusing on the operating aspects like exchange trading methodologies, marking and margining aspects etc. They consciously avoid entering the mathematical/stochastic structure that forms the very basis of this course and it covers the pricing and applications of these instruments.

**ABOUT INSTRUCTOR :**

Prof. Jatinder Pal Singh, is a Fellow member of the Institute of Chartered Accountants of India & Institute of Company Secretaries of India, an Associate Member of Institute of Cost Accountants of India & Institution of Engineers (India). He is also a postgraduate in Physics, Mathematics and a graduate in Law & Operational Research. After about 10 years of corporate experience, he joined the Department of Management Studies, IIT Roorkee in 2001. He is presently Professor (HAG) in the said department at IITR. His research interests are in Econophysics, Mathematical finance, Financial risk management, International finance and corporate governance.

**COURSE PLAN :**

**Week 1** : Overview of derivatives

**Week 2** : Hedging & speculation with forwards & futures

**Week 3** : Stock index futures & their applications, Currency forwarders and futures

**Week 4** : Interest rate futures

**Week 5** : Basics of options: Types & characteristics; Bounds on prices; Parity ; American options: Early exercise, Bonds, Parity & Dividends

**Week 6** : Simple trading strategies with combinations of underlyings, Options & forwards; Payoff profiles & functions

**Week 7** : Option pricing

**Week 8** : Markov process and their experience in finance, Convergence of random variables & the distributions and their properties. The binomial model of option pricing ; Single & Multi- Period model, risk neutral valuation. Binomial valuation of American options ; Cox -Rubinstein model

**Week 9** : The Black Scholes Option Pricing Model

**Week 10** : Option Greeks & their relevance in financial engineering; Delta Hedging; Gamma Hedging. Swaps: meaning & types; Valuation of IRS & currency swaps ; Hedging with Swaps

**Week 11** : Introduction to the various measures of financial risk and their mathematical and statistical properties. Basics of credit risk and operational risk in relation to banks and financial institutions

**Week 12** : Value at risk: Empirical and Model based approaches to measurement of VaR for various types of Financial Instruments & Portfolios. VaR & Risk Management.



# WORKING CAPITAL MANAGEMENT

**PROF. ANIL K. SHARMA**

Department of Management  
IIT Roorkee

**TYPE OF COURSE** : Rerun| Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : M.Com, MBA, MFC, CA, ICWA, CS

**INDUSTRIES APPLICABLE TO** : All companies working in any area would value this course.

**COURSE OUTLINE :**

Working capital management has gained the attention of industry and academia as an exclusive area of study after liberalization of Indian Economy. Management of working capital sometimes becomes more important than the management of long term funds because the day-to-day operations of any business largely depend upon this source of finance. Many firms have been seen in the past closing down for the want of short term finance. The profitability of any business to a larger extent is affected by this source of finance due to efficient management of current assets and current liabilities. Hence, learning about managing working capital has become more important and critical in the modern scenario.

**ABOUT INSTRUCTOR :**

Dr. Anil K. Sharma an Associate Professor in the Department of Management Studies, IIT Roorkee is M.Com and M.Phil, First Class First and Gold Medalist and Ph.D. in Financial Management from Panjab University Chandigarh. He is working at IIT Roorkee for the past more than 16 years has more than 22 years teaching experience in total. His area of interest is finance and accounting he has equally goods interest in research in the same area.

**COURSE PLAN :**

**Week 01** : Introduction, meaning, concepts, classification and importance of working capital, Relevance of current assets and current liabilities in the balance sheet, Objectives of WCM.

**Week 02** : Factors determining working capital requirements, Assessment and forecasting of working capital requirements, Assessment and forecasting of working capital requirements, Operating cycle, Weighted Operating cycle

**Week 03** : Relevance of current assets and current liabilities and their inter-relationship, Management of different current assets, Management of Inventory.

**Week 04** : Risk and cost of holding inventory, Inventory management - tools, techniques, Inventory management - tools, techniques, Inventory management - tools, techniques, Inventory management

**Week 05** : models

Inventory management models, Determining stock levels and safety stocks, Types of organizations

**Week 06** : holding inventory, Inventory strategies & techniques, Inventory strategies & techniques.

Cases on Inventory Management, Management of Accounts Receivables, Creation and size of

**Week 07** : accounts receivables, Motives of extending credit, Limitations of A/Rs-Marginal tax considerations

Limitations of A/Rs-Tax considerations, Determining maximum length of credit period, Credit terms,

**Week 08** : opportunity costs, receivables at cost or sale price

Financial statements analysis wrt. A/Rs, Financial statements analysis wrt. A/Rs, Financial, Cash

**Week 09** : management-meaning and concept statements analysis wrt.

Cash flow presentation as per IFRS, NOCF & priority outflows, Management of liquidity-Shiftability

**Week 10** : theory, Liquidity newly defined, liquidity crises 7 firm level action, Measurement of liquidity

Window dressing, Certainty model by Baumol, Uncertainty model by Miller & Orr, Cash flow

**Week 11** : forecasting, Cash collection system.

Management of Accounts Payables, Trade credits-terms of purchase, stretching accounts payables,

**Week 12** : Cost of Stretching A/Ps.

Financing Working Capital Gap, Sources of working capital finance, Bank finance, Tondon and Chore committees on Bank finance.



## DATA ANALYSIS & DECISION MAKING - III

**PROF. RAGHU NANDAN SENGUPTA**

Department of Management  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Probability & Statistics, Operations Research

**INTENDED AUDIENCE** : Masters in Business Administration, Economics, Statistics/Mathematics, Industrial Engineering, Operations Research/Operations

Management, PhD in related fields

**INDUSTRIES APPLICABLE TO** : Manufacturing industry, Chemical industry, Steel industry, Cement industry, etc

**COURSE OUTLINE :**

This is the third part of the three part course (DADM-I, DADM-II, DADM-III) which covers Operations Research and its tools with applications. In general, Decision Analysis and Decision Making (DADM) covers three main areas which are: Multivariate Statistical Analysis with its applications, Other Decision Making Models like DEA, AHP, ANP, TOPSIS, etc., and Operations Research and its tools with applications. This three part DADM course will be more practical and application oriented rather than theoretical in nature.

**ABOUT INSTRUCTOR :**

Prof. Raghu Nandan Sengupta completed his Bachelors in Mechanical Engineering from Birla Institute of Technology Mesra, Ranchi INDIA and his FPM (PhD) from Indian Institute of Management Calcutta, with specialization in Operations Management. His research interests are in Sequential Analysis, Statistical and Mathematical Reliability, Optimization and its use in Financial Optimization. At Indian Institute of Technology Kanpur, India he is a Professor in the Industrial and Management Engineering Department and teaches courses like Probability and Statistics, Stochastic Processes and their Applications, Management Decision Analysis, Financial Risk Management, etc. He is also the recipient of IUSSTF Fellowship 2008 and visited Operations Research & Financial Engineering department at Princeton University, USA, ERASMUS MUNDUS Fellowship 2011 to Warsaw University, Poland, EU-NAMASTE Fellowship 2015 to IST, University of Lisboa, Portugal, DAAD Fellowship 2015 to TU Dresden, Germany.

**COURSE PLAN :**

**Week 1:** Introduction, Ideas of Optimization and Modeling

**Week 2:** Linear Programming (LP) and related topics

**Week 3:** Simplex Method, Interior point Method and related concepts

**Week 4:** Non-Linear Programming (NLP)

**Week 5:** Goal Programming

**Week 6:** Stochastic Programming

**Week 7:** Programming and other related methods

**Week 8:** Polynomial Optimization

**Week 9:** Reliability Based Programming

**Week 10:** Robust Optimization

**Week 11:** Parametric programming, etc

**Week 12:** Multi-objective Programming





# HUMAN RESOURCE DEVELOPMENT

**PROF. KAILASH B.L. SRIVASTAVA**

Department of Humanities and Social Sciences  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: Rerun   Core   PG
<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 16 Nov 2019

**INTENDED AUDIENCE** : M.E/M.Tech,M.S,M.Sc, PhD, MBA, MBA(HR)

**INDUSTRIES APPLICABLE TO** : IT Companies/ R&D Companies/ Pharma Companies/ Manufacturing and Services sector

## COURSE OUTLINE :

The course aims to equip students to develop themselves into a critically reflective and capable HRD practitioner, or a manager who can facilitate the learning of others. The major objective of the course is to explain and demonstrate the contribution of HRD in an organization and enable student to develop an ability to decide learning and training needs; and have competence in the design and delivery of learning programmes. Organizations are made up of people: their knowledge, skills, attitudes and interconnections. In order to survive and thrive, organizations need to facilitate the growth of all of these as part of a HRD strategy. Human Resource Development (HRD) is a key activity that systematically leads to the growth and development of people in organisations, and makes organisations more effective. The process of identifying needs and designing and delivering HRD interventions that are part of the course are crucial skills for all managers. The course will focus on the role of HRD in designing and implementing appropriate strategies in line with the business goals of their organization.

## ABOUT INSTRUCTOR :

Dr. Kailash B.L. Srivastava is Professor, Department of Humanities and Social Sciences and Joint Professor in Vinod Gupta School Management, and specializes in the area of Human Resource Management and Development and Organizational Behaviour at Indian Institute of Technology, Kharagpur. He holds a first class Master's degree in Psychology from Gorakhpur University and Ph.D. from Indian Institute of Technology, Kanpur, and has around 25 years of teaching, research, and training experience.

## COURSE PLAN :

- Week 01** : Introduction to Human Resource Development: Emergent of HRD, Critical HRD roles, challenges for HRD.
- Week 02** : HRD in global perspective, HRD- Performance link, Strategic perspective of HRD.
- Week 03** : HRD Process Model: identification of HRD needs and Design and development of HRD programmes.
- Week 04** : HRD Process Model: Methods of Implantation, Evaluation of HRD programmes.
- Week 05** : Employee coaching and performance management: Coaching to improve poor performance, coaching analysis.
- Week 06** : HRD interventions: Mentoring for employee development: Role of mentoring in development.
- Week 07** : Employee counseling for HRD: Overview of counseling programme, employee assistance programme, stress management, employee wellness and health promotion.
- Week 08** : Competency framework of HRD: why competency mapping? Understanding the competency mapping framework.
- Week 09** : Career Planning, management, and development: Career development stages and activities, role of individual and organization in career planning, Issues in career management.
- Week 10** : Intellectual capital (IC), its measurement and management: Components of IC, measurement models of IC, IC index and challenges for HR.
- Week 11** : HRD, Organizational Learning, and learning organizations.
- Week 12** : The future of HRD and HRD Ethics: Research, practice and education of HRD for innovation and talent development and management, Role of HRD in developing ethical attitude and behavior and development, Ethical problems with HRD roles.





# PERFORMANCE AND REWARD MANAGEMENT

**PROF. SUSMITA MUKHOPADYAY**

Department of VGSOM  
IIT KHARAGPUR

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic understanding of business management

**INTENDED AUDIENCE** : Any interested student

**INDUSTRIES APPLICABLE TO** : People Management in organization. So this course will have strong industry support.

## **COURSE OUTLINE :**

The present course will offer a sound basis to the individuals who later will join as HR managers or practioners or HR learners in developing an understanding towards performance and management of human resources which indeed will always be relevant for an organization. The course contents have been designed specifically to not just build a base but to foster a holistic understanding towards the concepts. The course will help the students to learn various facets of performance and reward management ranging from its meaning and strategic importance to its implementation and implications for an organization.

## **ABOUT INSTRUCTOR :**

Prof. Susmita Mukhopadhyay's areas of specialization include Human Resource Management and Industrial Psychology, Business Values and Ethics, and Organizational Behaviour. A gold medalist in M.Sc., she is the recipient of the Young Scientist Award and Search of Excellence Award. She was selected for the Microfinance Researchers Alliance Fellow Program Centre for microfinance, Institute of Financial Management and Research, Chennai, in 2009.

## **COURSE PLAN :**

- Week 1:** Understanding meaning of Performance management and reward systems management with an performance management process
- Week 2:** Developing an understanding as to why performance management and reward management are of strategic importance and their role in strategic planning
- Week 3:** Implementation of a performance management system; defining performance and choosing a measurement approach and understanding meaning of results.
- Week 4:** Implementing a performance management system in your organization
- Week 5:** Role of performance management in employee development, addressing performance managemnet skills and team reward Management
- Week 6:** Overview, reward system, understanding total, strategic and international reward
- Week 7:** Understanding linkage between performance management and reward, an overview of various types of reward; financial reward, non-financial reward; contingent pay scheme; bonus scheme; team pay; rewarding for business performance; recognition scheme
- Week 8:** Valuing and grading jobs, understanding pay levels, job evaluation schemes, equal pay, market rate analysis, designing of grade and pay structure
- Week 9:** Rewarding special groups, rewarding directors and senior executives, sales and customer service staff, knowledge workers, manual workers.
- Week 10:** Understanding relevance of employee benefits and pension schemes, employee benefits, flexible benefits, pension scheme
- Week 11:** Developing and managing reward systems, evaluating reward management, responsibility for reward
- Week 12:** Understanding the implications for Performance and Reward Management in the present organizational dynamics with case studies



## E - BUSINESS

**PROF. MAMATA JENAMANI**

Department of Industrial and Systems Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/ PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc

**INDUSTRIES APPLICABLE TO** : All the companies

### COURSE OUTLINE :

The Internet has changed the way companies carry out their businesses. The primary objective of this course is to introduce concepts, tools and approaches to electronic business to the post-graduate and undergraduate students. Further, the subject will help the students to develop skills to manage businesses in the digital world. The course will cover following aspects of E-Business Systems.

Part 1: Foundations of E-Business systems

Part 2: Infrastructure

Part 3: Functional Areas

Part 4: Decision Support for E-Business Systems

The course provides a balance approach including concepts from technology and management.

### ABOUT INSTRUCTOR :

Prof. Mamata Jenamani, My broad area of Interest is E-Business. The specific focus areas include web data analytics and supply chain optimization in the context ICT applications. My interest in web data analytics started with my doctoral work where I modeled user behavior in a website and used it for personalization.

### COURSE PLAN :

**Week 01** : Introduction to E-Business

**Week 02** : Making Functional Areas E-Business Enabled : Value chain and supply chain, inter and intra organizational business processes, ERP

**Week 03** : Making Functional Areas E-Business Enabled : E-Procurement

**Week 04** : Making Functional Areas E-Business Enabled : E-marketing, E-Selling, E-Supply Chain Management

**Week 05** : Technologies for E-Business: Internet and Web based system

**Week 06** : Technologies for E-Business: Security and payment systems

**Week 07** : Technologies for E-Business: Supply chain integration technologies (EDI, RFID, Sensors, IoT, GPS, GIS)

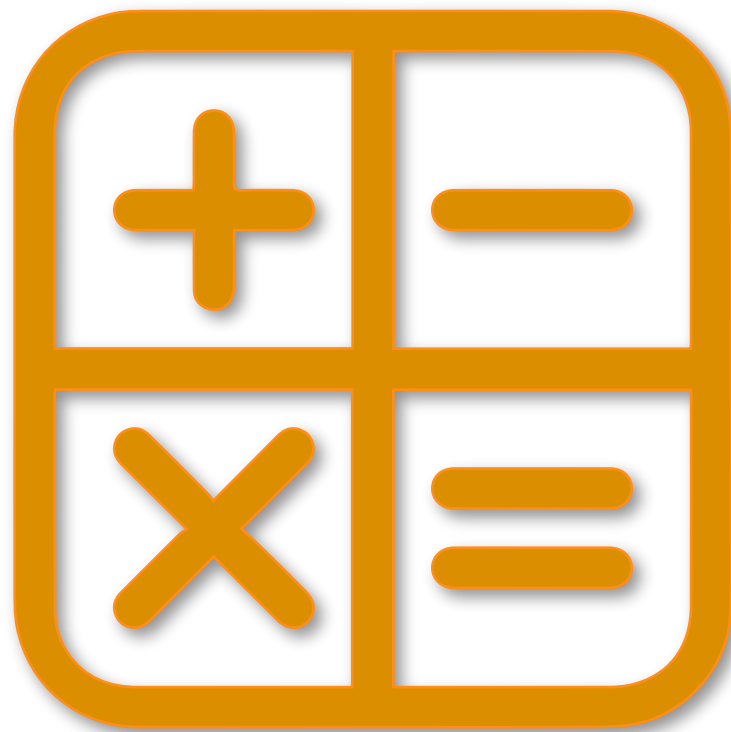
**Week 08** : Technologies for E-Business: Supply chain integration technologies (Web services and cloud)

**Week 09** : Decision Support in E-Business: Web analytics

**Week 10** : Decision Support in E-Business: Customer behavior modeling

**Week 11** : Decision Support in E-Business: Auctions

**Week 12** : Decision Support in E-Business: Recommender systems



# MATHEMATICS



# MATHEMATICS

## 04 weeks

01. Mathematical Methods for Boundary Value Problems

## 08 weeks

- 01. Calculus of One Real Variable
- 02. Calculus of Several Real Variables
- 03. Numerical methods
- 04. Introduction to Abstract and Linear Algebra
- 05. Introduction to Abstract Group Theory
- 06. Introduction To Rings And Fields
- 07. Matrix Analysis with Applications
- 08. Operations Research
- 09. Introduction to R Software

## 12 weeks

- 01. Integral Transforms And Their Applications
- 02. Higher Engineering Mathematics
- 03. Mathematical Finance
- 04. Stochastic Processes
- 05. Introduction to Fuzzy Set Theory, Arithmetic and Logic
- 06. Regression Analysis



# MATHEMATICAL METHODS FOR BOUNDARY VALUE PROBLEMS

**PROF.SOMNATH BHATTACHARYYA**

Department of Mathematics

IIT Kharagpur

**TYPE OF COURSE** : New | Core\_Elective | UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic UG course in Mathematics/ Undergraduate Calculus

**INTENDED AUDIENCE** : Undergraduates of any Engineering course, Mathematics, Physics and Postgraduate student of Mathematics/ Mechanical/ Aerospace/Chemical Engineering

## **COURSE OUTLINE :**

This course is intended to provide methods to solve linear and nonlinear boundary value problems involving ordinary as well as partial differential equations. The course will start providing mathematical tools based on integral transformation, Fourier series solution and Greens function for obtaining analytic solutions for BVPs. This course, apart from being a part of regular undergraduate/ postgraduate mathematics course, will provide a guidance to solve BVPs arise in mathematical modeling of several transport phenomena.

## **ABOUT INSTRUCTOR :**

Prof. S. Bhattacharyya is a senior Professor in the Department of Mathematics, IIT, Kharagpur. His specialization is Applied Mathematics. He teaches Integral Transform Techniques, Partial Differential Equations, Numerical solutions of PDEs and other related courses. His research works involve numerical solutions of PDEs and he has published more than 120 research papers in reputed international journals. He has undertaken sponsored research projects and guided 15 PhD students. He has organized and delivered lectures at conferences, AICTE sponsored short term courses and GIAN courses on the topics related to Applied Mathematics. He has received fellowships for research collaboration in USA, UK and Germany.

## **COURSE PLAN :**

- Week 1:** Boundary Value Problems (BVP) and its Applications. Analytical Methods:  
Maximum Principle, Green's function; Separation of Variables ; Eigen Values, Eigen Functions.
- Week 2:** Integral Transform Techniques for BVPs and its limitations
- Week 3:** Numerical Techniques for BVP: Shooting Method; Finite Difference Method; Block tri-diagonal System of Equations
- Week 4:** Numerical Methods for Non-linear BVPs; Elliptic type of Partial Differential Equations; Successive-Over-Relaxation Method; Multigrid Methods.



# CALCULUS OF ONE REAL VARIABLE

**PROF. JOYDEEP DUTTA**

Department of Humanities and Social Sciences  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED SUPPORT** : B.E/B.Tech, B.Sc

**PRE-REQUISITES** : Basic Mathematics till 12th standard

**COURSE OUTLINE :**

This course intends to develop a thorough understanding of the fundamental aspects of calculus of single variable which is fundamental tool in Sciences, Engineering and Economics.

**ABOUT INSTRUCTOR :**

Prof. Joydeep Dutta is currently a Professor of Economics at the Department of Humanities and Social Sciences, IIT Kanpur. He was previously a Professor at the Department of Mathematics and Statistics at IIT Kanpur. His research interest primarily lies in optimization though he loves Mathematics as a whole.

**COURSE PLAN :**

- Week 01** : Introduction to Numbers, Countability and Uncountability, Examples of Irrational numbers, Function, Limits of Functions-I.
- Week 02** : Limit of Functions-II, Continuous Functions, Intermediate Value Theorem, Maximum Value Theorem, Supremum & Infimum
- Week 03** : Derivative of a Function, Rules of Differentiation, Derivatives maxima & minima, Rolle's Theorem and Lagrange MVT(Mean-Value Theorem), Monotonic Functions and Inverse Function.
- Week 04** : Newton's Method for solving Equations, Optimization Problems  
Integration-I : In the style of Newton and Leibnitz, Integration-II : In the spirit of Newton and Leibnitz, Integration-III : Newton and Leibnitz Style
- Week 05** : Indefinite Integrals, Integration by Parts, Integration of Rational Functions, Trapezoidal Rule for evaluating definite integral, Simpson's Rule for evaluating definite integral.
- Week 06** : Applications of Definite Integral-I, Applications of Definite Integral-II, Applications of Definite Integral-III, Applications of Definite Integral-IV, Transcendental Functions-I.
- Week 07** : Transcendental Functions-II, Taylor's Expansion-I, Taylor's Expansion-II, Infinite Sequence-I, Infinite Sequence-II
- Week 08** : Infinite series and their convergence, Tests for Convergence of a series, Absolute and conditional convergence, Power Series, Historical Development of the Calculus.





# CALCULUS OF SEVERAL REAL VARIABLES

**Prof. JOYDEEP DUTTA**

Department of Economic Sciences

IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Calculus of One Real Variable

**INTENDED AUDIENCE** : UG students of Engineering/ Sciences streams

**COURSE OUTLINE :**

This course introduces Calculus of several real variables, which has important applications in science and engineering. The modern world would have been impossible without it. We introduce and discuss the subject in a non-traditional way taking the vector approach in most places. We start with the basics of Vectors, study continuity and partial derivatives, multiple integrals and their applications and end with the Stoke's Theorem and Gauss divergence theorem.

**ABOUT INSTRUCTOR :**

Prof. Joydeep Dutta is a Professor in the Department of Economic Sciences at IIT Kanpur. His research interest lies in convex analysis and optimization. He has given several MOOC courses including "Calculus of one real variable". Calculus continues to fascinate him and intrigue him.

**COURSE PLAN :**

**Week 1:** Vectors and Matrices

**Week 2:** Functions of several variables and partial derivatives

**Week 3:** IFT, Taylor's Theorem, Maxima and Minima

**Week 4:** Lagrange Multiplier Rule

**Week 5:** Multiple Integrals

**Week 6:** Line Integrals

**Week 7:** Surface Integrals

**Week 8:** Green's Theorem, Stokes Theorem and Gauss Divergence Theorem



# NUMERICAL METHODS

**PROF. AMEEYA KUMAR NAYAK**

Department of Mathematics  
IIT Roorkee

**PROF. SANJEEV KUMAR**

Department of Mathematics  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**INDUSTRIES APPLICABLE TO** : TCS, Intel, General Electric, General Motors, ABB, Nuclear Industries, etc.

**COURSE OUTLINE :**

This course is a basic course offered to UG student of Engineering/Science background. It contains solution of system of linear equations, roots of non-linear equations, interpolation, numerical differentiation and integration. It plays an important role for solving various engineering sciences problems. Therefore, it has tremendous applications in diverse fields in engineering sciences.

**ABOUT INSTRUCTOR :**

Dr.Ameeya Kumar Nayak is Associate Professor in Department of Mathematics at IIT Roorkee and actively involved in teaching and research in the direction of numerical modeling of fluid flow problems for last ten years. His research interests are in the fundamental understanding of species transport in macro and micro-scale confinements with applications in biomedical devices and micro electro mechanical systems.

Dr.Sanjeev Kumar is working as an Associate Professor with Department of Mathematics, IIT Roorkee. Earlier, he worked as a postdoctoral fellow with Department of Mathematics and Computer Science, University of Udine, Italy and assistant professor with IIT Roorkee.

**COURSE PLAN :**

- Week 01** : Introduction to significant digits and errors, Solution of system of linear Equations (direct methods, Iterative methods, Ill-conditioned systems)
- Week 02** : Roots of Nonlinear Equations (Bisection method, Regula-Falsi method, Newton-Raphson method, Fixed point iteration method, convergence criteria )
- Week 03** : Eigenvalues and Eigenvectors, Gerschgorin circle theorem , Jacobi method, Power methods
- Week 04** : Interpolation (Finite difference operators, difference tables, Newton's Forward/Backward difference)
- Week 05** : Interpolation ( Central difference formula's i.e. Bessel and Stirling's interpolation formulae, Divided differences, Lagrange interpolation and Newton's divided difference interpolation)
- Week 06** : Numerical Differentiation (Using Forward/ Backward/central difference formula) Week:7 Integration (Trapezoidal and Simpson's rules for integration)
- Week 07** : Numerical Integration
- Week 08** : Solution of first order and second order ordinary differential equations (Euler method, Euler modified method, Runge-Kutta methods, Milne PC method)



# INTRODUCTION TO ABSTRACT AND LINEAR ALGEBRA

**PROF. SOURAV MUKHOPADHYAY**

Department of Mathematics  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, B.Sc

## COURSE OUTLINE :

Abstract and Linear Algebra are applicable to every discipline, be it engineering and technology, economics or social sciences. It is essential for the students to get acquainted with the subject of Abstract and Linear Algebra at an early stage. The present course has been designed to introduce the subject to undergraduate/postgraduate students in science and engineering. The course contains a good introduction to each topic and an advance treatment of theory at a fairly understandable level to the students at this stage.

## ABOUT INSTRUCTOR :

Dr. Sourav Mukhopadhyay is an Associate Professor at Indian Institute of Technology Kharagpur. He has completed his B.Sc (Honours in Mathematics) in 1997 from University of Calcutta, India. He has done M.Stat (in statistics) and M.Tech (in computer science) from Indian Statistical Institute, India, in 1999 and 2001 respectively. He worked with Cryptology Research Group at Indian Statistical Institute as a PhD student and received his Ph.D. degree in Computer Science from there in 2007. He was a Research Assistant at the Computer Science department of School of Computing, National University of Singapore (NUS). He visited Inria Rocquencourt, project CODES, France and worked as a post-doctoral research fellows at the School of Computer Engineering, Nanyang Technological University (NTU), Singapore. He was a post-doctoral research fellow and a part time Lecturer with School of Electronic Engineering, Dublin City University (DCU), Ireland.

## COURSE PLAN :

**Week 01** : Basic set theory

**Week 02** : Group Theory

**Week 03** : Rings and Polynomial rings

**Week 04** : Field and finite fields

**Week 05** : Matrices and determinants

**Week 06** : Vector spaces over fields

**Week 07** : Linear transformations and their matrices

**Week 08** : Linear equations



# INTRODUCTION TO ABSTRACT GROUP THEORY

**PROF. KRISHNA HANUMANTHU**

Department of Mathematics  
Chennai Mathematical Institute

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.Sc, M.Sc

**PRE-REQUISITES** : Any BSc student who is familiar with high school mathematics can take this course

**COURSE OUTLINE :**

This course will introduce abstract groups. We will start with definitions, basic properties and constructions and cover many important theorems in basic group theory, such as Lagrange's theorem, Cauchy's theorem and Sylow theorems. A major emphasis of the course will be to present numerous worked-out examples and problems. A part of the lecture every week will be devoted to explicit calculations.

**ABOUT INSTRUCTOR :**

Krishna Hanumanthu is an Associate Professor of Mathematics at Chennai Mathematical Institute (CMI). He studied BSc and MSc in CMI during 1998-2003 and did his PhD in mathematics at University of Missouri during 2003-2008. He joined CMI as a faculty member in 2011 after working for 3 years at University of Kansas. His main areas of research are algebraic geometry and commutative algebra. He has been teaching for almost 15 years and taught introductory courses on abstract algebra (including group theory) many times.

**COURSE PLAN :**

**Week 01** : Motivation, definition, examples and basic properties

**Week 02** : Subgroups, subgroups of integers, homomorphisms

**Week 03** : Quotient groups, isomorphism theorems

**Week 04** : Group operations, counting formula

**Week 05** : Symmetric groups

**Week 06** : Operations of a group on itself, class equation

**Week 07** : Sylow theorems I

**Week 08** : Sylow theorems II



# INTRODUCTION TO RINGS AND FIELDS

**PROF. KRISHNA HANUMANTHU**

Department of Mathematics  
Chennai Mathematical Institute

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : A little bit of abstract group theory and linear algebra.

**INTENDED AUDIENCE** : B.Sc and M.Sc students studying Mathematics

## **COURSE OUTLINE :**

This course will cover basics of abstract rings and fields, which are an important part of any abstract algebra course sequence. The course begins with definitions; important examples cover prime, maximal ideals; important classes of rings like integral domains, UFDs and PIDs, prove the Hilbert basis theorem about noetherian rings.

## **ABOUT INSTRUCTOR :**

Prof. Krishna Hanumanthu is an Associate Professor of Mathematics at Chennai Mathematical Institute (CMI). He studied BSc and MSc in CMI during 1998-2003 and did his PhD in Mathematics at University of Missouri during 2003-2008. He joined CMI as a faculty member in 2011 after working for 3 years at University of Kansas. His main areas of research are Algebraic Geometry and Commutative Algebra.

## **COURSE PLAN :**

**Week 1:** Definition of rings, examples, Polynomial Rings, Homomorphisms.

**Week 2:** Ideals, prime and maximal ideals, quotient rings.

**Week 3:** Noetherian rings, Hilbert basis theorem.

**Week 4:** Integral domains, Quotient fields.

**Week 5:** Unique factorization domains, Principal ideal domains.

**Week 6:** Definition of fields, Examples, Degree of field extensions.

**Week 7:** Adjoining roots, Primitive element theorem.

**Week 8:** Finite fields.



# MATRIX ANALYSIS WITH APPLICATIONS

**PROF. S. K. GUPTA**

Department of Mathematics  
IIT Roorkee

**PROF. SANJEEV KUMAR**

Department of Mathematics  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : A basic course on Probability

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**INDUSTRIES APPLICABLE TO** : Goldman Sachs, FinMachenics, Deutsche Bank and other finance companies.

**INTENDED AUDIENCE** : UG and PG students of technical universities/colleges

## COURSE OUTLINE

This course is offered to UG and PG students of Engineering/Science background. It contains the concepts related to matrix theory and their applications in various disciplines. It covers a depth understanding of matrix computations involving rank, eigenvalues, eigenvectors, linear transformation, similarity transformations, (diagonalisation, Jordan canonical form, etc). It also involves various iterative methods, including Krylov subspace methods. Finally, topics like positive matrices, non-negative matrices and polar decomposition are discussed in detail with their applications.

## ABOUT INSTRUCTOR

Dr. S. K. Gupta is an Associate Professor in the Department of Mathematics, IIT Roorkee. His area of expertise includes nonlinear, non-convex and Fuzzy optimization. He has guided three PhD thesis and have published more than 45 papers in various international journals of repute.

Dr. Sanjeev Kumar is working as an associate professor with Department of Mathematics, IIT Roorkee. Earlier, he worked as a postdoctoral fellow with Department of Mathematics and Computer Science, University of Udine, Italy and assistant professor with IIT Roorkee. He is actively involved in teaching and research in the area of computational algorithms, inverse problems and image processing. He has published more than 55 papers in various international journals conferences of repute. He has completed a couple of sponsored research projects and written several chapters in reputed books published with Springer and CRC press.

## COURSE PLAN

**Week 1** : Echelon form and Rank of a matrix, Solution of system of linear equations.

**Week 2** : Vector spaces and their properties, subspaces, basis and dimension, linear transformations.

**Week 3** : Eigen values and eigen vectors, Cayley Haminton theorem, diagonalization.

**Week 4** : Special matrices, Gerschgorin theorem, inner product spaces, matrix norms and Gram Schmidt Process

**Week 5** : Normal and Positive Definite matrices, Quadratic forms with applications

**Week 6** : Evaluation of matrix functions, SVD and its applications

**Week 7** : Stationary and non-stationary iterative methods for linear system

**Week 8** : Krylov subspace methods, analysis of positive and non-negative matrices, polar decomposition theorem





# OPERATIONS RESEARCH

**PROF.KUSUM DEEP**

Department of Mathematics  
IIT Roorkee

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Any student who wants to learn the basic concepts of Operations Research

**INDUSTRIES APPLICABLE TO** : All industries who have to minimize cost of production or maximum output

**COURSE OUTLINE :**

Optimization is the most important sub area of the discipline Operations Research. Optimization problems arise in all walks of human activity- particularly in Engineering, Business, Finance and Economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

**ABOUT INSTRUCTOR :**

Prof.Kusum Deep is presently working as a Professor in IIT,Roorkee. His area of Interests are Numerical Optimization, Nature Inspired Optimization, Computational Intelligence, Genetic Algorithms, Particle Swarm Optimiz.She had authered text books of "Optimization Techniques", jointly with Prof. C. Mohan Indian Ed., New Age, New Delhi, 2009 and Foreign Ed., New Age Science, UK, 2009.

**COURSE PLAN :**

**Week 1:** Introduction to OR Models; More OR Models Graphical Method for LPP Convex sets Simplex Method

**Week 2:** Big M Method ;Two Phase Multiple solutions of LPP; Unbounded solution of LPP Infeasible solution of LPP

**Week 3:** Revised Simplex Method ; Case studies and Exercises - I, II & III ; Primal Dual Construction

**Week 4:** Weak Duality Theorem ; More Duality Theorems; Primal-Dual relationship of solutions; Dual Simplex Method Sensitivity Analysis-I

**Week 5:** Sensitivity Analysis-II; Case studies and Exercises - I & II; Integer Programming ; Goal Programming

**Week 6:** Multi-Objective Programming; Dynamic Programming ;Transportation Problem; Assignment Problem ; Case studies and Exercises

**Week 7:** Processing n Jobs on Two Machines ; Processing n Jobs through Three Machines Processing

two jobs through m machines Processing n jobs through m machines Case studies and Exercises

**Week 8:** Two Person Zero-Sum Game Games without Saddle Point Solution of Mixed Strategy Games

Linear Programming method for solving games Case studies and Exercises



# INTRODUCTION TO R SOFTWARE

**PROF. SHALABH**

Department of Mathematics  
IIT Kanpur

<b>TYPE OF COURSE</b>	: Rerun   Core/Elective   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (26 Aug'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 17 Nov 2019

**PREREQUISITES** : Mathematics background up to class 12 is needed.  
Having some preliminary knowledge will be helpful but not necessarily mandatory.

**INTENDED AUDIENCE** : UG students of Science and Engineering.

**INDUSTRIES APPLICABLE TO** : All industries involved in mathematical and statistical computations, programming and simulations and having R & D set up will use this course.

## COURSE OUTLINE

Any scientific task without the knowledge of software is difficult to imagine and complete in the current scenario. R is a free software that is capable of handling mathematical and statistical manipulations. It has its own programming language as well as built in functions to perform any specialized task. We intend to learn the basics of R software in this course.

## ABOUT INSTRUCTOR

Prof. Shalabh is a Professor of Statistics at IIT Kanpur. His research areas of interest are linear models, regression analysis and econometrics. He has more than 22 years of experience in teaching and research. He has developed several web based NPTEL courses including on regression analysis and has conducted several workshops on statistics for teachers, researchers and practitioners. He has received several national and international award and fellowships. He has authored more than 70 research papers in national and international journals. He has written four books and one of the book on linear models is coauthored with Prof. C.R. Rao.

## COURSE PLAN

**Week 1:** Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.

**Week 2:** Use of R as a calculator, functions and matrix operations, missing data and logical operators.

**Week 3:** conditional executions and loops, data management with sequences.

**Week 4:** Data management with repeats, sorting, ordering, and lists.

**Week 5:** Vector indexing, factors, Data management with strings, display and formatting.

**Week 6:** Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames.

**Week 7:** Data frames, import of external data in various file formats, statistical functions, compilation of data.

**Week 8:** Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivariate data through graphics, correlations, programming and illustration with examples.



# INTEGRAL TRANSFORMS AND THEIR APPLICATIONS

**PROF.SARTHOK SIRCAR**

Department of Mathematics  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Ordinary Differential Equations (ODEs) , Complex variables (optional)

**INDUSTRIES APPLICABLE TO** : Industries in areas of Signal Processing and Communications, Data Science, Computational Fluid Dynamics, Software Development

## **COURSE OUTLINE :**

The course is designed as an introduction to the theory and applications of integral transforms to problems in Linear Differential Equations, to Boundary and Initial Value Problems in Partial Differential Equations and Continuum Mechanics. Many new applications in Applied mathematics, Physics, Chemistry, Biology and Engineering are included. This course will serve as a reference for advanced study and research in this subject as well as for its applications in the fields of Signal Processing, Informatics and Communications, Neuroscience, Fluid Mechanics, Quantum Mechanics, Computer Assisted Tomography (CAT). The course is open to all MTech, PhD students, some final year advanced undergraduate and honors students.

## **ABOUT INSTRUCTOR :**

Dr.S.Sircar currently working as an Assistant Professor in the Department of Mathematics at Indraprastha Institute for Information Technology, Delhi. His prior academic appointments include Lectureship in the Division of Mathematical Sciences, University of Adelaide, Australia; Research Associate in Division of Applied Mathematics, University of Colorado, Boulder; Research Fellow in Biomathematics in the University of Utah; Visiting Scholar in the Center for Nanophase Material Science at Oak Ridge National Laboratory, and Research Scientist in Corning Inc. at Ithaca, NY. His main mathematical interests are in the development and analysis of nonlinear hyperbolic and elliptic partial differential equations, with applications which lie at the interface of applied mathematics and biology.

## **COURSE PLAN :**

- Week 1** : Basic concepts of integral transforms. Fourier transforms: Introduction, Basic properties, Applications to solutions of Ordinary Differential Equations (ODE), Partial Differential Equations
- Week 2** : Applications of Fourier Transforms to solutions of ODEs, PDEs and Integral Equations, Evaluation of definite integrals. Laplace transforms: Introduction, Existence criteria
- Week 3** : Laplace transforms: Convolution, differentiation, integration, inverse transform, Tauberian Theorems, Watson's Lemma, solutions to ODE, PDE including Initial Value Problems (IVP) and Boundary Value Problems (BVP).
- Week 4** : Applications of joint Fourier-Laplace transform, Definite integrals, Summation
- Week 5** : Hankel Transforms: Introduction, properties and applications to PDE, Mellin transforms: Introduction, Properties, Applications; Generalized Mellin transforms.
- Week 6** : Hilbert Transforms
- Week 7** : Stieltjes Transform
- Week 8** : Z - Transforms
- Week 9** : Radon transform
- Week 10**: Fractional Calculus and its application
- Week 11**: Integral transforms in fractional equation
- Week 12**: Wavelet Transform: Discussion on continuous and discrete, Haar, Shannon and Daubechie Wavelets



# HIGHER ENGINEERING MATHEMATICS

**PROF. P. N. AGRAWAL**

Department of Mathematics  
IIT Roorkee

**TYPE OF COURSE** : New | Core | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : UG and PG students of technical institutions/ universities/colleges.

## **COURSE OUTLINE :**

This course is a basic course offered to UG/PG students of Engineering/Science background. It consists of four main topics : 1. Discrete Mathematics 2. Graph theory 3. Linear programming problems 4. Queuing theory.

## **ABOUT INSTRUCTOR :**

Dr. P. N. Agrawal is a Professor in the Department of Mathematics, IIT Roorkee. His area's of research includes approximation Theory and Complex Analysis. He delivered 13 video lectures on Engineering Mathematics in NPTEL Phase I and recently completed Pedagogy project on Engineering Mathematics jointly with Dr. Uday Singh in the same Department. Further he has offered online certification course "Mathematical methods and its applications" namely "Integral equations and calculus of variations and its applications" and "Numerical Linear Algebra", "Advanced Engineering Mathematics". He has taught engineering mathematics to B.Tech and M.Tech students at IIT Roorkee for many years.

## **COURSE PLAN :**

**Week 1:** Representation of statements, Duality, Tautologies and Contradictions, Quantifiers, Predicates and validity of arguments

**Week 2:** Propositional Logics, Languages and Grammar, Finite state machines and their transitional table diagrams, Lattices, Partially ordered sets-I

**Week 3:** Partially ordered sets-II, Duality and Lattices as algebraic system, Sublattice-I & II, Boolean Algebra

**Week 4:** Switching Algebra, Boolean Functions, Different representation of Boolean functions, table diagrams, Lattices, Partially ordered sets-I

**Week 5:** Circuit minimization and simplification-II, Karnaugh Map-I & II, Various types of Graph

**Week 6:** Eulerian and Hamilton Graphs, Travelling salesman problem, Vertex and edge connectivity, Matrix representation of graph, Incidence and adjacency matrices of graphs

**Week 7:** Planar graphs, Kuratowski's Theorem, Detection of planarity, Euler's formula, Duality of a Planar graph

**Week 8 :** Colouring of Graphs, Chromatic numbers, Four color theorem, Graphical method-I & II

**Week 9 :** Simplex method

**Week 10:** Two phase method-II, Dual Simplex method, Application of Dual Simplex method, Sensitivity Analysis-I

**Week 11:** Queuing System. Distribution of arrivals and service times, Analysis of M/M/1:FIFO, Application of M/M/1 FIFO, Analysis of M/M/S FIFO

**Week 12:** Application of M/M/S FIFO



# MATHEMATICAL FINANCE

**PROF. N. SELVARAJU**  
**PROF. SIDDHARTHA CHAKRABARTY**  
 Department of Mathematics  
 IIT Guwahati

**TYPE OF COURSE** : New | Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Background in basics of probability theory

**INTENDED AUDIENCE** : Students at advanced undergraduate and postgraduate level in Mathematics, Statistics and allied areas as well as students of Engineering and Management interested in this field.

**INDUSTRIES APPLICABLE TO** : Finance Industry

## COURSE OUTLINE :

The course on 'Mathematical Finance' gives an introduction to this interesting and growing area. In particular, the course will cover two Nobel-prize winning frameworks, namely portfolio theory and the option pricing theory.

## ABOUT INSTRUCTOR :

Prof. Selvaraju has more than ten years of teaching experience (in addition to research experience) in the areas of financial mathematics, financial engineering, stochastic calculus and portfolio theory and has offered several courses to the B.Tech. (Mathematics and Computing) and M.Sc. (Mathematics and Computing) students of IIT Guwahati.

Prof. Chakrabarty has more than ten years of teaching experience (in addition to research experience) in the areas of financial engineering, computational finance, portfolio theory and financial risk management and has offered several courses to the B.Tech. (Mathematics and Computing) and M.Sc.

## COURSE PLAN :

**Week 1:** Introduction to financial markets, financial instruments, bonds, stocks and financial derivatives.

**Week 2:** Time value of money, simple and compound interest rate, net present value, internal rate of return and annuities.

**Week 3:** Markowitz portfolio theory, risk and return, two and multi asset portfolio theory, efficient frontier.

**Week 4:** Capital Asset Pricing Model and portfolio performance analysis.

**Week 5:** No arbitrage principle, pricing of forwards and futures, properties of options.

**Week 6:** Derivative pricing by replication in binomial model.

**Week 7:** Discrete probability spaces, filtration, conditional expectation

**Week 8:** Discrete time martingales, Markov chain, risk-neutral pricing in binomial model for European and American derivatives.

**Week 9:** General probability spaces, conditional expectation, Brownian motion.

**Week 10:** Ito integral, Ito formula, Girsanov's theorem, martingale representation theorem, stochastic differential equation.

**Week 11:** Black-Scholes-Merton (BSM) model, pricing of European derivatives in BSM framework.

**Week 12:** Valuation of European options in BSM model, BSM formula, BSM partial differential equation, hedging, model completeness, fundamental theorems of asset pricing.





# STOCHASTIC PROCESSES

## PROF. S. DHARMARAJA

Department of Mathematics  
IIT Delhi

**TYPE OF COURSE** : Rerun | Core | UG **EXAM DATE** : 17 Nov 2019  
**IPRE-REQUISITES** : A basic course on Probability **COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**INDUSTRIES APPLICABLE TO** : Goldman Sachs, FinMachenics, Deutsche Bank and other finance companies.

## COURSE OUTLINE

This course explains the stochastic processes & concepts which students need for their experiments and research. It also covers theoretical concepts pertaining to handling various stochastic modeling. This course provides classification and properties of stochastic processes, discrete and continuous time Markov chains, simple Markovian queueing models, applications of CTMC, martingales, Brownian motion, renewal processes, branching processes, stationary and autoregressive processes.

## ABOUT INSTRUCTOR

Prof. S. Dharmaraja Department of Mathematics Indian Institute of Technology, Delhi earned his M.Sc. degree in Applied Mathematics from Anna University, Madras, India, in 1994 and Ph.D. degree in Mathematics from the Indian Institute of Technology Madras, in 1999.

## COURSE PLAN

**Week 1:** Probability theory refresher; Introduction to stochastic process; (contd.)

**Week 2:** Probability theory refresher (contd.) Problems in random variables and distributions; Problems in Sequence of random variables

**Week 3:** Definition and simple stochastic process; Definition, classification and Examples; Simple stochastic processes

**Week 4:** Discrete-time Markov chains; Introduction, Definition and Transition Probability Matrix Chapman-Kolmogorov Equations; Classification of States and Limiting Distributions

**Week 5:** Discrete-time Markov chains (contd.); Limiting and Stationary Distributions; Limiting Distributions, Ergodicity and stationary distributions. Time Reversible Markov Chain, Application of Irreducible Markov chains in Queueing Models; Reducible Markov Chains

**Week 6:** Continuous-time Markov chains; Definition, Kolmogorov Differential Equation and Infinitesimal Generator Matrix Limiting and Stationary Distributions, Birth Death Processes; Poisson processes

**Week 7:** Continuous-time Markov Chains (contd.); M/M/1 Queueing model; Simple Markovian Queueing

**Week 8:** Applications of CTMC; Queueing networks; Communication systems; Stochastic Petri Nets

**Week 9:** Martingales; Conditional Expectation and filtration; Definition and simple examples

**Week 10:** Brownian Motion; Definition and Properties; Processes Derived from Brownian Motion; Stochastic Differential Equation

**Week 11:** Renewal Processes; Renewal Function and Equation; Generalized Renewal Processes and Renewal Limit Theorems Markov Renewal and Markov Regenerative Processes; Non Markovian Queues; Application of Markov Regenerative Processes

**Week 12:** Branching Processes, Stationary and Autoregressive Processes





# INTRODUCTION TO FUZZY SET THEORY, ARITHMETIC AND LOGIC

**PROF. NILADRI CHATTERJEE**

Department of Mathematics  
IIT Delhi

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : M.Sc Mathematics, M.Sc Computer Science

## **COURSE OUTLINE :**

The primary purpose of this course is to introduce students to the areas of Fuzzy set theory and Fuzzy logic. No previous knowledge is needed regarding Fuzzy set theory or Fuzzy logic. But familiarity with Classical set theory, and Two-valued logic will be helpful. In most real-life applications of any decision making one needs to face many types of uncertainty. While as humans we can deal with this uncertainty with our reasoning prowess, it is not clear how to deal with this uncertainty in a system. Fuzzy sets and Fuzzy logic gives us one way of representing this uncertainty and reasoning with them. This course is aimed at providing a strong background for the subject.

## **ABOUT INSTRUCTOR :**

Niladri Chatterjee is a Professor in Department of Mathematics, IIT Delhi. He is B.Stat and M.Stat from Indian Statistical Institute Kolkata. He obtained M.Tech and PhD in Computer science from University College London. His major research interests are Artificial Intelligence, Machine Learning, Natural Language Processing, Statistical Modeling among others. He has more than 30 years of research and teaching experience. He is also member of several Government committees related to AI and Machine Learning.

## **COURSE PLAN :**

**Week 1:** Introduction to Fuzzy sets , Crisp vs Fuzzy Types of Fuzzy sets, Membership functions , Alpha cuts

**Week 2:** Operation on fuzzy sets, t-norm, complements t-conorm, combination of operations continued

**Week 3:** Introduction to Fuzzy arithmetic , Interval arithmetic

**Week 4:** +, -, \* using alpha cuts MIN and MAX Fuzzy numbers

**Week 5:** Fuzzy arithmetic using Alpha cuts continued, Decomposition principle

**Week 6:** Extension principle , Fuzzy arithmetic using Extension Principle, Fuzzy Equations

**Week 7:** Relations, Introduction to Fuzzy relations, Projections, Equivalence relation, Transitive closure, Compatibility relation

**Week 8:** Fuzzy relational equation Solution Methods continued

**Week 9:** Introduction to possibility theory Possibility vs probability, Belief and Plausibility, Dempsters rule, Possibility and Necessity

**Week 10:** Fuzzy Logic, Multi valued logic , Fuzzy propositions

**Week 11:** Linguistic hedges, Inference from propositions continued

**Week 12:** Inference from fuzzy propositions continued



# REGRESSION ANALYSIS

**PROF. SOUMEN MAITY**

Department of Mathematics  
IISER Pune

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG 12

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PREREQUISITES** : Probability and Statistics

**INTENDED AUDIENCE** : B.Sc, M.Sc, B.Tech, M.Tech

**INDUSTRIES APPLICABLE TO** : Goldman Sachs, FinMachenics, Deutsche Bank and other finance companies.

## COURSE OUTLINE

Regression analysis is one of the most powerful methods in statistics for determining the relationships between variables and using these relationships to forecast future observations. The foundation of regression analysis is very helpful for any kind of modelling exercises. Regression models are used to predict and forecast future outcomes. Its popularity in finance is very high; it is also very popular in other disciplines like life and biological sciences, management, engineering, etc. In this online course, you will learn how to derive simple and multiple linear regression models, learn what assumptions underline the models, learn how to test whether your data satisfy those assumptions and what can be done when those assumptions are not met, and develop strategies for building best models.

## ABOUT INSTRUCTOR

Prof. Soumen Maity is an Associate Professor of Mathematics at Indian Institute of Science Education and Research (IISER) Pune. He received a PhD from the Theoretical Statistics & Mathematics Unit at Indian Statistical Institute (ISI) Kolkata, India in 2002. He has postdoctoral experience from Lund University, Sweden; Indian Institute of Management (IIM) Kolkata, India; and University of Ottawa, Canada. Prior to joining IISER Pune in 2009, he worked as Assistant Professor at IIT Guwahati and IIT Kharagpur.

## COURSE PLAN

**Week 1** : Simple Linear Regression (Part A, B, C)

**Week 2** : Simple Linear Regression (Part D, E)

**Week 3** : Multiple Linear Regression (Part A, B, C)

**Week 4** : Multiple Linear Regression (Part D); Selecting the best regression equation (Part A, B)

**Week 5** : Selecting the best regression equation (Part C, D)

**Week 6** : Multicollinearity (Part A, B, C)

**Week 7** : Model Adequacy Checking (Part A, B, C)

**Week 8** : Test for influential observations ; Transformations and weighting to correct model inadequacies (Part A)

**Week 9** : Transformations and weighting to correct model inadequacies (Part B, C)

**Week 10** : Dummy variables (Part A, B, C)

**Week 11** : Polynomial Regression Models (Part A, B, C)

**Week 12** : Generalized Linear Model (Part A, B); Non-Linear Estimation



# INTRODUCTION TO METHODS OF APPLIED MATHEMATICS

## PROF. VIVEK KUMAR AGARWAL

Department of Mathematics  
DTU Delhi

## PROF. MANI MEHRA

Department of Mathematics  
IIT Delhi

**TYPE OF COURSE** : New | Core/Elective | UG/PG **EXAM DATE** : 16 Nov 2019  
**PRE-REQUISITES** : A basic course on Probability **COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**INDUSTRIES APPLICABLE TO** : Goldman Sachs, FinMachenics, Deutsche Bank and other finance companies.

**INTENDED AUDIENCE** : UG and PG students of technical universities/colleges

## COURSE OUTLINE

This course is aimed at final year undergraduate and graduate students in engineering, physics and applied mathematics. This will cover the very important and essential topics used by almost all branches of Science and engineering.

## ABOUT INSTRUCTOR

Prof. Mani Mehra is presently working as an Associate Professor in the department of Mathematics, IIT Delhi. She earned her PhD from IIT Kanpur in 2005.

Prof. Vivek Kumar Aggarwal in presently worked as an Assistant Professor dept. of Applied Mathematics, DTU Delhi. He earned his PhD in Mathematics from IIT Kanpur in 2005.

## COURSE PLAN

- Week 1** : Introduction
- Week 2** : Applications of Green Function to solve, some ODE
- Week 3** : Introductions of Integral equations, classification
- Week 4** : Applications of Integral equation to solve various Problems
- Week 5** : Laplace Transforms and its properties
- Week 6** : Application of Laplace Transforms to solve various Problems
- Week 7** : Fourier Transforms and its properties
- Week 8** : Application of Fourier Transforms to solve various Problems
- Week 9** : Orthogonal expansions, orthogonal Polynomials and their Properties
- Week 10** : Application of Orthogonal Polynomials
- Week 11** : Introduction to Wavelets
- Week 12** : Applications of Wavelets to solve various ODE/PDE



# **MECHANICAL ENGINEERING**



# MECHANICAL ENGINEERING

## 04 weeks

1. Computer numerical control CNC of machine tools and processes
2. Product Design Using Value Engineering
3. Two-Phase flow with phase change in conventional and miniature channels
4. Smart Materials and Intelligent System Design
5. Selection Of Nanomaterials For Energy Harvesting and Storage Applications
6. A short lecture series on contour integration in the complex plane
7. Manufacturing Automation

## 08 weeks

01. Manufacturing of Composites
02. Robotics
03. Design for Quality, Manufacturing and Assembly
04. Refrigeration and air-conditioning
05. Principles of Metal Forming Technology
06. Fluid Machines
07. Design Practice
08. Steam Power Engineering

## 12 weeks

01. Engineering Fracture Mechanics
02. Fundamentals of manufacturing processes
03. Manufacturing Systems Technology
04. Work System Design
05. Concepts of Thermodynamics
06. Energy Conservation and Waste Heat Recovery
07. Heat Exchangers: Fundamentals and Design Analysis
08. Fundamentals of Surface Engineering: Mechanisms, Processes and Characterizations
09. Engineering Metrology
10. Noise Management and Control
11. Convective Heat Transfer
12. Fundamentals of Gas Dynamics
13. Industrial Safety Engineering
14. Advanced Concepts in Fluid Mechanics
15. Applied Thermodynamics For Engineers
16. Dynamic Behaviour Of Materials
17. Engineering Mechanics
18. Fundamentals Of Artificial Intelligence
19. Fundamentals of Conduction and Radiation
20. Plastic Working Of Metallic Materials
21. Turbulent Combustion: Theory and Modelling
22. Mathematical Modeling Of Manufacturing Processes
23. Aircraft Propulsion
24. Solid Mechanics



# PRODUCT DESIGN USING VALUE ENGINEERING

**PROF.INDERDEEP SINGH**

Department of Mechanical Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Core\_Elective | PG/UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : All industries where products are being conceptualized, designed and developed in order to satisfy the human needs and requirements.

**COURSE OUTLINE :**

It has been established worldwide that the most successful economies are based on innovation and creativity led entrepreneurship. The government is focusing on putting concerted efforts to produce job creators. The current MOOC on Product Design using Value Engineering is conceptualized and planned in such a way that it helps both job creators as well as job seekers. The main objective of the course is to acquaint the learners with the practical knowledge regarding conceptualization, design and development of a new product with a focused Value Engineering Approach. The need of a new product, the product design process, the application of Value Engineering principles in product design process have been discussed in the course. The difference between the concept of Value Engineering and Cost Cutting has been elaborated with examples.

**ABOUT INSTRUCTOR :**

Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology, Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed eight video and one web course under the National Programme on Technology Enhanced Learning (NPTEL, MOOCs). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

**COURSE PLAN :**

**Week 1:** Introduction to product design and development, Product design steps and Product analysis, Profit consideration, Value Engineering (history, concept and definitions), Value Engineering vs. Cost cutting

**Week 2:** Creative thinking, Problem identification and VEJP, Types of product functions, Functional analysis, Functional Analysis System Technique (FAST)

**Week 3:** Function-cost relationship I & II, VE applications in product design, Case study I & II

**Week 4:** VE tools and techniques I & II, Behavioral roadblocks, VE Success stories I & II





# A SHORT LECTURE SERIES ON CONTOUR INTEGRATION IN THE COMPLEX PLANE

**PROF. VENKATA SONTI**

Department of Mechanical Engineering  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic Engineering Mathematics

**INTENDED AUDIENCE** : Masters and PhD students

**COURSE OUTLINE :**

This course involves a very brief theory on complex variables and several examples on contour integration that use branch cuts and indentations in the complex plane. There are several elaborate courses on complex variables but not enough on this particular application.

**ABOUT INSTRUCTOR :**

Prof. Venkata Sonti is an Associate Professor at Indian Institute of Science, Bangalore with an Academic identity of 37 journal articles. He did his Ph.D in Purdue University. His research interests lies in the area of vibration and wave propagation in plates and shells, asymptotics in sound structure interaction.

**COURSE PLAN :**

**Week 1:** Theory : Theory of complex variables

**Week 2:** Theorems

**Week 3:** Examples

**Week 4:** Examples and Laplace transform



# TWO-PHASE FLOW WITH PHASE CHANGE IN CONVENTIONAL AND MINIATURE CHANNELS

**PROF. MANMOHAN PANDEY**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Undergraduate level with background (first course) in fluid mechanics, Thermodynamics and heat transfer.

**INTENDED AUDIENCE** : Postgraduate and final year undergraduate students in mechanical and chemical engineering; engineers working in the industry and R&D labs.

**INDUSTRIES APPLICABLE TO** : Companies and R&D labs working in the areas of power generation, refrigeration, oil & gas production, and Thermal management of electronics.

## **COURSE OUTLINE :**

Gas-liquid flows occur in various industrial applications, such as power generation, refrigeration, oil & gas production, and thermal management of future electronic devices. In this course, one-dimensional models of two-phase flow with and without phase change will be introduced. Methods of pressure drop prediction for adiabatic gas-liquid flow as well as flow boiling will be discussed. Special methods for pressure drop modeling of two-phase flow in miniature channels will also be introduced.

## **ABOUT INSTRUCTOR :**

Manmohan Pandey is a Professor of Mechanical Engineering at Indian Institute of Technology (IIT) Guwahati, India. He has been teaching there since 2000 and has also taught at two other IITs, namely, IIT Bombay and IIT Gandhinagar. He has taught over a dozen different courses at undergraduate as well as postgraduate level. His research interest is in two-phase flow instabilities, nuclear reactor thermal hydraulics, flow boiling in miniature channels, and miniature loop heat pipes. He has published a number of papers in reputed scientific journals and conference proceedings. He is a member of the editorial board of the international journal Science and Technology of Nuclear Installations (Hindawi). He has supervised five doctoral theses and a number of masters' theses. He is currently supervising five doctoral students and four masters' students.

## **COURSE PLAN :**

**Week 1:** Introduction to two-phase flow, Two-phase flow regimes, Homogeneous model

**Week 2:** Separated flow model, Drift flux model

**Week 3:** Pressure drop modeling with homogeneous model, separated flow model, drift flux model

**Week 4:** Pressure drop modeling of two-phase flow and boiling in miniature channels



# COMPUTER NUMERICAL CONTROL CNC OF MACHINE TOOLS AND PROCESSES

**PROF. ASIMAVA ROY CHOUDHURY**

Department of Mechanical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG

**COURSE DURATION** : 4 weeks (26 Aug'19 - 20 Sep'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Knowledge of Machine tools, Workshop practice Desirable but not necessary : binary logic, logic gates, curved surface geometry

**INDUSTRY SUPPORT** : Manufacturing companies employing CNC machining technology

## COURSE OUTLINE

These lectures would introduce the idea of Computer Numerical Control (CNC) of machine tools and processes to the students. It will cover classification of such machine tools, technology and devices employed in CNC machines, 2D and 3D programming and interpolation. With every part, there will be MCQ, tutorial, problem solving and discussions.

## ABOUT INSTRUCTOR

Prof. Asimava Roy Choudhury Department of Mechanical Engineering Indian Institute of Technology Kharagpur received his B.E, (Mechanical) Degree from Jadavpur University in 1983, M.Tech. (Machine Tools Engg) from IIT Kharagpur in 1984 and Ph.D. (Engg) from IIT Kharagpur in 1999. Asimava Roy Choudhury is at present a Professor in the Mechanical Engineering Department of IIT Kharagpur. His interests include: Computer numerical control, Direct slicing in Rapid Prototyping, Non-traditional manufacturing processes and Laser coating of surfaces.

## COURSE PLAN

**Week 1** : Computer Numerical Control Machines : Introduction and Classification

**Week 2** : Technologies and devices employed in CNC machines

**Week 3** : 2-D Programming and Interpolation

**Week 4** : 3-D programming and related topics



# SMART MATERIALS AND INTELLIGENT SYSTEM DESIGN

**PROF. BISHAKH BHATTACHARYA**

Department of Mechanical Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, Ph.D

**PRE-REQUISITES** : Basics of Nature and Properties of Materials, Linear algebra

**INDUSTRIES APPLICABLE TO** : Aerospace, Automobile, Manufacturing industries

**COURSE OUTLINE :**

Smart Structures and Intelligent System are becoming an integral part of new aerospace and automobile systems due to high performance and fast response potential. Knowledge in this field is multi-disciplinary in nature involving materials, composites, basic electronics, control system and informatics. In this short course, I intend to convey the core flavor of the field by introducing the basic concepts behind such system along with some industrial applications developed in the SMSS laboratory of IIT Kanpur.

**ABOUT INSTRUCTOR :**

Prof. Bishakh Bhattacharya is currently Dr. Gurumukh D. Mehta and Veena M. Mehta Chair Professor at the Department of Mechanical Engineering and joint faculty at Cognitive Science and Technology, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design and Child-Reconfigurable Robot Interaction. He is the coordinator of Space Technology Cell, IIT Kanpur and head of the SMSS (Smart Materials, Structures and Systems) Laboratory.

<http://home.iitk.ac.in/~bishakh/>

**COURSE PLAN :**

**Week 01** : Introduction to Smart Materials

**Week 02** : Mechanics of Composite Materials

**Week 03** : Induced Strain Actuation Mechanisms

**Week 04** : Intelligent System Design



# SELECTION OF NANOMATERIALS FOR ENERGY HARVESTING AND STORAGE APPLICATIONS

**PROF. KAUSHIK PAL**

Department of Mechanical Engineering  
IIT Roorkee

**TYPE OF COURSE** : New | Core\_Elective | PG/UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : UG & PG students of Metallurgy, Nano Science & Nanotechnology, Chemical Engg, Chemistry, Electronics, Electrical, Physics, and Material Science etc. R&D personnels from industries

**INDUSTRIES APPLICABLE TO** : Nanotech – Energy based industries: BHEL; NTPC; Eaton corporation plc; Tata power solar; Mega Engineer Infrastructure Ltd; Green Hydrogen company; etc.

**COURSE OUTLINE :**

Selection of nanomaterials for energy harvesting and storage applications is an interdisciplinary course which deals with selection of nanomaterials and key challenges to improve performance of the energy harvesting and storage devices/techniques. In this course we will be covering different energy harvesting and storage techniques and the parameters that are to be considered in selecting the nanomaterials for the same.

**ABOUT INSTRUCTOR :**

Dr. Kaushik Pal is Associate Professor in Department of Mechanical and Industrial Engineering, IIT Roorkee since 2012. He obtained his PhD Degree (2009) from IIT, Kharagpur and then joined Gyeongsang National University, South Korea for pursuing Post-Doc research. His fields of interests are surface modification of nano-materials and use of such materials in different energy harvesting storage applications, sensors, Mechanical and bio-medical applications. Currently, he is acting as reviewer of several internationally known journals and is an active member of National Academy of Sciences, American Chemical Society (ACS) and Royal Society of Chemistry (RSC). He is also the recipient of Brain Korea (BK-21) fellowship award and DAAD fellowship award.

**COURSE PLAN :**

**Week 1** : Introduction

**Week 2** : Hydrogen energy

**Week 3** : Nanogenerators

**Week 4** : Energy storage, Nanomaterials used for energy storage, Key challenges for energy storage, Solution of key challenges, Type of energy storages



# MANUFACTURING AUTOMATION

**PROF. SOUNAK KUMAR CHOUDHURY**

Department of Mechanical Engineering

IIT Kanpur

**TYPE OF COURSE** : New | Elective | Both

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic Engineering Courses

**INTENDED AUDIENCE** : Mechanical Engineering, Metallurgy, Aerospace Engineering, Production Engineering

**INDUSTRIES APPLICABLE TO** : All Manufacturing industries, Machine tool manufacturing industries, Automobile Industries and aeronautical assembly industries

## **COURSE OUTLINE :**

The course will basically deal with the following topics: Introduction, Detroit type automation, Analysis of automated flow lines, Automated assembly systems & Orientation of parts in automatic assembly.

## **ABOUT INSTRUCTOR :**

Prof. Sounak Kumar Choudhury have completed my Ph.D. in Mechanical Engineering from Moscow, Russia in 1985 followed by post-doctoral at the same university till 1986. From 1986 I am involved in teaching and research in the Mechanical Engineering Department of Indian Institute of Technology Kanpur. My areas of specialization are conventional and non-conventional machining, automatic control, hydraulic control, machine tools and manufacturing automation.

## **COURSE PLAN :**

- Week 1:** Definition; Discussion on Pros and Cons of Automation; Benefits of Automation; Types of automation: Fixed automation, programmable automation, and Flexible automation- Typical Features and examples; Reasons for automating; Automation strategies; Automated flow lines: the objectives of the use of flow line automation; General forms of Work Flow - criteria for selection; Methods of workpart transport: Continuous, intermittent and asynchronous: types and their selection; Transfer Mechanisms; Examples of transfer mechanisms for linear travel and rotary transfer mechanisms; Buffer Storage;
- Week 2:** Flow line Performance Analysis: Average production time and production rate; Mean time per cycle when machine breakdown occurs; Flow line Performance Analysis: Line efficiency; Cost per item produced; Partial automation: Reasons for using, Advantages and drawbacks; Production and Throughput: Examples; Effect of machine Jamming; Component Quality Control; Choice of assembly methods: Cost, Production Rate, Availability of Labour, and Market Life of the Product; Advantages of Automatic Assembly; Design for automated assembly; Components of automatic Assembly Machines;
- Week 3:** Transfer systems; Assembly Machines: In-Line, Rotary; Continuous and Intermittent Transfer; Indexing Machines: Factors affecting the choice; Various Indexing Mechanisms; Vibratory bowl feeders: Mechanics of Vibratory Conveying - its analysis; Effect of Frequency, Track Acceleration and Vibration Angle; Effect of Track Angle and Coefficient of Friction; Summary of Bowl Feeder Design; Spiral Elevators; General Requirements of Part Feeders; Non-vibratory feeders : Reciprocating Tube Hopper Feeder - its analysis; General Features. Centerboard Hopper Feeder: Analysis: Maximum Track Inclination, Total Cycle Time, Mean Feed Rate; Transfer Mechanisms; Examples of transfer mechanisms for linear travel and rotary transfer mechanisms; Buffer Storage;
- Week 4:** Reciprocating Tube Hopper Feeder: Principle of Operation; External Gate Hopper Feeder: Its Analysis: Maximum Peripheral Velocity, Mean Feed rate; Rotary Disk Feeder: Indexing and Rotary Disk Feeder with continuous drive and their analysis: Load sensitivity, Efficiency and Mean Feed Rate; Orientation of Parts in Automatic Assembly: In-Bowl and Out-of-Bowl Toolings; Typical Orienting Systems: Wiper Blade, Pressure Break, slot in the track; Analysis of Part Orienting Systems; Examples of Out-of-Bowl Toolings; Feed Tracks: Analysis of Horizontal Delivery Feed Track; "ON-OFF" Sensors; Reliability of Feeding.





# MANUFACTURING OF COMPOSITES

**PROF. J RAMKUMAR**

Department of Mechanical Engineering  
IIT Kanpur

<b>TYPE OF COURSE</b>	: Rerun   Core/Elective   UG/PG
<b>COURSE DURATION</b>	: 8 weeks (26 Aug'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 17 Nov 2019

**INTENDED AUDIENCE** : Students of all Engineering and Science disciplines.

**PRE-REQUISITES** : The student should have completed two semesters of UG Engineering or Science program.

**INDUSTRIES APPLICABLE TO** : HAL, NAL, SAIL, ISRO

## COURSE OUTLINE

Selecting manufacturing technique has emerged as one the paramount challenge in the field of composites. Composites are now being used in almost every field of industry, and students working in the area of the composites need to learn the basics, and progressive techniques of composites manufacturing. This course covers the important aspects of composites manufacturing: process selection guidelines, thermoset and thermoplastic Composites manufacturing processes, process parameters and characterizations. Applications and use of each manufacturing process is focused and this is represented separately.

## ABOUT INSTRUCTOR

Prof. Janakranjan .Ramkumar is currently a Professor of Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers.

## COURSE PLAN

**Week 1:** Introduction to Composites; Introduction to Composites; Function of the Matrix and Reinforcement in Composites Matrices: Thermosets and Thermoplastic; Fiber Reinforcement

**Week 2:** Properties and testing composites; Properties of Composites; Composites testing; Composites design: Laminate theory, Rule of mixtures, symmetry and balance

**Week 3:** Thermoset Composites manufacturing processes; Material selection process cont.; Material selection process cont. Design for manufacturing.

**Week 4:** Thermoset composite manufacturing processes; Thermoset Composite manufacturing:Lay-up processes,Spray up process; Thermoset Composite manufacturing:Fiber placement process; Thermoset Composite manufacturing:Resin transfer moulding

**Week 5:** Thermoplastic composite manufacturing processes; Thermoset Composite manufacturing:Vacuum assisted resin transfer moulding; Thermoset Composite manufacturing:Compression molding process; Thermoset composites manufacturing:Filament winding

**Week 6:** Thermoplastic composite manufacturing processes; Thermoplastic Composite manufacturing:Sheet moulding Thermoplastic Composite manufacturing: Injection moulding, sheet moulding, Calendaring; Thermoplastic Composite manufacturing:Extrusion, Blow molding, rotational molding, Thermoforming

**Week 7:** Metal and ceramic matrix composites; Metal Matrix Composites:Metal matrix and reinforcement; Manufacturing processes for Metal Matrix Composites:Dispersion hardened and particle composite; Manufacturing processes for Metal matrix composites:Layer composites and infiltration method

**Week 8:** Prevention of Damage, repair of Composites and selection of processes; Ceramic matrix composites: Hot isostatic processing ; Non – destructive testing of Composites; Manufacturing process selection: Cost, performance, size shape, rate of production. Steps for process selection



# ROBOTICS

**PROF. D.K. PRATIHARI**

Department of Mechanical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, PhD

**INDUSTRIES APPLICABLE TO** : RDCIS, Ranchi CMERI, Durgapur Reliance Industries C-DAC, Kolkata

## COURSE OUTLINE :

The course will start with a brief introduction to robots and robotics. The motivation behind keeping robots in modern industries will be discussed. After providing a brief history of robotics, different components of a robotic system will be identified. The method of determining degrees of freedom of a robotic system will be discussed with some examples. After classifying the robots based on certain criteria, workspace analysis of manipulators will be carried out. Applications of robots in different areas like in manufacturing units, medical science, space, and others, will be discussed. Various methods of robot teaching will be explained with some suitable examples. Economic analysis will be conducted to decide whether we should purchase a robot. Both forward and inverse kinematics problems will be solved with the help of some suitable examples. To ensure smooth variation of joint angles of the robot, trajectory planning schemes will be explained. After carrying out velocity analysis with the help of Jacobian matrix, inverse dynamics problems of robots will be solved using Lagrange-Euler formulation. Control scheme used in robots to realize the joint torques will be discussed. Besides manipulators, analysis will be carried out on wheeled and multi-legged robots. The working principles of various sensors used in robots will be explained in detail. The steps to be followed in robot vision will be discussed with some suitable examples. The principles of motion planning algorithms will be explained in detail. Thus, this course will deal with all the issues related to kinematics, dynamics, control schemes and robot intelligence.

## ABOUT INSTRUCTOR :

Prof. D.K. Pratihari received BE (Hons.) and M. Tech. from REC (NIT) Durgapur, India, in 1988 and 1994, respectively. He obtained his Ph.D. from IIT Kanpur, India in 2000. He received University Gold Medal, A.M. Das Memorial Medal, Institution of Engineers' (I) Medal, and others. He completed his post-doctoral studies in Japan and then, in Germany under the Alexander von Humboldt Fellowship Programme. He is working now as a Professor (HAG scale) of IIT Kharagpur, India. His research areas include robotics, soft computing and manufacturing science.

## COURSE PLAN :

**Week 01** : Introduction to Robots and Robotics

**Week 02** : Introduction to Robots and Robotics (contd.); Robot Kinematics

**Week 03** : Robot Kinematics (contd.); Trajectory Planning

**Week 04** : Robot Dynamics

**Week 05** : Robot Dynamics (contd.); Analysis of Wheeled Robot; Analysis of Biped Robot

**Week 06** : Sensors

**Week 07** : Robot Vision; Robot Motion Planning

**Week 08** : Robot Motion Planning; Summary



# DESIGN FOR QUALITY, MANUFACTURING AND ASSEMBLY

## PROF. PALANIAPPAN RAMU

Department of Mechanical Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech,  
M.S, B.Sc, M.Sc, PhD

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Fiat Chrysler Automotive, Daimler India, Cyient, Saint Gobain

### COURSE OUTLINE :

In the context of product design, it is very important to appreciate the limitations of a design from manufacturing and assembly perspective and to produce high quality products at low cost. This course will introduce methods that can provide guidance to design teams in simplifying product structure to reduce manufacturing and assembly costs, quantify improvements and how robust design concepts can be used for ensuring quality. This course aims at introducing the need to account for variability, mathematically represent it, formulate it and control it. Concepts such as quality, robustness, six sigma and orthogonal array will be discussed.

### ABOUT INSTRUCTOR :

Prof. Saravana Kumar is interested in development of representational and computational tools for virtual and physical prototyping applied to arrive at solutions to design problems. Some of the specific research areas include CAD and 3D data acquisition technologies: geometrical modelling schemes, X-ray tomography, photogrammetry and image-based modelling systems, and rapid prototyping.

Prof. Palaniappan Ramu research interest revolves around optimization and treating uncertainties in product and process design to obtain reliable, robust and quality designs. Most of his work is focused on reduction of computer or physical experiments, building better metamodels, intelligently explore design space and enable better predictions and optimal designs under uncertainties.

### COURSE PLAN :

**Week 01** : Introduction, course expected outcomes, discussion on quality

**Week 02** : Measuring quality: Quality loss function. Discussion on robustness, six sigma concepts

**Week 03** : Quantifying robustness: Signal to Noise Ratio, problem formulation using SNR. Design of experiment discussions

**Week 04** : Orthogonal array, linear graphs, triangular tables, finding optimum combinations. Case studies

**Week 05** : Design for Manufacturing: over the wall design, most influential phase in design, best practices in injection molding and sheet metal working

**Week 06** : Design for additive manufacturing, single point and multipoint tools

**Week 07** : Design for Assembly: Boothroyd Dewhurst method, theoretical minimum number of parts, Xerox producibility index (XPI) method

**Week 08** : Do's and don'ts in manual assembly, assembly time estimation, design for robotic assembly considerations. Design for sustainability



# REFRIGERATION AND AIR-CONDITIONING

**PROF. RAVI KUMAR**

Department of Mechanical and Industrial Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E / B.Tech

**INDUSTRIES APPLICABLE TO** : All HVAC Industries

## COURSE OUTLINE :

This course provides a simple understanding of Refrigeration and Air-conditioning fundamentals. Ideally suited to those with a little or no knowledge of the subject. The course consists of different refrigeration cycles and understanding of psychrometry and psychrometric processes used for the purpose of air-conditioning. Further, the comfort air-conditioning and indoor environment health are also addressed in this course.

## ABOUT INSTRUCTOR :

Dr. Ravi Kumar is a Professor in the Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee. He has taught Refrigeration & Air-conditioning to UG and PG students of the Department. He is a member of ASHRAE, IIFIR and ASME. He has supervised number of masters and doctoral students in this area.

## COURSE PLAN :

- Week 01** : Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.
- Week 02** : Aircraft Refrigeration Cycles, Vapour Compression Cycle, P-h Charts, Actual Vapour Compression Cycle.
- Week 03** : Actual Vapour Compression Cycle, Compound Compression with Intercooling, Multiple Evaporator and Cascade System, Problem Solving.
- Week 04** : Refrigerants, Vapour Absorption Systems.
- Week 05** : Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.
- Week 06** : Psychrometric Processes, Infiltration Design Conditions, Cooling Load.
- Week 07** : Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems.
- Week 08** : Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving.



# PRINCIPLES OF METAL FORMING TECHNOLOGY

**PROF. PRADEEP K. JHA**

Dept. of Mechanical and Industrial Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E / B.Tech, M.E / M.Tech, M.S

**PRE-REQUISITES** : Introduction to manufacturing technology or manufacturing processes.

**INDUSTRIES APPLICABLE TO** : Manufacturing Industries where forming takes place, for example SAIL, BHEL, Foundry and Forge industries like HEC, Bharat Forge etc.

## COURSE OUTLINE :

The course focuses on understanding the science and technology of different forming processes. Most of the metallic objects undergo at least one of the metal forming operations, except the cast ones. Understanding basic principles of metal forming and further being applied by engineers and metallurgists directly contribute towards improvement in production in the industries. The concept of stress, deformation and failure, mechanics of metalworking and analysis of different metal working processes will be covered during the whole course. Introduction and working principle of powder metallurgy forging will be presented in the end. The course will enable the students be conversant with working principles so that they can use the knowledge gained towards increasing the productivity of manufacturing industries in the long run.

## ABOUT INSTRUCTOR :

Dr. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, especially casting processes.

## COURSE PLAN :

**Week 01** : Introduction and classification of metalworking processes, Behavior of materials

**Week 02** : Concept of stress and strain, Hydrostatic and deviatoric stresses

**Week 03** : Flow curve Yield criteria for ductile materials, plastic stress strain relationships

**Week 04** : Yielding and ductility during instability, Effect of strain rate and temperature on flow properties

**Week 05** : mechanics of metalworking, Analysis methods, Hot and cold working

**Week 06** : Introduction, classification and analysis of forging and rolling operations

**Week 07** : Defects in rolled and forged components, Analysis of extrusion process

**Week 08** : Classification and analysis of wire and tube drawing and sheetmetal working, Powder metallurgy forming



# FLUID MACHINES

**PROF. SANKAR KUMAR SOM**

Dept. of Mechanical and Industrial Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic knowledge of Fluid Mechanics

**INDUSTRY SUPPORT** : G.E., I.O.C.L, G.A.I.L., O.N.G.C, Shell

## COURSE OUTLINE

This is an introductory course in Fluid Machines. The subject Fluid Machines has a wide scope and is of prime importance in almost all fields of engineering. The course emphasizes the basic underlying fluid mechanical principles governing energy transfer in a fluid machine and also description of the different kinds of hydraulic and air machines along with their performances. There is a well balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong foundation on Fluid Machines and will be able to apply the basic principles, the laws, and the pertinent equations to engineering design of the machines for required applications.

## ABOUT INSTRUCTOR

Prof. Sankar Kumar Som, is currently an Emeritus Professor (on re-employment) in the Department of Mechanical Engineering at the Indian Institute of Technology, Kharagpur. His field of expertise is thermo fluid sciences. His research interest is combustion science, and in particular, droplet and spray combustion. Apart from guiding 16 doctoral students and publishing more than 100 research papers in peer-reviewed international journals, he has served as principal investigator and chief consultant in several industrial projects with different government and private organizations.

## COURSE PLAN

**Week 1** : Introduction and basic principles

**Week 2** : Hydraulic Impulse Turbine

**Week 3** : Hydraulic Reaction Turbine Part I

**Week 4** : Hydraulic Reaction Turbine Part II and Hydraulic Pump Part I

**Week 5** : Hydraulic Pump Part II

**Week 6** : Hydraulic Pump Part III

**Week 7** : Air Compressor Part I

**Week 8** : Air Compressor Part II





# DESIGN PRACTICE

**PROF. SHANTANU BHATTACHARYA**

Department of Mechanical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : No prerequisite  
**INDUSTRY SUPPORT** : SMIL (Gurgaon), HAL Kanpur and Lucknow, Small & medium scale production industries

## COURSE OUTLINE

The course is intended for beginners in post graduate studies in Design. It can also serve well for aspiring professionals in industry who will be willing to undertake careers in the field of design.

## ABOUT INSTRUCTOR

Prof. Shantanu Bhattacharya currently holds Professor position in Department of Mechanical Engineering at Indian Institute of Technology Kanpur, India. He is also serving as Head of the Design programme at the same institute at present.

## COURSE PLAN

**Week 1** : Introduction and stages of engineering designs of products  
**Week 2** : Concurrent engineering in today's competitive business environment  
**Week 3** : Stanford model of design thinking  
**Week 4** : Product design specifications and constraints  
**Week 5** : Creating forms and their geometric transformation models  
**Week 6** : Material selection processes for designers  
**Week 7** : Introduction to electronics  
**Week 8** : Axiomatic designs



# STEAM POWER ENGINEERING

**PROF. VINAYAK N. KULKARNI**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic UG-level Thermodynamics

**INTENDED AUDIENCE** : Undergraduate students of Mechanical Engineering Industry personnel associated from Thermal power plant; Faculty members associated with Mechanical /Chemical/ Automobile Engineering.

**INDUSTRIES APPLICABLE TO** : Thermax, NTPC

## **COURSE OUTLINE :**

This course deals with steam power plants. One part of the course is about Simple steam power cycle, reheat, regeneration and superheating. Further actual cycle with component efficiencies would also be discussed. Then each component of the plant is discussed in detail. Initially, types of steam generators and their parts are highlighted. Then steam turbine, its type, efficiency and arrangements are focused. Thus this course would provide an understanding on electricity generation or transportation application using steam as working medium.

## **ABOUT INSTRUCTOR :**

Prof. Vinayak N. Kulkarni is an Associate Professor in the Department of Mechanical Engineering of Indian Institute of Technology, Guwahati since January 2015. He completed his undergraduate studies in Mechanical Engineering from the Shivaji University, Maharashtra, India. His post graduation and PhD is from Aerospace Engineering Department of Indian Institute of Science Bangalore. His teaching interests are Basic and Applied thermodynamics, Gas Dynamics, Aircraft propulsion and fluid mechanics. His research interests are Experimental and computational compressible flows, IC engines and non-conventional energy.

## **COURSE PLAN :**

**Week 1:** Vapour Power Cycles: Carnot cycle, Rankine cycle, reheat cycle

**Week 2:** Vapour Power Cycles: Regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration

**Week 3:** Vapour Power Cycles: Low temperature power cycles, ideal working fluid and binary/multi-fluid cycles

**Week 4:** Steam Generator: Subcritical and supercritical boilers, fluidized bed boilers, fire-tube and watertube boilers, mountings and accessories

**Week 5:** Steam Turbine: Impulse and reaction stage, degree of reaction, velocity triangle,

**Week 6:** Steam Turbine: efficiencies Velocity and pressure compounding,

**Week 7:** Steam Turbine: Reheat factor and nozzles

**Week 8:** Cooling Tower: Hygrometry and psychrometric chart



# ENGINEERING FRACTURE MECHANICS

**PROF. K. RAMESH**

Department of Applied Mechanics  
IIT Madras

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCES** : B.E/B.Tech, M.E/M.Tech, M.S/M.Sc, Ph.D

**PRE-REQUISITES** : Basic course on Strength of Materials. Course on Theory of Elasticity desirable

**INDUSTRIES APPLICABLE TO** : HAL, Honeywell, GE, GM, NAL, DMRL, DRDO, BEML, Mahindra&Mahindra, Tata Motors, L&T, VSSC, Defense and Atomic energy Laboratories

## COURSE OUTLINE :

The course covers the basic aspects of Engineering Fracture Mechanics. Spectacular failures that triggered the birth of fracture mechanics, Modes of loading, Classification as LEFM and EPFM, Crack growth and fracture mechanisms, Energy release rate, Resistance, Griffith Theory of fracture, Extension of Griffith Theory by Irwin and Orowan, R-Curve, Pop-in phenomena, Crack branching. Necessary and sufficient conditions for fracture, Stress and Displacement fields in the very near and near-tip fields, Westergaard, Williams and Generalised Westergaard solutions, Influence of the T-stress and higher order terms, Role of photoelasticity on the development of stress field equations in fracture mechanics, Equivalence between SIF and G, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip, Irwin and Dugdale models, Fracture toughness testing, Feddersen TMs residual strength diagram, Paris law, J-integral, HRR field, Mixed-mode fracture, Crack arrest methodologies.

## ABOUT INSTRUCTOR :

Prof. K. Ramesh is currently a Senior Professor at the Department of Applied Mechanics, IIT Madras; as its Chairman during (2005-2009) and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He received his undergraduate degree in Mechanical Engineering from the Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology Madras.

## COURSE PLAN :

- Week 01** : EFM Course outline and Spectacular Failures
- Week 02** : Introduction to LEFM and EPFM, Fatigue Crack Growth Model
- Week 03** : Crack Growth and Fracture Mechanisms, Griffith TMs Theory of Fracture
- Week 04** : Energy Release Rate
- Week 05** : Review of Theory of Elasticity
- Week 06** : Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G
- Week 07** : Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes
- Week 08** : SIF for Various Geometries
- Week 09** : Modeling Plastic Deformation, Irwin TMs model, Dugdale Model
- Week 10** : Fracture Toughness Testing, Paris Law and Sigmoidal curve
- Week 11** : Crack Closure, Crack Growth Models, J-Integral
- Week 12** : Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies



# FUNDAMENTALS OF MANUFACTURING PROCESSES

**PROF. D.K. DWIVEDI**

Dept. of Mechanical and Industrial Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech,M.E/M.Tech,M.S,PhD

**COURSE OUTLINE :**

It is proposed to include fundamental of following aspects of manufacturing technology: Understanding Manufacturing: concept of manufacturing, need, scope, advantages, limitation, application, materials and manufacturing, classification of manufacturing, process capabilities, selection, break even analysis of manufacturing processes. Casting: approach, steps, pattern, molding, gate and riser, melt treatment, solidification, casting processes: sand mould, shell mould, permanent mould casting, casting defect and their remedy. Forming: approach, hot and cold forming, rolling, forging, extrusion, drawing, sheet metal forming, press, dies, types of dies and die set sheet metal operations punching, blanking, notching, nibbling. Joining: approach, need, principle of fusion welding, gas welding, thermit welding, arc welding common arc welding processes, resistance welding, weldability of metals, solidification of weld, weld discontinuities and their remedy. Machining: approach, mechanism, classification, cutting tool, tool material, heat generation, cutting fluid, grinding, internal and external surface grinding, centerless grinding designation and selection of grinding wheel, trueing and balancing, honing, reaming, lapping, polishing etc. Improving properties: heat treatment of steel and aluminum alloys, Fe-C diagram, TTT diagram, and CCT diagram, heat treatment processes annealing, normalizing, quenching tempering, surface modification methods namely without change chemistry, changing chemical composition and development of coating and cladding.

**ABOUT INSTRUCTOR :**

Prof. D.K. Dwivedi obtained BE (mechanical engineering) , in 1993 from GEC Rewa, ME (welding engineering) from Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 12 years at IIT Roorkee of subjects related with manufacturing at UG level and welding engineering related subjects at PG level.

**COURSE PLAN :**

- Week 01** : Understanding Manufacturing
- Week 02** : Selection of manufacturing processes
- Week 03** : Metal Casting: Steps of casting processes
- Week 04** : Metal Casting: Sand Moulding II
- Week 05** : Metal Casting: Cleaning of casting
- Week 06** : Metal working processes: Rolling
- Week 07** : Metal working processing: Sheet metal operations (Shearing)
- Week 08** : Material removal processes: Mechanism of the metal cutting
- Week 09** : Material removal processes: Tool materials
- Week 10** : Material removal processes: Grinding operations
- Week 11** : Joining of metals: Weldability and welding defects
- Week 12** : Heat treatment: Tempering



# MANUFACTURING SYSTEMS TECHNOLOGY (Part 1 and 2)

**PROF. SHANTANU BHATTACHARYA**

Department of Mechanical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : M.Sc, Ph.D

**INDUSTRIES APPLICABLE TO** : SMIL (Gurgaon), HAL (Kanpur and Lucknow), Cyient (Hyderabad), Small and medium scale production industries

**COURSE OUTLINE :**

This is an introductory level course in Manufacturing Systems Technology and management. For most enterprises, the long term goal is to stay in business, grow and make profits. This is particularly true for manufacturing enterprises, which must understand the dynamic changes that are taking place in business environment and are flexible enough to change at every level. This course is an introductory course for engineering professionals who would like to take up careers in manufacturing and also for professionals who are already in manufacturing careers and would like to see the technological changes that manufacturing paradigm has witnessed in the last 3 decades.

**ABOUT INSTRUCTOR :**

Prof. Shantanu Bhattacharya is currently an Associate Professor at the Department of Mechanical Engineering at the Indian Institute of Technology Kanpur. Prior to joining IIT Kanpur he was associated with Suzuki Motors in the senior management level and has over 6 years of experience in various production capacities and positions.

**COURSE PLAN :**

- Week 01** : Manufacturing properties of materials, Computer aided designing. (Contd)
- Week 02** : Manufacturing properties of materials, Computer aided designing. Manufacturing
- Week 03** : properties of materials, Computer aided designing.
- Week 04** : Principles and process planning of basic machining processes, Machine tools design.
- Week 05** : Principles and process planning of basic machining processes, Machine tools design.
- Week 06** : Computer aided process planning
- Week 07** : Introduction to CNC part programming, Product design
- Week 08** : Just-in-time manufacturing
- Week 09** : Quality systems engineering
- Week 10** : Cost of quality and statistical quality control
- Week 11** : Cost of quality and statistical quality control
- Week 12** : Robotic systems planning and designing



# WORK SYSTEM DESIGN

**PROF.INDERDEEP SINGH**

Department of Mechanical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**INDUSTRIES APPLICABLE TO** : All the industries using work system theory to improve their productivity and effectiveness.

## COURSE OUTLINE :

Work System Design deals with the systematic examination of the methods of doing work with an aim of finding the means of effective and efficient use of resources and setting up of standards of performance for the work being carried out. The systematic examination of work involves what is done? And how it is done? As well as what is the standard time to do the work? This is required to have an in-depth analysis of all the elements, factors, resources and relationships affecting the efficiency and effectiveness of the work being studied. The course also aims at scientifically establishing the time required for a qualified worker to carry out a work element at a defined rate of working. Ergonomic aspects of work system design are also included in the course contents. The scope of this course is not only limited to the manufacturing applications but it is also relevant for service sector industry.

## ABOUT INSTRUCTOR :

Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management.

## COURSE PLAN :

- Week 01** : Work System Design: Introduction, Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models
- Week 02** : Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity.
- Week 03** : Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, , Techniques of Work Study, Human Aspects of Work Study.
- Week 04** : Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Examples.
- Week 05** : Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams.
- Week 06** : String Diagrams, Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts.
- Week 07** : Memo-Motion Study, Cycle graph and Chrono-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods.
- Week 08** : Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Time Study Equipment, Performance Rating.
- Week 09** : Performance Rating: Examples, Allowances, Computation of Standard Time, Numerical on Computation of Standard Time, Case Study
- Week 10** : Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST
- Week 11** : Ergonomics: Basic Concept, Industrial Ergonomics, Ergonomics: Anthropometry, Man-Machine System-1, Man-Machine System-2
- Week 12** : Case Study of Office Chair, Case Study of Tower Crane Cabin, Case Study of Car Seat, Case Study of Computer System, Case Study of Assembly Line Worker.





# CONCEPTS OF THERMODYNAMICS

**PROF. SUMAN CHAKRABORTY**

Department of Mechanical Engineering  
IIT Kharagpur

**PROF. ADITYA BANDYOPADHYAY**

Department of Cryogenic Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : B.Tech students of all disciplines and  
teachers of undergraduate thermodynamics

**EXAM DATE** : 17 Nov 2019

**INDUSTRIES APPLICABLE TO** : Fiat Chrysler Automotive, Daimler India, Cyient, Saint Gobain

**COURSE OUTLINE :**

Thermodynamics is the basic building block of all of modern day industries (power generation, iron and steel, food processing etc.) and human convenience (refrigeration, engines, air conditioning etc.). Understanding and applying various ideas of thermodynamics is therefore at the heart of progress in science and engineering. The course aims at building strong fundamentals of work and heat interactions for various systems. Through various examples, the ideas of several industrial components and power/refrigeration cycles are further elucidated by addressing the problems from first principles. The ideas are extended to real systems where exergy or equivalently, the availability of a state is analyzed to give a feel of real problems to the students. Uniqueness of this course is a delicate balance between fundamental concepts and applications, in a manner consistent with the recently proposed AICTE Model Curriculum guidelines.

**ABOUT INSTRUCTOR :**

Dr. Suman Chakraborty is currently a Professor in the Mechanical Engineering Department as well as an Institute Chair Professor of the Indian Institute of Technology Kharagpur, India, and the Head of the School of Medical Science and Technology. He is also the Associate Dean for Sponsored Research and Industrial Consultancy. His current areas of research include microfluidics, nanofluidics, micro-nano scale transport.

Dr. Aditya Bandyopadhyay is currently an Assistant Professor in the Mechanical Engineering Department at Indian Institute of Technology Kharagpur, India. His research interests include micro- and nanofluidics, transport through porous media, and electrohydrodynamics. He completed his Dual Degree from IIT Kharagpur (Institute Silver Medal) in 2012 and received his Ph.D. from IIT Kharagpur in 2015

**COURSE PLAN :**

- Week 01** : Fundamental definitions and concepts in thermodynamics
- Week 02** : Properties of pure substances
- Week 03** : Work and heat
- Week 04** : First law of thermodynamics for closed systems
- Week 05** : First law of thermodynamics for open systems – I
- Week 06** : First law of thermodynamics for open systems – II
- Week 07** : Second law of thermodynamics
- Week 08** : Entropy transfer for closed systems
- Week 09** : Entropy transfer for open systems
- Week 10** : Irreversibility and exergy
- Week 11** : Thermodynamic Cycles: Air Standard Cycles, Vapour Power Cycles
- Week 12** : Thermodynamic Cycles: Vapour Power Cycles (contd), Refrigeration Cycles



# ENERGY CONSERVATION AND WASTE HEAT RECOVERY

**PROF. PRASANTA KUMAR DAS**

Department of Mechanical Engineering  
IIT Kharagpur

**PROF. ANANDAROOP BHATTACHARYA**

Department of Mechanical Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG/PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**PRE-REQUISITES** : Basic Thermodynamics

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INDUSTRIES APPLICABLE TO** : BHEL, NTPC, CESC, WBSEB, DVC and other power companies, GE, Siemens, Alstom

## COURSE OUTLINE :

Estimates from analyses and audits from various industries suggest that 20 to 50% of industrial energy input is lost as waste heat. This waste heat can be in the form of hot exhaust gases, water/fluid streams (from condensers in power plants) or heat lost from hot equipment and surfaces. As the world strives for higher energy efficiencies, it is imperative that along with better equipment we focus on recovering the energy stored in this “waste heat” and utilize it for useful purposes. The proposed course introduces us to various methods of Waste Heat Recovery that has been employed by the industry to harness the energy stored in waste heat and use it for generation of additional electric power.

## ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean PG Studies and Research at IIT Kharagpur. His research interests lie in the broad area of thermal engineering with special emphasis on two phase flows. He possesses a vast experience in teaching and research.

Prof. Anandaroop Bhattacharya is an Associate Professor of Mechanical Engineering at IIT Kharagpur. His research interests lie in the areas of electronics cooling, transport in porous media and gas turbine heat transfer. Prior to joining IIT, Anandaroop spent 12 years in the industry in USA and India working at Intel, General Motors and General Electric Research Centers.

## COURSE PLAN :

- Week 01** : Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
- Week 02** : Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency
- Week 03** : Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples
- Week 04** : Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
- Week 05** : Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and  $\epsilon$ -NTU method
- Week 06** : Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network
- Week 07** : Heat pipes & Vapor Chambers, Direct conversion technologies – Thermoelectric Generators.
- Week 08** : Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD
- Week 09** : Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.
- Week 10** : Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage
- Week 11** : Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.
- Week 12** : Energy Economics



# HEAT EXCHANGERS: FUNDAMENTALS AND DESIGN ANALYSIS

**PROF. PRASANTA KUMAR DAS**

Department of Mechanical Engineering  
IIT Kharagpur

**PROF. INDRANIL GHOSH**

Department of Cryogenic Engineering  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, Ph.D

**PRE-REQUISITES** : Basis knowledge of Statistical Mechanics

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INDUSTRIES APPLICABLE TO** : All the companies generating coal based and nuclear based power (NTPC, different state electricity boards, CPRI, BARC, and NPCL etc.). Companies dealing with the design and fabrication of heat exchangers, auto mobile industries, process industries, oil refineries. Companies dealing with waste heat recovery and renewable. Some specific companies could be BHEL, ALSTOM, HP, HPCL, IOCL, THERMAX, BPCL, GAIL, Reliance, TATA Chemicals etc.

## COURSE OUTLINE :

Heat exchangers are extensively used in diverse industries covering power generation, refrigeration and air conditioning, cryogenics, oil refineries and chemical processes, automobiles and other transport devices. The performance of a heat exchanger is very important for the conservation of energy, assurance of product quality, process viability and environmental protection. The present course aims at developing a familiarity with various types of heat exchangers, their construction and applications. Conventional methods of heat exchanger analysis; brief design methodology of typical heat exchangers and synthesis of heat exchanger network. It is planned to develop an appreciation and basic expertise in heat exchanger through description, mathematical analysis and numerical examples.

## ABOUT INSTRUCTOR :

Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean Post Graduate Studies and Research at IIT Kharagpur. He possesses a vast experience in teaching and research. His research interests lie in the broad area of thermal engineering with a special emphasis on two phase flow.

Indranil Ghosh received his B. Sc. and M. Sc. in Physics from Jadavpur University in 1990 and 1992 respectively, M.Tech and Ph.D. from the Cryogenic Engineering Centre, Indian Institute of Technology, Kharagpur in 1995 and 2005 respectively.

## COURSE PLAN :

**Week 01** : Background, Application, Classification, Common terminologies

**Week 02** : Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing and rating. F-LMTD and -NTU method.

**Week 03** : Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types.

**Week 04** : Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer, Fin tube heat exchanger.

**Week 05** : Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design, application. Multistream PFHE.

**Week 06** : Multistream PFHE continued. Direct contact heat exchangers, types, application, simple analysis.

**Week 07** : Regenerators, types of regenerators, construction, application. Theory of Regenerator, NTU and method.

**Week 08** : Heat pipes, construction, working principle, application, analysis. Special heat pipes.

**Week 09** : Microscale Heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations

**Week 10** : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

**Week 11** : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.

**Week 12** : Heat Exchanger testing, steady state and dynamic methods.



# FUNDAMENTALS OF SURFACE ENGINEERING: MECHANISMS, PROCESSES AND CHARACTERIZATIONS

**PROF. D.K. DWIVEDI**

Department of Mechanical Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : M.E/M.Tech, M.S, M.Sc, Ph.D

**INDUSTRIES APPLICABLE TO** : Mining, Hydropower, Cement and Manufacturing

**COURSE OUTLINE :**

The course content is designed to have systematic and comprehensive understanding on various aspects related with surface engineering of metallic components for enhanced tribological life. It is proposed to include fundamental mechanisms of wear such as adhesive, abrasive, erosive, cavitation, corrosion etc., governing laws, materials properties importance for improved wear resistance under different wear conditions, materials increased tribological life, processes for engineering surfaces of three board categories a) regulating the micro-structure without changing chemical composition b) modification of chemical composition of near surface layers and c) developing of films, coating, and cladding on the. Methods of characterization needed for evaluating the metallurgical and mechanical and tribological properties and performance of engineered surfaces shall also be presented. Presentations will be supported with case studies for effective communication of concepts and procedures. Case studies will be taken up regarding surface engineering of various metal systems like ferrous and non-ferrous metals using different approaches discussed.

**ABOUT INSTRUCTOR :**

Dr. D.K. Dwivedi obtained BE (Mechanical Engineering) , in 1993 from GEC Rewa, ME (welding engineering) from Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 12 years at IIT Roorkee of subjects related with manufacturing at UG level and welding engineering related subjects at PG level including failure analysis of welded joints. He has undertaken work of failure investigation valves, penstocks, bridges for many private and public sector industries especially in hydropower sector.

**COURSE PLAN :**

**Week 01** : Introduction

**Week 02** : Introduction - contd.

**Week 03** : Surface damage

**Week 04** : Surface damage - contd.

**Week 05** : Materials for wear resistant applications

**Week 06** : Processes for Controlling Wear: Structural Modification

**Week 07** : Processes for Controlling Wear: Composition Modification

**Week 08** : Processes for Controlling Wear: Composition Modification - contd.

**Week 09** : Processes for Controlling Wear: Composition Modification & Weld Surfacing

**Week 10** : Processes for Controlling Wear: Coatings & Cladding

**Week 11** : Processes for Controlling Wear: Coatings & Overlays

**Week 12** : Processes for Controlling Wear: Coatings & Characterization



# ENGINEERING METROLOGY

**PROF. JANAKRANJAN RAMKUMAR**

Department of Mechanical Engineering  
IIT Kanpur

**PROF. AMANDEEP SINGH**

Dept. of Industrial and Production Engineering  
NIT, Jalandhar

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION:** 12 weeks(29 Jul'19 - 18 Oct'19)

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, M.Sc, PhD **EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : The student should have completed two semesters of UG Engineering or Science program.

**INDUSTRIES APPLICABLE TO** : HAL, NAL, SAIL, ISRO

**COURSE OUTLINE :**

Engineering metrology is the use of measurement science in manufacturing. The study of metrology is highly valuable for the students and practitioners, specifically from mechanical and allied engineering stream. For a product to be successful, it needs to be manufactured according to metrological specifications, otherwise heavy costs are incurred to comply with the specifications in the later stage. Also, the role played by measurements in the day today life makes it essential to study metrology. This course is designed to impart the knowledge to develop measurement procedures, conduct metrological experiments, and obtain and interpret the results. A laboratory demonstration are also induced to enhance the learning process. The course would be useful in many areas in the traditional and modern high technology viz. manufacturing, industrial, scientific research, defense, and many others.

**ABOUT INSTRUCTOR :**

Dr. Janakranjan Ramkumar is currently a Professor of Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award.

Dr. Amandeep Singh is working as Assistant Professor in the Department of Industrial and Production Engineering Department, National Institute of Technology, Jalandhar, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has over eight years of industrial and academic experience.

**COURSE PLAN :**

**Week 01** : Introduction to Engineering Metrology

**Week 02** : Introduction to Engineering Metrology, contd

**Week 03** : Statistics in Metrology

**Week 04** : Linear Measurements

**Week 05** : Angular and rotation measurements

**Week 06** : Comparators

**Week 07** : Optical measurements, and temperature measurements

**Week 08** : Screw threads metrology, and gears metrology

**Week 09** : Transducers

**Week 10** : Flow and Pressure measurements, and strain measurements

**Week 11** : Surface finish metrology, and mechatronics

**Week 12** : Nano-metrology, and Quality control



# NOISE MANAGEMENT AND CONTROL

**PROF. NACHIKETA TIWARI**

Department of Mechanical Engineering  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E, M.E, M.Sc, Ph.D

**PRE-REQUISITES** : Must be enrolled into a B. Tech. program or equivalent and should have completed at least Second year of his 4-year program.

**INDUSTRIES APPLICABLE TO** : Automotive, NVH, Acoustics, Railways, Power Generation and all industry that has to address issues related to noise.

## COURSE OUTLINE

This course is intended for all those who want to understand noise, its control, and its management. Thus, the course is open to students of engineering and science, and also to all those who from the industry and research organizations – who are working in area of sound, NVH and acoustics. Each lecture will be followed by a quiz, which will help student the concepts better, and gain deeper insights to measurement process. The course is fairly generic so that there is no need for a particular background. Rather, what is needed is openness, and ability to learn and check out new ideas with comfort.

## ABOUT INSTRUCTOR :

Dr. Nachiketa Tiwari is an Associate Professor of Mechanical Engineering at IIT Kanpur. He has extensive experience in area of acoustics and noise. Earlier, he worked for over 13 years at the R&D Headquarters Bose Corporation in Massachussetts. He has developed several courses on noise, acoustics, and NVH. He has been engaged in several noise and vibration related projects to fulfill the needs of India's industry as well as research organizations. He has established Dhvani, an Acoustics Lab at IITK, which is one of the best in the country.

## COURSE PLAN :

**Week 01** : Intro and terminology

**Week 02** : Concept Review

**Week 03** : Wave Mechanics

**Week 04** : 1-D Waves

**Week 05** : Spherical Waves

**Week 06** : Noise Measurement

**Week 07** : Noise Sources

**Week 08** : Noise Sources

**Week 09** : Acoustic Criteria & Room Acoustics

**Week 10** : Room Acoustics & Silencers

**Week 11** : Silencers & Vibration Isolation

**Week 12** : Silencers & Vibration Isolation





# CONVECTIVE HEAT TRANSFER

**PROF. SAPTARSHI BASU**

Department of Mechanical Engineering  
IISc Bangalore

<b>TYPE OF COURSE</b>	: Rerun   Core/Elective   UG/PG
<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 17 Nov 2019

**INTENDED AUDIENCE** : B.E, M.E, M.Sc, Ph.D  
**PRE-REQUISITES** : Heat Transfer and Fluid Mechanics  
**INDUSTRIES APPLICABLE TO** : GE, Siemens, HPCL, GTRE

## COURSE OUTLINE

Convective heat transfer is ubiquitous to many domains ranging from large scale power generation to microscale flow. The course as outlined aims to offer insights and fundamentals into convective heat transfer processes. The course will first cover the basics of conservation equations in generalized convective heat transfer systems. Subsequently in the later modules, it will offer in depth analyses of specific areas like a.) internal and external forced convection, b.) internal and external free convection and c.) advanced topics like turbulent heat transfer. The coverage will benefit people from many industries like gas turbines, solar thermal, materials processing to name a few.

## ABOUT INSTRUCTOR

Prof. Saptarshi Basu, Department of Mechanical Engineering, Indian Institute of Science, Bangalore leads large scale initiatives in the area of combustion, multi-phase flow and heat transfer. He is a project leader in the National Center for Combustion Research and Development and SERIUS (Solar Energy Research Institute for India and the United States). Before joining IISc, Dr. Saptarshi Basu was an Assistant Professor in the Department of Mechanical, Materials and Aerospace Engineering at University of Central Florida from August 2007-May 2010. Dr. Saptarshi Basu received his M.S. and Ph. D. degrees in Mechanical Engineering from University of Connecticut in 2004 and 2007 respectively.

## COURSE PLAN

- Week 1** : Introduction to Convective Heat Transfer
- Week 2** : Introduction to external forced convection
- Week 3** : Integral solutions-II
- Week 4** : Other wall heating conditions-unheated length
- Week 5** : Effect of conduction across a solid coating
- Week 6** : Heat transfer to fully developed flow-I
- Week 7** : Heat transfer to developing flow-II
- Week 8** : Integral solutions-II
- Week 9** : Vertical channel flow-I
- Week 10** : Scaling analysis-II
- Week 11** : Rayleigh-Benard convection
- Week 12** : Introduction to turbulent heat transfer -II



# FUNDAMENTALS OF GAS DYNAMICS

**PROF. A.SAMEEN**

Department of Aerospace Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core/Elective | UG/PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Undergraduate students of Mechanical and Aerospace Engineering

**PRE-REQUISITES** : Thermodynamics and fluid mechanics

**INDUSTRIES APPLICABLE TO** : Aerospace industry

## COURSE OUTLINE

The course introduces compressible flow and its constitutive equations. The physical concepts behind isentropic flows, area-Mach number relation etc will be discussed with practical problems in mind. Properties of shocks and expansions are important parts of this course. All the numerical examples will be in SI units.

## ABOUT INSTRUCTOR

Prof. A. Sameen, Department of Aerospace Engineering, IIT-Madras

Research interest: Fluid Mechanics

Current interests: Stability, Transition and Turbulence, Thermal Convection, Quantum Fluids, Magnetohydrodynamics

## COURSE PLAN

- Week 1 :** Fluids, compressible flow I & II laws of TD Clausius inequality
- Week 2:** Control volume analysis Conservation of mass Conservation of momentum
- Week 3:** Conservation of energy, Tutorial
- Week 4:** Sonic velocity, Wave propagation, Pressure-energy relation
- Week 5:** Stagnation concept, Isentropic flows, Stagnation relations, Tutorial
- Week 6:** Varying area flow Mass, momentum, energy equations Converging nozzle
- Week 7:**  $M^*$  concept, Gas tables, C-D nozzle, Tutorial
- Week 8:** Standing normal shocks, Prandtl's relation, Normal shocks in CD nozzle
- Week 9:** Rankine-Hugoniot equation, Moving shocks, Tutorial
- Week 10:** Oblique Shocks, Theta-Beta-M relation, Shock polar curves
- Week 11:** Expansion fans, Prandtl-Meyer flow, Tutorial
- Week 12:** Conculsion



# INDUSTRIAL SAFETY ENGINEERING

**PROF. MAITI**

Department of Mechanical Engineering  
IIT Kharagpur

<b>TYPE OF COURSE</b>	: Rerun   Core/Elective   UG/PG
<b>COURSE DURATION</b>	: 12 weeks (29 Jul'19 - 18 Oct'19)
<b>EXAM DATE</b>	: 16 Nov 2019

**INTENDED AUDIENCE** : Students of all Engineering and Science disciplines.

**PRE-REQUISITES** : The student should have completed two semesters of UG Engineering or Science program.

**INDUSTRIES APPLICABLE TO** : HAL, NAL, SAIL, ISRO

## COURSE OUTLINE

Safety is one of the key dimensions of engineering asset management. Safety by design or prevention through design is in the core for maintaining engineering systems safe. The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings. Upon completion of the course, the students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability.

## ABOUT INSTRUCTOR

Prof. Maiti, PhD, Professor, Department of Industrial & Systems Engineering, Indian Institute of Technology (IIT), Kharagpur has more than fifteen years of teaching, research and consulting experience on Safety Analytics, Quality Analytics and Engineering Ergonomics. He has published more than 70 papers in international and national journals of repute and more than 30 papers in conference proceedings. Till date, he has supervised 11 PhD candidates to successful completion and currently supervising 8 PhD research candidates. He has been executing a number of Industry-sponsored consulting and Government as well industry funded research projects. His current UAY project entitled "Safety analytics – save people at work from accidents and injuries" was funded by MHRD, Ministry of Steel, and Tata Steel Limited.

## COURSE PLAN

**Week 1** : Introduction, key concepts, terminologies, and safety quantification, safety by design

**Week 2** : Hazard identification techniques (e.g., HAZOP, FMEA, etc.)

**Week 3** : Fault tree and event tree analysis (qualitative & quantitative)

**Week 4** : Bow-tie and quantitative risk assessment (QRA)

**Week 5** : Safety function deployment

**Week 6** : Safety vs reliability – quantification of basic events (repair to failure, repair-failure-repair, and combined processes)

**Week 7** : Safety vs reliability – quantification of basic events (contd.)

**Week 8** : Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)

**Week 9** : Human error analysis and safety

**Week 10** : Accident investigation and analysis

**Week 11** : Application of virtual reality

**Week 12** : OSHAS 18001 and OSHMS



# ADVANCED CONCEPTS IN FLUID MECHANICS

**PROF. SUMAN CHAKRABORTY**  
**PROF. ADITYA BANDOPADHYAY**  
IIT Kharagpur  
Mechanical Engineering

**TYPE OF COURSE** : New | Core | UG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B. Tech/M. Tech/MS/B.Sc./M.Sc./PhD students of all disciplines and teachers of undergraduate Fluid Mechanics

**INDUSTRIES APPLICABLE TO** : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others)

## **COURSE OUTLINE :**

This is a course which deals with advanced concepts in Fluid Mechanics. The course emphasizes the fundamental in underlying fluid mechanical principles and application of those principles to solve real life problems. There is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance.

## **ABOUT INSTRUCTOR :**

Prof. Suman Chakraborty is a Professor in the Mechanical Engineering Department of the Indian Institute of Technology (IIT) Kharagpur, India, and Indian National Academy of Engineering Chair Professor. He is also currently the Head, School of Medical Science and Technology at IIT Kharagpur. He has research interests in the area of Microfluidics and MicroNano scale transport processes, including their theoretical, computational, and experimental modeling, encompassing the underlying fundamentals as well as bio-medical.

Prof. Aditya Bandopadhyay is currently an Assistant Professor in the Mechanical Engineering Department at Indian Institute of Technology Kharagpur, India. His research interests include micro- and nanofluidics, transport through porous media, and electrohydrodynamics. He completed his Dual Degree from IIT Kharagpur (Institute Silver Medal) in 2012 and received his Ph.D. from IIT Kharagpur in 2015.

## **COURSE PLAN :**

**Week 1:** Essential Mathematical Foundations

**Week 2:** Kinematics of Fluid Flows

**Week 3:** Dynamics of Inviscid Flows

**Week 4:** Potential Flows

**Week 5:** Integral forms of Conservation Equations: Reynolds Transport Theorem

**Week 6:** Dynamics of Viscous Flows: Derivation of Navier-Stokes Equation

**Week 7:** Exact Solutions of Navier-Stokes Equations for Fully Developed Laminar Flows and some Unsteady Flows

**Week 8:** Laminar Boundary Layers

**Week 9:** Instability; Introduction to Turbulence

**Week 10:** Turbulence (contd.); Fluid flow about Immersed bodies

**Week 11:** Geophysical Fluid Dynamics

**Week 12:** Creeping Flows; Microscale Fluid Flows



# APPLIED THERMODYNAMICS FOR ENGINEERS

**PROF.DIPANKAR N. BASU**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Fundamentals of Thermodynamics

**INTENDED AUDIENCE** : Undergraduate students of Mechanical Engg and similar branches; Faculty members associated with Mechanical Engineering; Practicing engineers associated with Thermal Industries (such as Power, Automobile, Airconditioning etc.).

**INDUSTRIES APPLICABLE TO** : Any industry associated with the design, development & operation of thermal equipment, such as power stations, automobiles, airconditioning etc.,

## **COURSE OUTLINE:**

Thermodynamics is a subject of fundamental interest to Mechanical engineers and therefore is always taught in the 2nd or 3rd semester. Present course can be viewed as the next step, where the thermodynamic principles will be employed to discuss about different power producing & absorbing cycles. Properties of pure substance will be discussed, along with the thermodynamic property relations, thereby enabling the participants to estimate all relevant thermodynamic properties at any particular state of point. Subsequently the gas & vapor power cycles will be analyzed, followed by the principles of cogeneration & combined cycles. Then the refrigeration cycles will be introduced, followed by a discussion on the selection of refrigerants. The properties of gas mixtures and gas-vapor mixtures will also be discussed, leading to psychrometry & psychrometric processes. The course will be completed with a brief introduction to the chemical equilibrium.

## **ABOUT INSTRUCTOR :**

Dr. Dipankar N. Basu is an Associate Professor in the department of Mechanical Engineering at Indian Institute of Technology, Guwahati since June 2012. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his PhD from Indian Institute of Technology, Kharagpur in 2011. He served as an Assistant Professor at IEST Shibpur for four years before joining IIT Guwahati. His principal research interest is in the field of Nuclear Thermalhydraulics, Two-phase flow, Supercritical heat transfer and Microchannel heat transfer. He is currently working on computational tool development for simulation of flows with free-surfaces and fluid-structure interaction. He has co-authored more than 70 referred journal and conference publications and also a book chapter on Supercritical Natural Circulation Loop. He is a regular reviewer of many reputed international journals and also associated with several sponsored projects.

## **COURSE PLAN :**

**Week 1:** Review of Thermodynamic Principles

**Week 2:** Thermodynamic Property Relations

**Week 3:** Properties of Pure Substances

**Week 4:** Air Standard Cycles

**Week 5:** Real Cycles for Reciprocating Engines

**Week 6:** Gas Turbine Cycles

**Week 7:** Vapor Power Cycles

**Week 8:** Cogeneration & Combined Cycles

**Week 9:** Refrigeration Cycles

**Week 10:** Gas Mixtures

**Week 11:** Gas-vapor Mixtures

**Week 12:** Chemical Reactions



# DYNAMIC BEHAVIOR OF MATERIALS

**PROF. PRASENJIT KHANIKAR**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Solid Mechanics and Materials Science

**INTENDED AUDIENCE** : Mechanical Engineers, Civil Engineers, Materials Engineers

**INDUSTRIES APPLICABLE TO** : Defense, Automotive, Aerospace

## **COURSE OUTLINE :**

Study of materials behavior in extreme environments and development of new materials for such environments has become a vital research area for materials scientists and engineers in the 21<sup>st</sup> century. Mechanical properties of materials under dynamic loading are considered as an important area of research and development in Defense, Automotive and Aerospace industries. This course will be important to mechanical, materials and civil engineers to understand materials behavior for ballistic applications, explosive forming or welding applications, automotive and aerospace applications.

## **ABOUT INSTRUCTOR :**

Dr. Prasenjit Khanikar is an Assistant Professor of Mechanical Engineering Department at the Indian Institute of Technology, Guwahati. His research interests include development of materials and structures for high strain rate applications, modeling and experimental characterization of materials microstructure and crystalline plasticity. Dr. Khanikar received his PhD in Mechanical Engineering from North Carolina State University, USA. Before joining IIT Guwahati, he was working as a Postdoctoral Research Scientist at Columbia University in the City of New York, USA.

## **COURSE PLAN :**

**Week 1:** Introduction: Dynamic deformation and failure

**Week 2:** Introduction to waves: Elastic waves; Types of elastic waves; Reflection, Refraction  
Interaction of waves

**Week 3:** Plastic waves and shock waves: Plastic waves of uniaxial stress, uniaxial strain and combined stress; Taylor's experiments; Shock waves

**Week 4:** Shock wave induced phase transformation; Explosive-material interaction and detonation

**Week 5:** Experimental techniques for dynamic deformation: Intermediate strain rate tests; Split Hopkinson pressure bar; expanding ring test; gun systems

**Week 6:** Review of mechanical behavior of materials (especially metals): Elastic and plastic deformation of metals; dislocation mechanics;

**Week 7:** Plastic deformation of metals at high strain rates: Empirical constitutive equations; relationship between dislocation velocity and applied stress; physically based constitutive equations

**Week 8:** Plastic deformation in shock waves: Strengthening due to shock wave propagation; Dislocation generation; Point defect generation and deformation twinning

**Week 9:** Strain localization/shear bands: Constitutive models; Metallurgical aspects

**Week 10:** Dynamic Fracture: Fundamentals of fracture mechanics; Limiting crack speed, crack and dynamic fracture toughness; Spalling and fragmentation

**Week 11:** Dynamic deformation of materials other than metals: Polymers; Ceramics; Composites

**Week 12:** Applications: Armor applications; Explosive welding and forming





# ENGINEERING MECHANICS

**PROF. K. RAMESH**

Department of Applied Mechanics  
IIT Madras

**TYPE OF COURSE**

: New | Elective | UG/PG

**COURSE DURATION**

: 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE**

: 17 Nov 2019

**PRE-REQUISITES** : Basic course on Strength of Materials. Course on Theory of Elasticity desirable

**INDUSTRIES APPLICABLE TO** :HAL, Honeywell, GE, GM, NAL,DMRL, DRDO,BEML, Mahindra&Mahindra, Tata Motors, L&T, VSSC, Defense and Atomic energy Laboratories

**COURSE OUTLINE :**

The course covers the basic aspects of Engineering Fracture Mechanics. Spectacular failures that triggered the birth of fracture mechanics, Modes of loading, Classification as LEFM and EPFM, Crack growth and fracture mechanisms, Energy release rate, Resistance, Griffith Theory of fracture, Extension of Griffith Theory by Irwin and Orowan, R-Curve, Pop-in phenomena, Crack branching. Necessary and sufficient conditions for fracture, Stress and Displacement fields in the very near and near-tip fields, Westergaard, Williams and Generalised Westergaard solutions, Influence of the T-stress and higher order terms, Role of photoelasticity on the development of stress field equations in fracture mechanics, Equivalence between SIF and G, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip, Irwin and Dugdale models, Fracture toughness testing, Feddersen's residual strength diagram, Paris law, J-integral, HRR field, Mixed-mode fracture, Crack arrest methodologies.

**ABOUT INSTRUCTOR :**

Prof. K. Ramesh is currently a Senior Professor in the Department of Applied Mechanics, IIT Madras. He served as Chairman during (2005-2009) and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He received his undergraduate degree in Mechanical Engineering from Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology, Madras.

**COURSE PLAN :**

**Week 1:** EFM Course outline and Spectacular Failures

**Week 2:** Introduction to LEFM and EPFM, Fatigue Crack Growth Model

**Week 3:** Crack Growth and Fracture Mechanisms, Griffith's Theory of Fracture

**Week 4:** Energy Release Rate

**Week 5:** Review of Theory of Elasticity

**Week 6:** Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G

**Week 7:** Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes

**Week 8:** SIF for Various Geometries

**Week 9:** Modeling Plastic Deformation, Irwin's model, Dugdale Model

**Week 10:** Fracture Toughness Testing, Paris Law and Sigmoidal curve

**Week 11:** Crack Closure, Crack Growth Models, J-Integral

**Week 12:** Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies



# FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

**PROF. SHYAMANTA M. HAZARIKA**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic Course in Probability and Linear Algebra

**INTENDED AUDIENCE** : Final Year B.Tech/M.Tech and PhD students

## **COURSE OUTLINE :**

There are complex real-world problems like speech recognition and machine translations that span across various practices of engineering. Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

## **ABOUT INSTRUCTOR :**

Prof. Shyamanta M Hazarika is with the Department of Mechanical Engineering at Indian Institute of Technology, Guwahati. Prof. Hazarika have an M.Tech in Robotics from IIT Kanpur. He has been awarded PhD from School of Computing, University of Leeds, England. From October 2009 to March 2010, he has been a Vertretungsprofessur (Substitute 'Full' Professor) of Cognitive Systems and NeuroInformatics, FB3 -Informatik, University of Bremen, Germany. His primary research interest is in Rehabilitation Robotics and Knowledge Representation and Reasoning. This translates into interest in bio-mimetic prosthetics; cognition and cognitive vision. From August 2010 to May 2017, he was a Professor in the Department of Computer Science and Engineering at Tezpur University, where in he had established the Biomimetic and Cognitive Robotics Lab.

## **COURSE PLAN :**

**Week 1:** Artificial intelligence: History, Trends and Future

**Week 2:** Problem Solving by search

**Week 3:** Problem Solving by search (contd)

**Week 4:** Knowledge Representation and Reasoning

**Week 5:** Knowledge Representation and Reasoning (Contd)

**Week 6:** Knowledge Representation and Reasoning (contd)

**Week 7:** Reasoning under uncertainty

**Week 8:** Planning

**Week 9:** Planning, Decision Making

**Week 10:** Decision Making

**Week 11:** Machine Learning

**Week 12:** Machine Learning (contd)



# FUNDAMENTALS OF CONDUCTION AND RADIATION

**PROF. AMARESH DALAL**  
**PROF. DIPANKAR N. BASU**  
Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : No specific pre-requisite. Fundamental knowledge of Mathematics should be sufficient.

**INTENDED AUDIENCE** : Undergraduate students of Mechanical Engineering and similar branches; Faculty member associated with Mechanical Engineering; Practicing engineers associated with thermal/power industries

**INDUSTRIES APPLICABLE TO** : Heat transfer is a topic of fundamental interest in mechanical engineering and hence any engineering firm & concerned industry should find this course interesting & valuable.

## **COURSE OUTLINE :**

This is introductory course on conduction and radiation heat transfer. This course emphasizes the fundamental concepts and provides detailed solution methodology. This course will provide students with the tools to model, analyze and solve a wide range of engineering applications involving conduction and radiation heat transfer.

## **ABOUT INSTRUCTOR :**

Prof. Amaresh Dalal is currently an Associate Professor in the Department of Mechanical Engineering of the Indian Institute of Technology, Guwahati. He received his PhD degree from Indian Institute of Technology Kanpur in 2009 and he was Post-doctoral Research Associate at Purdue University from Sep 2008 - Dec 2009. He has research interests in the area of Computational Fluid Dynamics and Heat Transfer, Finite Volume Methods and Unstructured Grid Techniques, Multiphase Flows. Dr. Dalal is now profoundly involved in developing a general purpose, versatile and robust computational fluid dynamics solver over hybrid unstructured grid which can solve a wide range of real-life fluid flow, heat transfer, and problems involving transport phenomena over complex geometries.

Prof. Dipankar N. Basu is an Associate Professor in the department of Mechanical Engineering at Indian Institute of Technology Guwahati since June 2012. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his PhD from Indian Institute of Technology Kharagpur in 2011. He served as an Assistant Professor at IEST Shibpur for four years before joining IIT Guwahati. His principal research interest is in the field of nuclear thermalhydraulics, two-phase flow, supercritical heat transfer and microchannel heat transfer. He has co-authored more than 70 referred journal and conference publications and also a book chapter on supercritical natural circulation loop.

## **COURSE PLAN :**

- Week 1:** Introduction to Heat Transfer
- Week 2:** Introduction to Conduction
- Week 3:** 1-D Steady-state Heat Conduction
- Week 4:** Special 1-D Heat Conduction Situations
- Week 5:** Heat Transfer from Extended Surfaces
- Week 6:** 2-D Steady-state Heat Conduction
- Week 7:** Transient Heat Conduction
- Week 8:** Numerical Methods in Conduction
- Week 9:** Fundamentals of Radiation Heat Transfer
- Week 10:** Radiative Properties of Real Surfaces
- Week 11:** Radiation Exchange between Surfaces
- Week 12:** Radiation with Participating Media



# PLASTIC WORKING OF METALLIC MATERIALS

**PROF. P.S. ROBI**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core\_Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Mechanical Engineering /Manufacturing Engineering/ Metallurgical Engineering students

**COURSE OUTLINE :**

Plastic working of metallic materials is an important subject area for applications like automobiles, aircraft, defense, construction, domestic use, etc. This course is developed for a variety of audience viz., undergraduate as well as post graduate students of Mechanical Engineering and Metallurgical Engineering, practicing engineers and technocrats. The course begins with the fundamentals of metal working and slowly moves to advanced analysis of metalworking. Most of the conventional metal working processes has been discussed highlighting the equipments used , the industrial processes and detailed analysis of the particular processes. After attending this course, the participant will be fully conversant with the conventional deformation processing techniques practiced by the present day metal industries.

**ABOUT INSTRUCTOR :**

Dr. P. S Robi did his B.Tech degree in Mechanical Engineering from Kerala University in 1986, M.Tech in Foundry –Forge Technology from NFFT Ranchi and subsequently earned his Ph.D degree from the Department of Metallurgical Engineering and Materials Science in 1995. He joined IIT Guwahati as an Assistant Professor in the department of Mechanical Engineering in 1997 and was promoted to Associate Professor, and later Full Professor. He served IIT Guwahati under various capacities, viz., Head, Department of Mechanical Engineering, Dean (Research and Development) and presently serving as Deputy Director. He is actively involved in teaching undergraduate and post graduate courses related to Materials and Manufacturing. His research interest is Materials development and Manufacturing. He has successfully completed 13 research projects. He has supervised 6 PhD thesis and around 32 M.Tech thesis and is presently supervising 7 PhD thesis.

**COURSE PLAN :**

**Week 1:** Fundamentals of metal working

**Week 2:** Flow curve determination

**Week 3:** Mechanics of Metal working

**Week 4:** Forging process

**Week 5:** Drawing Operations

**Week 6:** Extrusion of metals

**Week 7:** Rolling of Metals

**Week 8:** Sheet metal forming

**Week 9:** Drawing Operations (contd)

**Week 10:** Extrusion of metals (contd)

**Week 11:** Rolling of Metals (contd)

**Week 12:** Sheet metal forming (contd)



# TURBULENT COMBUSTION: THEORY AND MODELLING

**PROF. ASHOK DE**

Department of Aerospace Engineering  
IIT Kanpur

**TYPE OF COURSE** : New | Core/Elective | Both

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Fluid Mechanics, Thermodynamics, Basic Combustion, Basic turbulence

**INTENDED AUDIENCE** : Senior undergraduate students and postgraduate students of Mechanical, Aerospace and Chemical Engineering

**INDUSTRIES APPLICABLE TO** : Aerospace, Automobile, Chemical and Power Generation and Defense Industries

**COURSE OUTLINE :**

Combustion is still the world's dominant energy conversion technology. The fundamental knowledge of combustion is expected to improve the design of the industrial combustion systems by enhancing the flame stability, improving the combustion efficiency, and reduction in pollutant formation. In this course, an integrated understanding of theoretical, and numerical aspects of combustion especially in the field of unsteady turbulent combustion would be covered. The discussion would continue on basic techniques and recent progress in the fields of turbulent combustion while establishing important connections with the underlying combustion basics.

**ABOUT INSTRUCTOR :**

Prof. Ashoke De is currently working as Associate Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. He leads large scale initiatives in the modeling of turbulent reacting and non-reacting flows at IIT Kanpur. So far, he has authored more than 100 peer reviewed articles in journals and conferences. His primary research focus is the emerging field of computational mechanics with particular interest in combustion and turbulent flows.

**COURSE PLAN :**

**Week 1:** Introduction, Basics of Combustion

**Week 2:** Thermo-chemistry

**Week 3:** Thermo-chemistry, Combustion chemistry

**Week 4:** Heat & Mass Transfer, Coupling of chemical kinetics & Thermodynamics

**Week 5:** Laminar Premixed flame

**Week 6:** Laminar Non-premixed flame

**Week 7:** Turbulence, Turbulence modeling

**Week 8:** Turbulent premixed flames

**Week 9:** Turbulent premixed flames (contd.)

**Week 10:** Turbulent non-premixed flames

**Week 11:** Turbulent non-premixed flames (contd.)

**Week 12:** Combustion in two-phase flows





# MATHEMATICAL MODELING OF MANUFACTURING PROCESSES

**PROF. SWARUP BAG**

Department of Manufacturing Engineering  
IIT Guwahathi

**TYPE OF COURSE** : New | Elective | Both

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : There are no pre-requisites in educational qualification.

**INTENDED AUDIENCE** : Bachelor/Master/PhD students having background in Mechanical/Material Science/Metallurgical engineering/Production Engineering/Manufacturing Technology

**COURSE OUTLINE :**

The understanding of the basic mechanism such as heat and mass transport with associated fluid flow including metallurgical transformation, distortion and residual stress generation in different manufacturing processes is the focus of this course. This course is completely different from statistical or data driven modeling approach. This course emphasized on the understanding of the most general to advanced manufacturing processes based on scientific principle. The complex mechanism is presented in a simplified way to understand the subject at elementary level. The broad impact is that the students will be able to develop physics based computational model of manufacturing process using standard commercial package (However, this course does not intend to cover the learning of the commercial software)

**ABOUT INSTRUCTOR :**

Prof. Swarup Bag is presently working as an Associate Professor in the department of Manufacturing Engineering , IIT Guwahathi. His area of interests are Fusion welding processes, Finite element method, Laser micro joining, Heat transfer and fluid flow in fusion welding, Residual stress and distortion, Recrystallization in hot metal forming process, Optimization in manufacturing process etc.

**COURSE PLAN :**

**Week 1:** Introduction to Manufacturing processes

**Week 2:** Physics of manufacturing processes

**Week 3:** Conventional machining

**Week 4:** Conventional machining

**Week 5:** Non-conventional machining

**Week 6:** Metal forming

**Week 7:** Welding

**Week 8:** Casting and powder metallurgy

**Week 9:** Coating and additive manufacturing

**Week 10:** Heat treatment

**Week 11:** Micro/nano scale manufacturing

**Week 12:** Processing of non-metallic materials





# AIRCRAFT PROPULSION

**PROF. VINAYAK N. KULKARNI**

Department of Mechanical Engineering  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic UG-level Fluid Mechanics and Thermodynamics

**INTENDED AUDIENCE** : Undergraduate students of Aerospace and Mechanical Engineering and postgraduate students specializing in Thermofluids/Fluid Mechanics/Automobiles; Industry personnel associated with Aerospace Engineering; Faculty members associated with Mechanical / Aerospace Engineering.

**INDUSTRIES APPLICABLE TO** : Airbus, Boeing, General Electric

**COURSE OUTLINE :**

This course deals with gas power cycles for aircraft propulsion. Therefore different types of aircraft engines, their parts and their performance parameters are discussed. Then the cycle analysis and its different attachments for improvisation are also focused upon further, different parts of aircraft engines like compressor, turbines, combustor and nozzle are discussed in detail.

**ABOUT INSTRUCTOR :**

Dr. Vinayak N. Kulkarni has been an Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology Guwahati since January 2015. He completed his undergraduate studies in Mechanical Engineering in the Shivaji University, Maharashtra, India. His post graduation and PhD is from Aerospace Engineering Department of Indian Institute of Science Bangalore. His teaching interests are basic and applied thermodynamics, gas dynamics, aircraft propulsion and fluid mechanics. His research interests are experimental and computational compressible flows, IC engines and non-conventional energy.

**COURSE PLAN :**

**Week 1:** Introduction to Gas turbines and Aircraft Propulsion

**Week 2:** Aircraft propulsion

**Week 3:** Ideal and Real cycle analysis

**Week 4:** Ideal and Real cycle analysis(contd)

**Week 5:** Real cycles

**Week 6:** Real cycles (contd)

**Week 7:** Engine performance and Engine components

**Week 8:** Centrifugal Compressors

**Week 9:** Axial Compressors

**Week 10:** Axial and Radial Turbines

**Week 11:** Turbine cooling methods and Component matching

**Week 12:** Blade design and cascade theory



# SOLID MECHANICS

**PROF. AJEET KUMAR**

Department of Applied mechanics

IIT Delhi

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : 1st year engineering mechanics

**INTENDED AUDIENCE** : Undergraduate students

## COURSE OUTLINE :

Course, in this deformation of solid bodies and the underlying concepts are introduced to undergraduate students. The course begins by building solid foundation of the concept of Stress and Strain in Three-dimensional Deformable Bodies. It further uses these concepts to study extension, torsion and bending of beams. The one-dimensional theory of beams are also introduced. We also discuss various theories of failure which are critical for design of machine elements in industry.

## ABOUT INSTRUCTOR :

Prof. Ajeet Kumar is currently working as an Associate Professor in the Department of Applied Mechanics at IIT Delhi. He received his PhD from the Department of Theoretical & Applied Mechanics at Cornell University. He primarily works in the field of solid mechanics. His key topics of research are: Theory of continuum and nano rods, Finite deformation elastoplasticity, Computational Mechanics, Molecular modeling, Fluid-structure interaction, etc.

## COURSE PLAN :

**Week 1:** Mathematical preliminaries and notation; Kinematics of deformation: rigid vs deforming solids; Lagrangian and Eulerian descriptions; Concept of Traction vector

**Week 2:** Stress tensor and its representation in Cartesian coordinate system; Transformation of stress matrix; Equations of equilibrium; Symmetry of stress tensor;

**Week 3:** State of stress in simple cases ; Principal stress components and principal planes; Maximizing shear component of traction at a point; Mohr's circle

**Week 4:** Stress invariants; Octahedral Plane; Decomposition of stress tensor; Concept of strain and strain tensor; Longitudinal, shear and volumetric strains;

**Week 5:** State of strain in simple cases; Strain compatibility condition; Local infinitesimal rotation; Linear stress-strain relation: isotropic and orthotropic cases; Relation between material constants;

**Week 6:** Stress and strain matrices in cylindrical coordinate system; Equations of equilibrium in cylindrical coordinate system, Axisymmetric deformations: Combined extension-torsion of a cylinder

**Week 7:** Spinning of circular shafts; shrink-fit problems; Pure bending of symmetric beams; Bending under transverse load: shear stress distribution

**Week 8:** Bending of beams having non-symmetrical cross-section; Shear center, Shear flow in thin and open cross-section beams

**Week 9:** Deflection of a beam: Euler Bernoulli and Timoshenko beam models; Buckling of beams

**Week 10:** Reciprocal relations, Castigliano's theorem, Deflection of straight and curved beams using energy method

**Week 11:** Various theories of failure and their application

**Week 12:** Brief introduction to plasticity, Yield surface



# **METALLURGICAL AND MATERIALS ENGINEERING**



# METALLURGICAL AND MATERIALS ENGINEERING

## 04 weeks

- 01. Fundamentals of electronic device fabrication
- 02. Welding of Advanced High Strength Steels for Automotive Applications
- 03. Structural Analysis of Nanomaterials

## 08 weeks

- 01. Biomaterials for bone tissue engineering applications
- 02. Corrosion - Part II
- 03. Thermo-Mechanical And Thermo-Chemical Processes
- 04. Fundamentals and Applications of Dielectric Ceramics
- 05. An Introduction to Materials: Nature and Properties (Part 1: Structure of Materials)
- 06. Nanotechnology, Science and Applications

## 12 weeks

- 01. Advanced Materials and Processes
- 02. Physics of Materials
- 03. Transport Phenomena In Materials
- 04. Welding Metallurgy



# FUNDAMENTALS OF ELECTRONIC DEVICE FABRICATION

**PROF. PARASURAMAN S**

Department of Metallurgy and Material Science  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Fundamentals of Electronic Materials and Devices

**INTENDED AUDIENCE** : Engineering and Science students at the UG and PG level

**INDUSTRIES APPLICABLE TO** : Semiconductor device fabrications companies such as TSMC and Applied Materials will value this course

**COURSE OUTLINE :**

The course is intended to provide an understanding of current fabrication practices used in the semiconductor industry, along with the challenges and opportunities in Device Fabrication. It caters to UG and PG students from diverse backgrounds such as Chemical, Electrical, Mechanical, Metallurgy, Materials Science, Physics, and Chemistry. The course provides an overview on integrated circuit fabrication along with practices and challenges to continue to satisfy Moore's law.

**ABOUT INSTRUCTOR :**

Prof. Parasuraman is a faculty in the Dept. of Metallurgical and Materials Engineering IIT Madras. He graduated from IITM, with a B. Tech and M. Tech Dual degree and completed his PhD from the University of Illinois. He obtained a Postdoctoral fellowship from Johns Hopkins University, and worked at Intel Corp as a Yield Engineer, before joining IITM in 2013. His research interests include printed electronics and thin film deposition.

**COURSE PLAN :**

**Week 1:** Introduction and Overview of Semiconductor Device Fabrication

**Week 2:** Fabrication Operations: Oxidation, Doping, and Lithography

**Week 3:** Fabrication Processes: Etching and Growth. Process Evaluation

**Week 4:** Process Yield, Clean Room Design, and IC logic and packaging



# WELDING OF ADVANCED HIGH STRENGTH STEELS FOR AUTOMOTIVE APPLICATIONS

**PROF. MURUGAIYAN AMIRTHALINGAM**

Department of Metallurgical and Materials Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.E/M.Tech,M.S,B.Sc,M.Sc,PhD, Final year B.E/B.Tech students or Graduates  
of Metallurgical/Mechanical/Automobile/

**PRE-REQUISITES** : Production Engineering,Basic knowledge of steel physical metallurgy and welding processes.

**INDUSTRIES APPLICABLE TO** : All automotive manufacturers and their OEMs and Steel plants.

**COURSE OUTLINE :**

The use of advanced high strength steels (AHSS) is increasingly preferred in automotive applications due to improved crash energy management and enhanced strength-ductility combinations, resulting in greener and safer vehicles. The weldability of AHSS is generally poorer than conventional steels due to the high alloying contents required to obtain multi-phase microstructure. This course is aimed to discuss the (i) role of alloying elements in stabilizing multi-phase microstructures of AHSS, (ii) effect of weld thermal cycles on the evolution of microstructures and (iii) weldability of AHSS.

**ABOUT INSTRUCTOR :**

Dr. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research interests include welding metallurgy, welding processes development, steel product development and additive manufacturing

**COURSE PLAN :**

**Week 01** : Introduction to physical metallurgy of advanced high strength steels

**Week 02** : Introduction to welding processes in automotive industries (Advanced Gas Metal Arc, Resistance Spot and Laser Welding Processes).

**Week 03** : Welding metallurgy of advanced high strength steels – Effect of weld thermal cycles on the stability of phases, solidification behaviour, segregation and hot cracking susceptibility.

**Week 04** : Mechanical properties of advanced high strength steel weldments – Tensile shear testing, HAZ softening characteristics, role of modified weld thermal cycles (post pulsing and post weld heat treatments) to improve the mechanical properties.





# STRUCTURAL ANALYSIS OF NANOMATERIALS

**PROF. KAUSHIK PAL**

Department of Mechanical and Industrial Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, PhD

**INDUSTRIES APPLICABLE TO** : Nanotech based industries: Nanoshel; Adnano Technologies; Mittal Enterprises; Ultrananotech; Reinste Nano Ventures; etc.

## COURSE OUTLINE :

Structural analysis of nanomaterials is an important part of Materials Science and Nanoscience & Nanotechnology which deals with the study of crystal structure of materials and their defects. It is a prerequisite for the understanding of properties of nanomaterials to have a detailed knowledge of the structure from the atomic/molecular (local) level to the crystal structure and to the microstructure (mesoscopic scale and defect structure). The primary goal of structural analysis of nanomaterials is aiming at both investigating the structure-property relationship and discovering new properties, in order to achieve relevant improvements in current state-of-the art materials.

## ABOUT INSTRUCTOR :

Dr. Kaushik Pal is an Associate Professor in Department of Mechanical and Industrial Engineering, IIT Roorkee since 2012. He has obtained his Ph.D Degree (2009) from IIT, Kharagpur and then joined to Gyeongsang National University, South Korea for pursuing Post-Doc research. His fields of interests are surface modification of nano-materials and use of such materials in different electronic, mechanical and bio-medical applications. Currently, he is acting as reviewer of several internationally known journals and an active member of National Academy of Sciences, American Chemical Society (ACS) and Royal Society of Chemistry (RSC). Also, he is the recipient of Brain Korea (BK-21) fellowship award and DAAD fellowship award.

## COURSE PLAN :

**Week 01** : Introduction: Fundamental concepts of atomic structure and interatomic bonding, Structure of materials, Defects in structure of materials, Phase diagram: Determination of phases, Transformation of phases.

**Week 02** : Basic properties: Metals, Basic properties: Ceramics , Basic properties: Polymers, Selection of nanomaterials, Structure property relationship of advanced nanomaterials.

**Week 03** : Introduction to X-Ray Spectroscopy, Diffraction direction and methods of XRD, Determination of crystal structures by XRD Pattern, Precise parameter measurements, Orientation of single crystals.

**Week 04** : Qualitative analysis by diffraction, Quantitative analysis by diffraction, Microscopic structural analysis of nanomaterials-I, Microscopic structural analysis of nanomaterials-II, Other characterization used.



# BIOMATERIALS FOR BONE TISSUE ENGINEERING APPLICATIONS

**PROF. BIKRAMJIT BASU**

Department of Mechanical and Industrial Engineering  
IISc Bangalore

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students of BE/ME/MSc/PhD streams

**INDUSTRIES APPLICABLE TO** : Smith & Nephew/Adler Mediequip Pvt. Ltd., Pune, CIPET, Chennai

**COURSE OUTLINE :**

Biomaterials, recognized as a new class of materials in the Materials Science community, are being developed in last few decades for human health care. The design and development of biomaterials requires the integration of the concepts and expertise from two widely different disciplines, i.e. Materials Science & Engineering and Biological Science.

**ABOUT INSTRUCTOR :**

Dr. Bikramjit Basu is currently a full Professor at the Materials Research Center and holds Associate Faculty position at Center for Biosystems Science and Engineering, Indian Institute of Science (IISc), Bangalore. He is currently an Adjunct faculty at Indian Institute of Technology Kanpur (IITK). After his undergraduate and postgraduate degree in Metallurgical Engineering, he earned his PhD in Ceramics at Katholieke Universiteit Leuven, Belgium in March, 2001. After a brief post-doctoral stint at University of California, Santa Barbara; he joined IITK in November 2001 as Assistant Professor and was promoted to full Professor at IITK in March, 2012. Prof. Basu's international standing and impact on the field are illustrated by his prolific publication record (more than 225 peer-reviewed journal articles, including 30 papers in journals with high impact factor (>4.0), more than 20 invited review papers/book chapters) and citation record (total citation: ~ 5,300, H-index: 41). He currently serves on editorial board of 12 SCI journals. Dr. Basu has served as a research adviser to 16 PhD students, 20 Masters students and mentored 10 young academic colleagues.

**COURSE PLAN :**

**Week 01** : Introduction to Biomaterials and Biocompatibility

M1-Introduction, M2-Biomaterial, M3-Biocompatibility, M4- Host response

**Week 02** : Defining tissue engineering scaffolds and implants

M5-Tissue Eng, M6-Scaffold, M14-Bone structure, M15-Bone properties, M16-Implant-I, M17-Implant-II

**Week 03** : Structure and Properties of Proteins and Cells

M7-Proteins, M8-Cell structure, M13-Bacteria structure, M27-Antibacterial assay

**Week 04** : Stem cells and Cell fate processes

M11-Cell fate processes, M12-Cell division, M23-Cell differentiation, M24-Stem cells

**Week 05** : Cell-material Interaction (in vitro and in vivo) and Clinical trials

M18-Osseointegration, M19-in vivo testing, M9-Cell-material interaction, M10-Cell-signalling, M21-in vitro testing, M22-Cytotoxicity assays, M25-Clinical trials I, M26-Clinical trials II

**Week 06** : Manufacturing of Biomaterials (metals, ceramics and polymers)

M28-Metal manufacturing, M29-Ceramics manufacturing, M30- Polymers manufacturing, M31-Additive manufacturing

**Week 07** : HA-based composites, M32-HA-Ti-Toughness, Cell functionality, M33-HA-CaTiO<sub>3</sub> development, M34-HA-BaTiO<sub>3</sub> Functional Prop, M35-HA-Ag antimicrob & cell viability, M36-HA-ZnO, Cell fate & antimicrobial

**Week 08** : Glass ceramics for orthopedic and dental applications, acetabular socket and femoral head, prototype development; M37-Dental ceramics: processing, M38-Sr-based glass Ceramics, M39-Acetabular socket (Compression mold), M40-ZTA femoral ball head fabrication



## CORROSION - PART II

**PROF. KALLOL MONDOL**

Department of Metallurgy and Material Science  
IIT Kanpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Chemical Thermodynamics, Phase transformation and Electrochemistry

**INTENDED AUDIENCE** : Bachelor and Master's students, PhD students working in corrosion

**INDUSTRIES APPLICABLE TO** : Oil, Chemical and Power sector, Construction

### **COURSE OUTLINE :**

The course will begin with recap of electrochemical polarization and mixed potential theory. Corrosion events and passivity will be discussed on the basis of mixed potential theory. The course will also concentrate on different corrosion protection methods, various test methods to understand corrosion and stress effect in combination of corrosion of metals and alloys. Finally, it will discuss oxidation of metals and alloys.

### **ABOUT INSTRUCTOR :**

Prof. Kallol Mondal is a Professor in the Department of Materials Science and Engineering, IIT Kanpur. His specializations are Phase transformations of metals and alloys, Corrosion and oxidation behavior and Multi-phase steel development.

### **COURSE PLAN :**

**Week 1:** Introduction: - Electrochemical Polarization: Activation and Concentration polarization and Mixed Potential Theory (Recap)

**Week 2:** Corrosion events and Mixed Potential Theory - Understanding of corrosion event on the basis of mixed potential theory: Activation controlled and concentration controlled corrosion

**Week 3:** Passivation and Mixed Potential Theory - Theory of passivity in metals and alloys -

**Week 4:** Protection of Metals and Alloys and Mixed Potential Theory - Cathodic protection: Sacrificial anode and Impressed current cathodic protection (ICCP) - Industrial application and calculations Protection of Metals and Alloys: - Metal composition and structure - Environmental control over corrosion - Coating - Inhibitor

**Week 5:** Corrosion experiments - Potentiodynamic test - Galvanostatic test - Linear polarization- Immersion test - Salt fog test

**Week 6:** Stress effect on corrosion - Stress corrosion cracking (SCC) - Corrosion fatigue - Hydrogen embrittlement

**Week 7:** Oxidation of Metals and Alloys - Pilling Bedworth Ratio - Thermodynamics of oxidation: Ellingham diagram

**Week 8:** Oxidation of Metals and Alloys, Kinetics of oxidation - Effect of doping on the oxidation behavior



# THERMO-MECHANICAL AND THERMO-CHEMICAL PROCESSES

**PROF. VIVEK PANCHOLI**

Department of Metallurgy and Material Science  
IIT Roorkee

**PROF. S. R. MEKA**

Department of Metallurgy and Material Science  
IIT Roorkee

**TYPE OF COURSE** : New | Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep'2019

**PRE-REQUISITES** : Mechanical Metallurgy, Physical Metallurgy, Basic Thermodynamics

**INDUSTRIES APPLICABLE TO** : SAIL, TATA steel, Essar Steel, BHEL, JSW steel, Hindalco, TataMotors, Larsen & Toubro

**COURSE OUTLINE :**

Phase constitution and the dispersion of various phases in solids decisively influence the properties of materials. Size distribution of various phases in solids can be tailored by understanding and optimizing the solid state phase transformations in solids. Phase transformation can be influenced by coupling the heat treatment either by introduction of mechanical energy into solids or by altering the chemistry of solids. Accordingly several Thermo Mechanical and Thermo Chemical processes treatments have been developed by the researchers. This course is designed to provide the fundamental science behind these processes so that optimal utilization of these processes is possible.

**ABOUT INSTRUCTOR :**

Prof. Vivek Pancholi obtained BE (Industrial and Production Engg.) in 1995 from G.S.I.T.S. Indore, M.Tech.(Industrial Tribology) from IIT Delhi in 1997 and PhD in Metallurgical Engineering from IIT Bombay, in 2005. He joined IIT Roorkee as a faculty member in the Department of Metallurgical and Materials Engineering in 2006. He has about 12 years teaching experience at IIT Roorkee.

Prof. Sai Ramudu Meka is working as a faculty in the Department of Metallurgical and Materials Engineering, IIT Roorkee. He obtained his bachelor of engineering degree in Metallurgy from NIT, Surathkal in the year 2002. Then he served as a Junior Manager for Jindal Vijayanagara Steels Ltd.(JVSL), Toranagallu, Bellary, Karnataka. In 2004 he left JVSL to pursue his master's studies in Metallurgy and Materials science at IIT Kanpur.

**COURSE PLAN :**

**Week 1:** Introduction, Hot deformation processes I & II, Flow curves as a function of strain rate and temperature, Stress, strain, strain rate sensitivity

**Week 2:** Microstructural evolution, Recovery, Recrystallization, Dynamic recrystallization, DDRX, CDRX, GDRX

**Week 3:** Texture, Deformation texture (BCC), Deformation texture (FCC), Recrystallization texture (BCC), Recrystallization texture (FCC)

**Week 4:** Constitutive analysis, Low strain rate, Medium strain rate, High strain rate

**Week 5:** Deformation maps, Processing maps, Different models, Interpretation, Processing maps micro structure correlation

**Week 6:** SPD based thermo-mechanical processes, Friction stir Processing, Equal Channel Angular Processing, High pressure torsion

**Week 7:** Introduction to Thermo chemical surface treatments, Thermodynamics of Gas/solid equilibrium, Kinetics of reactions; heterogeneous reactions at surfaces and inward diffusion into solids

**Week 8:** Nitriding treatments; Gaseous/salt-bath/plasma, Carburizing treatments; Pack/ Gas/ Plasma/ Salt-bath, Low temperature processes for stainless steels



# FUNDAMENTALS AND APPLICATIONS OF DIELECTRIC CERAMICS

**PROF. ASHISH GARG**

Department of Metallurgy and Material Science  
IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic understanding of Physics and Materials Science Fundamentals of Crystallography and defects

**INTENDED AUDIENCE** : Undergraduate and postgraduate students of engineering and sciences who work in the area of electronic ceramics and dielectrics

**INDUSTRIES APPLICABLE TO** : Companies which make dielectric capacitors

**COURSE OUTLINE :**

This is a course on dielectric ceramics which focuses on fundamentals and applications of such materials. Dielectrics are important class of materials which are useful for many applications including Sensors, Actuators, Capacitors etc. This course will stress on understanding their structure, defect chemistry, and theory of both linear as well as nonlinear dielectrics followed by a brief discussion of their applications.

**ABOUT INSTRUCTOR :**

Prof. Ashish Garg is Professor of Materials Science and Engineering at IIT Kanpur. He works on electronic materials and devices and his current research is in the area of energy materials.

**COURSE PLAN :**

**Week 1:** Bonding and Structure of Ceramics

**Week 2:** Defects in Dielectric Ceramics

**Week 3:** Linear Dielectrics (Basic Mechanisms, Polarization mechanisms and polarizability, Frequency dependence)

**Week 4:** Linear Dielectrics (Frequency Dependence, Impedance analysis, Applications of linear dielectric materials)

**Week 5:** Non-linear Dielectrics (Basics and Piezoelectrics)

**Week 6:** Non-linear Dielectrics (Piezoelectrics and pyroelectrics)

**Week 7:** Non-linear Dielectrics (Ferroelectrics)

**Week 8:** Ferroics and multiferroics, Processing methods



# AN INTRODUCTION TO MATERIALS: NATURE AND PROPERTIES (PART 1: STRUCTURE OF MATERIALS)

**PROF. ASHISH GARG**

Department of Metallurgical and Material Science  
IIT Kanpur

**TYPE OF COURSE**

: Rerun | Elective | PG

**COURSE DURATION**

: 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE**

: 16 Nov 2019

**INDUSTRY SUPPORT** : Materials related companies

**PRE-REQUISITES** : 12th standard science background

**COURSE OUTLINE**

The course is first part of the broader course on Introduction to Nature of materials and would be suitable for undergraduate and postgraduate students of every branch of science and engineering. The first part of this course will focus on essentials of crystallography, crystal structures of different classes of materials, structure determination and defects in materials.

**ABOUT INSTRUCTOR**

Prof. Ashish Garg is Professor of Materials Science and Engineering at IIT Kanpur. Details of his research and teaching can be accessed on [home.iitk.ac.in/~ashishg](http://home.iitk.ac.in/~ashishg).

**COURSE PLAN**

**Week 1** : Introduction and Basic crystallography

**Week 2** : Symmetry

**Week 3** : Crystal Systems, Bravais Lattices and Miller Indices, Interstices

**Week 4** : Structure of Metals and Alloys

**Week 5** : Structure of Ceramics

**Week 6** : Structure of Polymers

**Week 7** : Structure Determination: X-ray diffraction

**Week 8** : Defects in Materials





# NANOTECHNOLOGY, SCIENCE AND APPLICATIONS

**PROF. PRATHAP HARIDOSS**

Department of Metallurgical and Material Engineering  
IIT Madras

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : First two years of undergraduate course of Engineering (Introductory, undergraduate level Physics, Chemistry and Mathematics)

**COURSE OUTLINE :**

This course will familiarize the student to the science related to various phenomena observed at the nanoscale. Following an introduction to the basic ideas of nanoscience and nanotechnology, several examples will be discussed which highlight the impact of nanoscale on various properties of technological interest. Technologies built on these phenomena will be discussed.

**ABOUT INSTRUCTOR :**

Prof. Prathap Haridoss is a in the Department of Metallurgical and Materials Engineering at IIT Madras. He works in the areas of Fuel Cell and Carbon Nanomaterials. He has a B.Tech in Metallurgical Engineering from IIT Madras, and a PhD in Materials Science and Engineering from the University of Wisconsin-Madison, USA. Before he joined as a faculty at IIT Madras, he served as a Senior Scientist at Plug Power, a Fuel Cell company in New York. He has 3 US patents, several International Journal publications, and has published a book titled Physics of Materials, Essential Concepts of Solid State Physics

**COURSE PLAN :**

**Week 1:** Introduction, History of Nanomaterials Top down approach, bottom up approach to synthesize nanomaterials

**Week 2:** Thermodynamic considerations

**Week 3:** Inverse Hall Petch relationship

**Week 4:** Optical effects

**Week 5:** Superplasticity

**Week 6:** Magnetic effects, Ferroelectric effects at nanoscale

**Week 7:** Severe Plastic Deformation

**Week 8:** Nanocomposites, Bulk nanoscale structures



# ADVANCED MATERIALS AND PROCESSES

**PROF. JAYANTA DAS**

Department of Metallurgical and Material Science  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : M.E/M.Tech, M.S, PhD,

**PRE-REQUISITES** : Physical Metallurgy, Mechanical Metallurgy, Phase transformation, Solidification Processing

**COURSE OUTLINE :**

Introduction and classification of structural and functional materials; High Temperature Materials: Structure, Processing, mechanical behaviour and oxidation resistance of Stainless Steels, Ni- and Co- Based Superalloys, Aluminides and Silicides, Carbon-Carbon and Ceramic Composites; Shape-Memory Alloys: Mechanisms of One-way and Two-way Shape Memory Effect, Reverse Transformation, Thermoelasticity and Pseudoelasticity, Examples and Applications; Bulk Metallic Glass: Criteria for glass formation and stability, Examples and mechanical behaviour; Nano-materials: Classification, size effect on structural and functional properties, Processing and properties of nanocrystalline materials, thin films and multilayered coatings, single walled and multiwalled carbon nanotubes; Soft and hard magnetic materials for storage devices: Design and Processing; Piezoelectric Materials: Processing and Properties; Advanced Processes applied for Advanced Materials: Single Crystal Growth, Rapid Solidification, Inert Gas Condensation, Physical and Chemical Vapour Deposition of Thin Films

**ABOUT INSTRUCTOR :**

Dr. Jayanta Das is working as a faculty member since 2010 at IIT Kharagpur. His research activities have mainly encompassed the areas of alloy design, processing of bulk metallic glasses and their composites by rapid solidification and mechanical alloying, high entropy alloys and synthesis of bulk nanostructured alloys by cryo-rolling, their characterization, structure-property correlations, micromechanics of deformation of these advanced metastable alloys. Dr. Das has to his credit more than 120 research publications in peer-reviewed journals of international repute, which were cited more than 4000 times and has contributed 3 book chapters. He was the recipient of DAAD Fellowship in 2002, and Marie Curie Fellowship in 2004. He has been awarded Institute Silver Medal and Greaves Foseco Cash Prize of IIT Kharagpur in 2003, Young Scientist Award of German Society of Materials Research in 2006, Deutsche Bank Junior Award in 2009 (IFW Dresden, Germany), and IET Young Engineers Award of Institution of Engineers India in 2012.

**COURSE PLAN :**

- Week 01** : Introduction to metastable and functional alloys
- Week 02** : Bulk Metallic glasses Part I: Fundamental concepts
- Week 03** : Bulk Metallic glasses Part II: Mechanical and Functional properties
- Week 04** : Shape memory alloys and Pseudoelasticity
- Week 05** : Shape memory alloys: Applications and case studies
- Week 06** : Introduction to high temperature materials
- Week 07** : Superalloys: Alloy design, Microstructure and Properties
- Week 08** : Nano-materials Part I
- Week 09** : Nano-materials Part II
- Week 10** : Soft and hard magnetic materials
- Week 11** : Non-equilibrium Processes, Single Crystal Growth, Rapid Solidification, Inert Gas Condensation
- Week 12** : Advanced Functional Alloys



# PHYSICS OF MATERIALS

**PROF. PRATHAP HARIDOSS**

Department of Metallurgical & Materials Engineering  
IIT Madras

**TYPE OF COURSE**

: Rerun | Core | UG

**COURSE DURATION**

: 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE**

: 16 Nov 2019

**PRE-REQUISITES**

: First Year under graduate level of physics and mathematics will be beneficial but is not absolutely necessary.

## COURSE OUTLINE

Materials display properties. What is the physics behind these properties? Starting from an electronic or atomic level, how can we arrive at the properties of the materials? These are the questions this course will attempt to answer. Focus will be on electronic properties, but other properties will also be looked at.

## ABOUT INSTRUCTOR

Prof. Prathap Haridoss has been a faculty in the Department of Metallurgical and Materials Engineering, IIT Madras, since 2001. He has a B.Tech in Metallurgical Engineering from IIT Madras, and a PhD in Materials Science from the University of Wisconsin-Madison, USA. Before joining IIT Madras as faculty, he worked as a Senior Scientist at Plug Power a Fuel cell company in Latham New York. He has published papers in the areas of Carbon nanomaterials, Fuel Cells, Lithium ion batteries, semiconducting nanomaterials, and recycling of electronic waste. He also has three US patents in the area of PEM Fuel cells.

## COURSE PLAN

**Week 01** : Properties of materials, thermal expansion

**Week 02** : DC and AC techniques to measure electronic conductivity, free electron gas,

**Week 03** : Drude model for electronic conductivity and for thermal conductivity; Successes and Limitations of the Drude model –

**Week 04** : The Wiedemann Franz Law; Statistical Mechanics, Maxwell-Boltzmann statistics; history of quantum mechanics; Drude

**Week 05** : Sommerfeld model, Fermi-Dirac Statistics; Confinement and quantization; calculating density of available states for electrons;

**Week 06** : Fermi Energy, Fermi Surface, Fermi Temperature; Reciprocal space ; Wigner seitz cells Brillouin zones;

**Week 07** : Calculating allowed and forbidden energy levels; Description of tight binding approximation, impact of inter atomic spacing on band gaps.

**Week 08** : Comparison of free electron approximation and tight binding approximation. Effect of pressure on band gaps;

**Week 09** : Direct Band gap, indirect Band gap semiconductors; Magnetic properties; Electron compounds/ Hume Rothery phases.

**Week 10** : Phonons, Optoelectronic properties;

**Week 11** : Superconductivity, Bose-Einstein Statistics;

**Week 12** : Physics of nano scale materials.



# TRANSPORT PHENOMENA IN MATERIALS

**PROF. GANDHAM PHANIKUMAR**

Department of Metallurgical and Material Science  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Undergraduate students of Metallurgical / Materials Engineering and related disciplines.

**PRE-REQUISITES** : Mathematics courses at 1st year UG level.

**INDUSTRIES APPLICABLE TO** : Tata Steel, JSW, Vedanta, Aditya Birla Group, Murugappa Group, Amalgamations Group, TCS etc.,

**COURSE OUTLINE :**

This course will introduce the concepts of fluid flow, heat transfer and mass transfer with behavior and processing of engineering materials as the focus.

**ABOUT INSTRUCTOR :**

Gandham Phanikumar doctoral work is on heat transfer, fluid flow and solute transfer during laser processing of dissimilar metals. After joining IIT Madras in 2005, he has been teaching a UG core course on transport phenomena for several years. His research continues to involve concepts of transport phenomena in materials processing.

**COURSE PLAN :**

**Week 01** : Mathematical foundations of transport phenomena, introduction to subscript notation & tensors

**Week 02** : Control volume formulation and concept of balance

**Week 03** : Navier-Stokes equations, exact solutions for simple geometries

**Week 04** : Friction factors, empirical relations in fluid flow

**Week 05** : Application of fluid flow solutions to materials processing

**Week 06** : Introduction to high temperature materials

**Week 07** : Exact solutions for heat transfer problems

**Week 08** : Empirical correlations, heat transfer coupled with fluid flow

**Week 09** : Mass Balance equations, governing equations

**Week 10** : Diffusive mass transfer, exact solutions for simple geometries

**Week 11** : Solute transfer during phase change

**Week 12** : Convective mass transfer correlations, Similarity across transport phenomena



# WELDING METALLURGY

**PROF. PRADEEP K. JHA**

Department of Metallurgy and Material Science  
IIT Roorkee

**TYPE OF COURSE** : New | Core | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Introduction to courses such as Welding processes, Materials science etc.

**INDUSTRIES APPLICABLE TO** : Manufacturing Industries like SAIL, BHEL etc.

**COURSE OUTLINE :**

The course focuses on understanding the metallurgy and solidification of weldments. The course will make the students aware with the metallurgical aspects of welding. For getting a sound weld, the students are required to be aware of the science behind the welding phenomena, especially in the domain of weld metal solidification, heat transfer, heat treatment processes, strengthening mechanisms etc. The course will be useful for engineering graduates as well as professionals working in the area of welding.

**ABOUT INSTRUCTOR :**

Prof. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, especially casting and welding processes.

**COURSE PLAN :**

**Week 1:** Introduction to welding metallurgy, phase diagrams

**Week 2:** Phase transformation, TTT and CCT diagrams

**Week 3:** Metal strengthening approaches

**Week 4:** Heat treatment processes for weldments

**Week 5:** Analysis of heat flow and temperature distribution in welding

**Week 6:** Concept of solidification in welding, constitutional supercooling

**Week 7:** Weld metal solidification cracking, cause and prevention of cracks

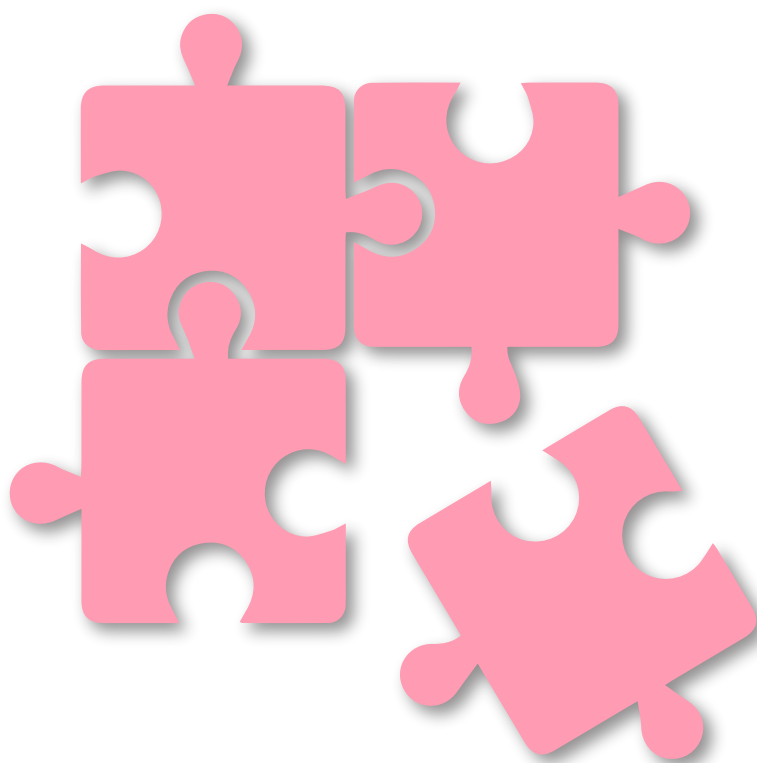
**Week 8:** Introduction to heat affected zones, Properties of HAZ

**Week 9:** Recrystallization and grain growth, HAZ in different materials

**Week 10:** Partially melted zone, Grain boundary solidification

**Week 11:** Liquidation cracking, Hydrogen cracking

**Week 12:** Metallurgical issues in welding



**MULTIDISCIPLINARY**





# MULTIDISCIPLINARY

## 04 weeks

- 01. Teaching And Learning in General Programs: TALG
- 02. Designing Learner-Centric MOOCs
- 03. Introduction To Learning Analytics
- 04. Stress Management
- 05. Designing learner-centric E-learning in STEM disciplines
- 06. Sustainable and Affordable Sanitation Solutions For Small Towns: Policy, Planning and Practice
- 07. Biology for engineers and other non-biologists
- 08. Ergonomics In Automotive Design
- 09. Ergonomics Workplace Analysis

## 08 weeks

- 01. TALE 2: Course Design and Instruction of Engineering Course
- 02. Accreditation and Outcome based Learning
- 03. Introduction to Research
- 04. Ecology and Environment
- 05. Manage TB
- 06. Game Theory
- 07. Health Research Fundamentals

## 12 weeks

- 01. Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts
- 02. Neuroscience of Human Movements
- 03. Numerical Methods for Engineers
- 04. System Design for Sustainability
- 05. Control systems



# TEACHING AND LEARNING IN GENERAL PROGRAMS: TALG LEARNING OUTCOMES

**PROF. N J RAO**

Consulting Professor  
IISc Bangalore

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Working and aspiring teachers of HSS

**INDUSTRIES APPLICABLE TO** : Educational Institutions, Corporate Training

## **COURSE OUTLINE :**

The quality of Teaching And Learning in General Programs (Humanities, Social Sciences and Sciences) (TALG) has come to be an important issue in India to all stakeholders including teachers, students, parents, Managements, Universities, UGC, AICTE, NAAC and Employers. Undergraduate programs of three or four year duration are offered in Humanities, Social Sciences and Sciences. 40,000 Degree Colleges provide most of the graduate level workforce to Government and Private Organizations in India. The quality of learning of their graduates will make a major difference to the wealth generating and service providing abilities of these organizations. While there has been significant increase in the last few decades in our understanding of how people learn, there has not been much intersection of this knowledge with the instructional practices at institutions of higher learning. The dominant instructional method still remains lecturing/one-way information transfer. Employers, Regulatory Bodies and Accreditation Agencies in India want the graduates attain a set of Program Outcomes (knowledge, skills and attitudes) to be identified by the Institutions offering the General Programs. These Program Outcomes need to be discipline agnostic. The curriculum of a program decides the nature of learning experiences including the courses, projects, field work, internships, and co-curricular and extra-curricular activities.

## **ABOUT INSTRUCTOR :**

Prof. N.J. Rao ,Previously the Chairman of CEDT (Centre for Electronics Design and Technology, IISc during 1981 – 1996, and Chairman, Department of Management Studies during 1998 – 2006, superannuated as Professor at CEDT in July 2006. Presently he is a Consulting Professor at International Institute of Information Technology (IIIT), Bangalore, a member of several committees associated with NBA, and a member of the Core Committee that defined the new Accreditation processes of NAAC. Present research interests include higher education, pedagogy and education technologies. He is presently working with Department of Higher Education, Kerala for improving quality of learning in Higher Education Degree Colleges, and several engineering colleges for curriculum design, pedagogy and quality of learning. He has designed and has been conducting a wide range of faculty development programs on NBA Accreditation, Curriculum Design.

## **COURSE PLAN :**

**Week 1:** OBE and Accreditation

**Week 2:** Outcomes and Cognition

**Week 3:** Knowledge Categories, and Affective and Psychomotor Domains

**Week 4:** Course Outcomes

# DESIGNING LEARNER - CENTRIC MOOCS

## MULTIFACULTY

<b>TYPE OF COURSE</b>	: Rerun   Elective   PG
<b>COURSE DURATION</b>	: 4 weeks (29 Jul'19 - 23 Aug'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**INTENDED AUDIENCE :** Teachers, MOOC creators

**INDUSTRIES APPLICABLE TO :** Companies creating online courses.L&D (Training) divisions in companies across various sectors.

## COURSE OUTLINE :

Massive Open Online Courses (MOOCs) have become a popular avenue for diverse learners to upgrade their knowledge and skills. Instructors who are new to creating MOOCs tend to focus on the use of technology features to mimic their classroom actions. While it is necessary to be aware of the technology affordances, it is more important to focus on the pedagogy of how to use the MOOC features effectively to foster student engagement and learning. Hence MOOC instructors need a set of design principles and guidelines to create a learner-centric MOOC.

## ABOUT INSTRUCTOR :

Sridhar Iyer is a faculty member in the Inter-Disciplinary Program in Educational Technology, His current research interests include: Technology enhanced learning environments for thinking skills, Pedagogies for effective use of educational technologies, development of ICT tools for educational applications, and Computer science education research.

Sahana Murthy is a faculty member in the Inter-Disciplinary Programme in Educational Technology a Prior to that she was a lecturer at the Experimental Study Group in MIT from 2006-09 during which she implemented and evaluated innovative teaching methods. Her current research interests lie in students' development of thinking skills through technology enhanced learning environments.

Jayakrishnan M is a Senior Scientist, He completed his PhD in "A Model for Large-scale In-service Teacher Training in Effective Technology Integration in Engineering Education" from the Inter-Disciplinary Programme in Educational Technology at IIT Bombay. His research interests in the field of Educational Technology include Teacher Technology Integration, Massive Open Online Learning, Sustainability in Teacher Professional Development and Computer Supported Collaborative Learning.

Sameer S Sahasrabudhe works as Senior Project Research Scientist, He has a graduation in fine arts, post graduate diplomas in animation film making and distance education, and a doctorate in the area of eLearning animation. He has a cumulative experience of 18 years, in the areas of advertising, animation film production, eLearning content creation, research, and teaching. As an evangelist of open source 3D animation software: Blender, he has conducted several workshops, on Blender animation, and has presented at various conferences. His courses on IITBombayX platform have been well received.

## COURSE PLAN :

**Week 01 :** The LCM model

**Week 02 :** Creating LeDs

**Week 03 :** Creating LbDs and LxTs

**Week 04 :** LxIs and Orchestration



# INTRODUCTION TO LEARNING ANALYTICS

**PROF. RAMKUMAR RAJENDRAN**

Educational Technology

IIT Bombay

**TYPE OF COURSE** : New | Core/Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basics in Probability, Beginner Level Programming Skill

**INTENDED AUDIENCE** : Computer Science, ECE, Electrical Engineering, Biotechnology

## **COURSE OUTLINE :**

Learning Analytics is a method to collect, measure, analyze and report data about learners and their interactions with a learning environment. Learning analytics is applying analytics on educational data to infer the student learning process and to provide support. This is an introduction and a first course in the series of learning analytics courses that will be offered in coming semesters.

## **ABOUT INSTRUCTOR :**

Ramkumar Rajendran is an Assistant Professor in IDP in Educational Technology at Indian Institute of Technology Bombay. He obtained his Ph.D. in Computer Science and Engineering from IITB-Monash Research Academy, IIT Bombay and Postdoctoral training at Vanderbilt University, USA.

## **COURSE PLAN :**

### **Week 1 : What is LA**

- Definition
- Relation with Academic Analytics
- Relation with Education Data Mining Learning
- LA - Big-Picture
- Relation with Machine Learning, EDM
- Four Levels of Learning Analytics
- Overview I
- Overview -II

### **Week 2 : Data Collection**

- How Big is Education data
- Data Collection from Learning Environments
- Pre-Processing
- Ethics in Learning Analytics
- Student Privacy

### **Week 3 : Descriptive Analytics**

- Data Visualization Example Dashboard Analytics

### **Week 4 : Predictive Analytics**

- Linear Regression Analytics Tools
- Demo of Weka/Rapidminer
- Demo of Linear Regression using Weka



# STRESS MANAGEMENT

**PROF. RAJLAKSHMI GUHA**

Centre for Educational Technology  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : M.E/M.Tech, M.S, M.Sc, PhD

**PRE-REQUISITES** : Basic knowledge in communication and a good understanding of English

**COURSE OUTLINE :**

Stress is a part of daily living and each individual responds to stress differently. Thus there's no "one size fits all" solution to managing stress. Stress management techniques can teach an individual healthier ways to cope with stress, help reduce its harmful effects, and prevent stress from spiraling out of control again in the future. The goal of stress management is not to eliminate all stress. This course aims to teach the student how to limit the harmful effects of stress while maintaining life's quality and vitality.

**ABOUT INSTRUCTOR :**

Prof. Rajlakshmi Guha is an Assistant Professor in the Centre for Educational Technology IIT Kharagpur. She has done her PhD in Psychology. Her interest areas are Cognitive Psychology, Social Psychology and Counselling Psychology.

**COURSE PLAN :**

**Week 01** : Scientific Foundations Of Stress

**Week 02** : Stress Psychophysiology

**Week 03** : Developing Resilience To Stress

**Week 04** : Strategies For Relieving Stress



# DESIGNING LEARNER-CENTRIC E-LEARNING IN STEM DISCIPLINES

**PROF. SAHANA MURTHY**

Educational Technology

IIT Bombay

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Students of any discipline. E-learning industry professionals.

**INDUSTRIES APPLICABLE TO** : E-learning companies

**COURSE OUTLINE :**

Instructional designers today have tremendous access to a variety of technology tools while designing e-learning. An important role for instructional designers is to integrate effective pedagogical strategies to promote students' engagement and learning. This course focuses on learner-centric principles and practices in the design of e-learning in STEM disciplines. Effective strategies and processes based on research from the learning sciences and educational technology will be discussed. Course participants will explore the application of e-learning design in various STEM topics in K-12 and higher education. The course will expose participants to some examples of basic and advanced technologies involved in designing e-learning.

**ABOUT INSTRUCTOR :**

Prof. Sahana Murthy is a faculty member in Educational Technology at the Indian Institute of Technology (IIT) Bombay, India. Her research interests include developing students problem-solving and thinking skills in science and engineering domains using technology enhanced learning environments. She has conducted several Faculty Professional Development Programs on research-based teaching strategies and effective integration of ICT in classrooms. She received her Bachelor degree from the University of Mumbai, India, Master degree in physics from IIT Bombay, and PhD in physics from Rutgers University.

**COURSE PLAN :**

**Week 1:** Identifying needs and setting objectives

**Week 2:** Research-based pedagogical strategies

**Week 3:** Effective integration of technology

**Week 4:** Designing with emerging technologies





# SUSTAINABLE AND AFFORDABLE SANITATION SOLUTIONS FOR SMALL TOWNS: POLICY, PLANNING AND PRACTICE

**PROF. N. C. NARAYANAN**

IDP in Climate Studies

IIT Bombay

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Academic Institutions, Government Agencies

## **COURSE OUTLINE :**

In addition to the technical aspects, the current course offers insights to integrated sanitation planning, specifically for small towns.

## **ABOUT INSTRUCTOR :**

Prof. N.C. Narayanan is a Professor at Centre for Technology Alternatives for Rural Areas. He obtained his Ph.D in Development Studies from International Institute of Social Studies, the Hague, Netherlands. He is also an Associate Faculty and Member of IDPC of Centre for Policy Studies and Associate Faculty of IDP on Climate Studies, IIT Bombay. He was a Fulbright Visiting Professor at the University of California Berkeley in 2016-17.

## **COURSE PLAN :**

- Week 1:** Current Status of Water Pollution in Indian cities: Problems, Issues and Challenges, Problems of Dominant Approach in Municipal Wastewater Management Shifts in Sanitation Planning: The Emergent Alternative Solutions, Strategies to Alternative Sanitation Planning for Small Towns
- Week 2:** Technology Options in Wastewater Management, Wastewater Management, Steps to Sanitation Planning for Small Towns (Case of Alibag), Developing Sanitation zones and waste watershed zones
- Week 3:** Current status of Solid Waste Management in Indian Cities: Problems, Issues and Challenges Shifts in Solid Waste Planning: The Emergent Alternative Solutions, Strategies and Steps to Solid Waste Planning for Small Towns: A case study of Alappuzha
- Week 4:** Current status of Fecal Sludge Management in Indian Cities: Problems, Issues and Challenges Approaches and Tools to Fecal Sludge Management Strategies and Steps to Fecal Sludge Management for Small Towns



# BIOLOGY FOR ENGINEERS AND OTHER NON-BIOLOGISTS

**PROF. G. K. SURAIISKUMAR**

Department of Chemical Engineering  
IIT Madras

**PROF. MADHULIKA DIXIT**

Department of Biotechnology  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG

**INTENDED AUDIENCE** : MBBS

**COURSE DURATION** : 4 weeks (29Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Any industry that wants to venture into a bio-related aspect.

**COURSE OUTLINE :**

It is well known that this is the century of biology in which significant advances in the understanding and application of biological systems are expected. The significant impact on the world is expected in terms of better healthcare, better processes, better products and an overall better quality of life. Thus, any person can be interested in knowing the fundamentals of biology to be able to understand, or participate in the biological revolution. For example, any engineer, irrespective of the parent discipline (mechanical, electrical, civil, chemical, metallurgical, etc.,) has a high probability of using the disciplinary skills toward designing/improving biological systems in the future. This course is designed to convey the essentials of cell and molecular biology to provide a frame-work for more specific understanding, and contribution by any interested person.

**ABOUT INSTRUCTOR :**

Prof. G. K. Suraishkumar is a Professor in the Department of Biotechnology, Indian Institute of Technology Madras (IITM). He has been at IITM as a Professor since May 2004, and was earlier a faculty member in the Department of Chemical Engineering at the Indian Institute of Technology Bombay (IITB) from April 1993 until mid-May 2004. He was also an Associate Faculty member in the erstwhile Centre for Biotechnology, which is now the Department of Biosciences and Bioengineering, at IITB, between 1995 and 2004. He earned his Ph.D. from Drexel University, Philadelphia, USA in 1993, and his B.Tech. in Chemical Engineering from IITM in 1986. He also did his Masters work at the University of Cincinnati, USA, between 1986 and 1988.

Prof. Madhulika Dixit is an Associate Professor in the Department of Biotechnology, Indian Institute of Technology Madras (IITM). She has been a faculty member in the Department since 2007. Prior to joining IIT Madras, she worked as Senior Scientist in the Institute of Cardiovascular Physiology, Goethe University, Frankfurt am Main, Germany from 2003-2006. She earned her PhD in Molecular Biology from IIT Bombay in 2001 and her Masters in Life Sciences from University of Mumbai in 1996. She did her post-doctoral training in Cardio-vascular Physiology at the University of Tennessee Health Science Center, Memphis, USA from 2001-2003.

**COURSE PLAN :**

**Week 1:** Introduction (G. K. Suraishkumar)

**Week 2:** Origin of life and Evolution (Madhulika Dixit)

**Week 3:** Water, Biomolecules, Enzymes, Introduction to metabolism (G. K. Suraishkumar)

**Week 4:** Cell structure, Cell cycle (Madhulika Dixit), Culture growth (G. K. Suraishkumar); Mendelian genetics (G. K. Suraishkumar) Chromatin, DNA structure, replication, transcription and translation (Madhulika Dixit)



# ERGONOMICS IN AUTOMOTIVE DESIGN

**PROF.SOUGATA KARMAKAR**

Department of Engineering Design  
IIT Guwahati

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Basic understanding of 'Applied Ergonomics'

**INTENDED AUDIENCE** : UG and PG students of Industrial Engineering

**INDUSTRIES APPLICABLE TO** : Industries associated with Automotive Design and Engineering

## **COURSE OUTLINE :**

Knowledge of 'Ergonomics/Human Factors Engineering' is of utmost necessity for automotive design and engineering to achieve optimal compatibility between occupants and vehicle components in terms of Physical, Cognitive and Environmental aspects. Although good number of Design and Engineering Schools in India are offering courses on Automobile Design, Transportation Design and Automobile Engineering, focus on Automotive Ergonomics is less due to lack of resources and trained faculty members. The current course would not only help the students and teachers involved in Automobile Design and Engineering to overcome the aforesaid limitations but also would be beneficial for the engineers and designers engaged in Automotive sectors.

## **ABOUT INSTRUCTOR :**

Prof. Sougata Karmakar is presently working as Associate Professor at Department of Design in Indian Institute of Technology, Guwahati, India. He received PhD degree for his work in the field of 'Virtual ergonomics using digital human modelling' from the Bharathiar University, India in Sept' 2009. He also received P.G. Diploma in Management (Specialization-Human Resource Management) from Pondicherry University, India. He gained research expertise in the field of ergonomics from Defence Institute of Physiology and Allied Sciences (DIPAS), Defence Research and Development Organization (DRDO), Delhi (Nov' 2004-Nov'2009). He is associated with well-equipped 'Ergonomics Laboratory' at department of Design, IIT Guwahati and continues his research work in the field of Ergonomics/Human Factors. Five research scholars have been awarded PhD degree under him and another five are pursuing their doctoral research under his guidance.

## **COURSE PLAN :**

**Week 1:** Introduction to Automotive Ergonomics

Anthropometric and biomechanical data in automotive design

**Week 2:** Occupant Packaging,

Automobile control and displays,

In vehicle and external visibility of the driver

**Week 3:** Entry and exit by drivers and passengers,

Driver distraction and driving performance measurement,

Driver Workload Measurement

**Week 4:** Virtual Ergonomics evaluation technique and its application in automotive design,

Automotive craftsmanship



# ERGONOMICS WORKPLACE ANALYSIS

**PROF. URMI R. SALVE**

Department of Engineering Design  
IIT Guwahati

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 4 weeks (29 Jul'19 - 23 Aug'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Minimum Graduation with an understanding of Basic Ergonomics

**INTENDED AUDIENCE** : Master Degree and PhD students

**COURSE OUTLINE :**

Ergonomic workplace analysis is a process where the ergonomic risk factors are evaluated using various validated tools and provide probable recommendations to minimize the risk factors for development of work related musculoskeletal disorders and improve the productive workday to reduce the cost for compensation, absenteeism and employee turnover. In the process of ergonomic workplace analysis an ergonomist needs to evaluate the physical work environment, psychosocial risk factors as well as various generic risk factors which leads to the development of work related musculoskeletal disorders. This course is based on the complete process evaluation of EWA.

**ABOUT INSTRUCTOR :**

Prof. Urmi Ravindra Salve, completed her PhD in science Ergonomics from Calcutta University. Prof. Salve has expertise in Human Factor Engineering, Research Methodology, Cognitive Ergonomics, Occupational Health Related Problem, Human Physiology. She has almost ten years research experience in the field of ergonomics and human factors engineering in different research bodies including TIFAC–CORE NITIE, National Institute of Industrial Engineering, Mumbai, India. She further worked in the field of Occupational Hygiene at National Institute of Miners' Health, Department of Mines, Govt. of India. She has more than 22 full study and abstract publication on the national and international journals and conference proceedings.

**COURSE PLAN :**

**Week 1:** Overview of Ergonomics and understanding of Ergo-system Overview of ergonomic workplace analysis

**Week 2:** Classification of techniques used in Ergonomics research

**Week 3:** Subjective assessment tool and Methods Postural evaluation

**Week 4:** Measurement of Work Effort and Fatigue



## TALE 2: COURSE DESIGN AND INSTRUCTION OF ENGINEERING COURSES

**PROF. N J RAO**

Consulting Professor

IISc Bangalore

**TYPE OF COURSE** : New | Elective | PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : TALE Module 1: Learning Outcomes

**INTENDED AUDIENCE** : Working and aspiring engineering teachers

### **COURSE OUTLINE :**

The quality of Teaching And Learning in Engineering (TALE) has come to be an important issue in India to all stakeholders including teachers, students, parents, Managements, University, AICTE, NBA and Industry. The curriculum of a program decides the nature of learning experiences including the courses, projects, internships, and co-curricular and extra-curricular activities. This course focuses on students attaining a certain set of outcomes requiring a shift from teacher centric approach to student centric instruction. There is no unique method that leads to good learning in all contexts. The course TALE addresses many of the common issues of teaching and learning in engineering in the Indian context and tries to provide a complete solution to a teacher to the process of design and conduct of an engineering course leaving all the academic freedom he/she wants to have.

### **ABOUT INSTRUCTOR :**

Prof. N.J. Rao ,Previously the Chairman of CEDT (Centre for Electronics Design and Technology, IISc during 1981 – 1996, and Chairman, Department of Management Studies during 1998 – 2006, superannuated as Professor at CEDT in July 2006. Presently he is a Consulting Professor at International Institute of Information Technology (IIIT), Bangalore, a member of several committees associated with NBA, and a member of the Core Committee that defined the new Accreditation processes of NAAC. Present research interests include higher education, pedagogy and education technologies. He is presently working with Department of Higher Education, Kerala for improving quality of learning in Higher Education Degree Colleges, and several engineering colleges for curriculum design, pedagogy and quality of learning. He has designed and has been conducting a wide range of faculty development programs on NBA Accreditation, Curriculum Design.

### **COURSE PLAN :**

**Week 1:** Course Design, Instructional System Design and ADDIE

**Week 2:** Analysis and Design Phases

**Week 3:** Development

**Week 4:** Implement and Evaluation Phases

**Week 5:** Learner Centered Education

**Week 6:** Instruction Methods

**Week 7:** Instruction for Outcomes

**Week 8:** Planning Instruction



## ACCREDITATION AND OUTCOME BASED LEARNING

**PROF. Arun Kumar RAY (Retd.)**

Department of Electronics & Electrical  
Communication Engineering

**SK DAS MANDAL**

Centre for Educational Technology  
IIT Kharagpur

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 8 weeks (26th Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Teachers of different educational Institutes

**COURSE OUTLINE :**

Twenty-first century education structured should be outcome based which developed certain critical core competencies such as collaboration, digital literacy, critical thinking, and problem-solving, self learning. The curriculum should incorporates higher order thinking skills, multiple intelligences, technology and multimedia, communication skill and self learning methodology along with authenticated scientific assessments and evaluation. Curriculum should provide direction so that student can learn by themselves and work both independently and interdependently. The course equips the learner with the tools and techniques for effective teaching and hand on practices through specially designed software with appropriate pedagogic framework for design outcome based curricula.

**ABOUT INSTRUCTOR :**

Prof. S K. Das Mandal received his degree in Electronics and Telecommunication Engineering in 1998 and Ph.D degree in 2007 from Jadavpur University, India. He is currently working in Indian Institute of Technology, Kharagpur as an Assistant Professor. His current research interests include automatic speech recognition, speech synthesis, and Computer Assisted Language Learning

Prof. A. K Ray (retd) was a professor at IIT Kharagpur in the Department of Electronics & Electrical Communication Engineering. He has publications to his credit.

**COURSE PLAN :**

**Week 1:** Graduate attribute and accreditation (Washington Accord, NBA etc.)

**Week 2:** Introduction to Outcome based Learning

**Week 3:** Taxonomies and Instructional Objectives

**Week 4:** Assessment and Evaluation

**Week 5:** ICT for Assessment and Evaluation

**Week 6:** Outcome-based Curriculum Design framework

**Week 7:** Outcome-based Curriculum Design

**Week 8:** Mapping of outcome based curriculum



# INTRODUCTION TO RESEARCH

## MULTIFACULTY

Prof. Prathap Haridoss  
Department of Metallurgical & Material Engineering

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED SUPPORT** : Students of ME/MTech/MS/MSc/PhD can benefit.

**PRE-REQUISITES** : Students who have completed undergraduate studies (in Engineering or Science) will be in a better position to benefit from this course

## COURSE OUTLINE :

Large numbers of students are actively considering and taking up research and associated higher studies. This course aims to introduce students to the important aspects of research. The intent of the course is to make students aware of the details associated with formal research and to help students overcome common misconceptions that may be present in their minds. By going through this course, students are likely to be able to take up research activities in a more systematic and formal manner right from the beginning.

## ABOUT INSTRUCTOR :

Multifaculty  
Coordinated by Prof. Prathap Haridoss  
Department of Metallurgical & Material Engineering

## COURSE PLAN :

- Week 1** : A group discussion on what is research; Overview of research;
- Week 2** : Literature survey , Experimental skills;
- Week 3** : Data analysis, Modelling skills;
- Week 4** : Technical writing; Technical Presentations; Creativity in Research
- Week 5** : Creativity in Research; Ethics in Research
- Week 6** : Design of Experiments
- Week 7** : Intellectual Property
- Week 8** : Department specific research discussions

# ECOLOGY AND ENVIRONMENT

## MULTIFACULTY

**TYPE OF COURSE** : Rerun | Elective | PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E,B.Tech

### COURSE OUTLINE :

The objectives of the course is to introduce and sensitize all BTech students to the issue of ecology, environment and sustainability. The lectures are aimed at posing various questions that are relevant for all students of engineering and management to incorporate sustainability and a sensitivity to ecology and environment in their design of products, processes and systems.

### ABOUT INSTRUCTOR :

The course will be taught by multiple instructors who have expertise in different areas of ecology, environment and sustainability. The instructors are faculty at IIT Madras and researchers in other organisations in specific areas of expertise in this topic.

### COURSE PLAN :

- Week 01** : Dr. B.S. Murty: Introduction (1), Sustainability Definition / Goals, Climate Change (2), Case Studies (3) (Eg: Dams, Chemicals, e-waste, IOT, Landfill siting etc)
- Week 02** : Dr. Sudhir Chella Rajan: Sustainability and Economics (3), Sustainability and Ethics (3)
- Week 03** : Dr. Ligy Philip (Water Quality/ Waste Management): Water Quality and Treatment (3), Waste Management and Treatment (3)
- Week 04** : Dr. B. S. Murty (Water Management/ Resources): Urban Drainage, Water Resource Management, Impact of Climate Change
- Week 05** : Dr. Srinivas Jayanti (Energy):Energy Demand / Resources (1), Pollution from Energy generation (1), Energy and Climate Change (Global Warming) (1), Energy and Sustainability (1), Long Range and Short Range Solutions (1), (Global vs. India)
- Week 06** : Dr. R. Ravi Krishna: Risk Assessment Definition (1), Pollutant Pathways / Safety/ Exposure (1), Liability /Examples (1), Life Cycle Assessment (2), Environmental Management and LCA (1).
- Week 07** : Dr. Sudhir Chella Rajan: Urban Planning / Sprawl (1), Challenges in Urban Planning,Transport (1), Energy (Smart Grid) (1), Water (1), Waste (1), Governance (1).
- Week 08** : Dr. Susy Varughese / Dr. Parag Ravindran: Ecology – definitions / Systems (1), Biodiversity (1), Examples of Historical Impact of economy on Ecology, Restoration / Ecological Engineering.  
Dr. Ligy Philip / Dr. Ravi Krishna: Solid Waste Management, Hazardous Waste Management, Wrap up Emphasis on Climate Change and Adaptation



## MANAGE TB

### DR. MOHAN NATRAJAN

Scientist F & Head, Department of Clinical Research  
NIRT

### DR. V.V. BANU REKHA

Scientist D, Department of Clinical Research  
NIRT

**TYPE OF COURSE** : Rerun | Elective | UG

**INTENDED AUDIENCE** : MBBS

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INDUSTRIES APPLICABLE TO** : Government/ Private Sector, Public Health Service Institutions/ Agencies and Medical Colleges/ Universities.

### COURSE OUTLINE :

The National Institute for Research in Tuberculosis (NIRT), Chennai is one of the premier institutes of the Indian Council of Medical Research (ICMR), Department of Health Research (DHR) of Govt. of India. It is an internationally reputed institution for Tuberculosis (TB) research and a WHO Collaborating Centre for TB Research and Training. ICMR-NIRT is offering an Online course for Doctors on TB. Manage TB is an Online course designed to provide basic information about TB and its management. The participants will be provided with an overview of the extent of the TB burden globally and nationally, its pathogenesis, diagnostic modalities, treatment regimens, prevention strategies and efforts towards TB elimination. National and International guidelines will be elaborated and new TB drugs, vaccines and diagnostics will be discussed.

### ABOUT INSTRUCTOR :

Dr. Mohan Natrajan - Course Director

Dr. V.V. Banu Rekha - Course Co-ordinator

### COURSE PLAN :

- Week 01** : Epidemiology and Pathogenesis of Tuberculosis: How is Tuberculosis affecting public health globally and nationally? | The Epidemiology of Tuberculosis | Pathogenesis of Tuberculosis | Clinical manifestations of Tuberculosis.
- Week 02** : Bacteriological Diagnosis of Tuberculosis smear and culture | Video demonstration of smear and culture techniques | Phenotypic drug susceptibility testing in Tuberculosis | Video demonstration of Phenotypic drug susceptibility testing techniques | Video demonstration of genotypic methods for TB diagnosis and drug susceptibility testing | Radiology in diagnosis of Tuberculosis.
- Week 03** : Approach to diagnosis of Pulmonary TB | Case discussion | Approach to diagnosis of Extra-pulmonary TB | Diagnosis of Childhood Tuberculosis | Video – demonstration of gastric fluid aspiration technique in a child.
- Week 04** : Management of Tuberculosis: Drugs for treating Tuberculosis and Principles of Chemotherapy | Treatment of Drug Sensitive Pulmonary Tuberculosis | Case discussion | Management of drug resistant Tuberculosis.
- Week 05** : Management of Extra - Pulmonary Tuberculosis | Panel discussion | Management of patients with HIV-TB coinfection | Case discussion | Management of TB in special situations.
- Week 06** : Treatment of Pediatric Tuberculosis | Management of Adverse effects to anti-TB drugs | Case discussion | Non-tuberculosis Mycobacteria: Diagnosis & Clinical Management | Newer Anti-TB drugs and regimens.
- Week 07** : Prevention of Tuberculosis: Management of Latent TB Infection | Airborne infection control in Tuberculosis | Vaccine for Tuberculosis.
- Week 08** : Towards Tuberculosis Elimination: Service offered by Revised National TB Control Programme | Tuberculosis notification | Addressing social barriers in Tuberculosis control | Standards for TB care in India | Global Tuberculosis control strategies.



# GAME THEORY

**PROF. K. S. MALLIKARJUNA RAO**

Industrial Engineering and Operations Research  
IIT Bombay

**TYPE OF COURSE** : New | Elective | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Calculus, Linear Algebra & Probability

**INTENDED AUDIENCE** : Maths/CS/Econ/EE/Management

## **COURSE OUTLINE:**

The aim of this course is to introduce the following topics at a basic level: combinatorial games, zero-sum games, non-zero sum games and cooperative games. Learning outcomes for the course: At the end of the course, the student should be able to Model and analyse conflicting situations using game theory.

## **ABOUT INSTRUCTOR :**

After obtaining his Ph.D from IISc Bengaluru, Prof. K.S. Mallikarjuna Rao has spent few years at Centre de Mathematique et Informatique, Marseille, France; Indian Statistical Institute Delhi, University of Texas at Dallas, USA; and at TIFR Bengaluru as a postdoctoral fellow. He joined IEOR, IIT Bombay in 2007, where he is currently Associate Professor. His research interests include probability, game theory, optimization and stochastic control.

## **COURSE PLAN :**

**Week 1** : Combinatorial Games: Introduction

**Week 2** : Impartial games Combinatorial games : Hex

**Week 3** : Zero-sum games

**Week 4** : Zero-sum games(contd)

**Week 5** : Non-zero sum games

**Week 6** : Non-zero sum games(contd)

**Week 7** : Cooperative games

**Week 8** : Cooperative games(contd)

# HEALTH RESEARCH FUNDAMENTALS

## MULTIFACULTY

<b>TYPE OF COURSE</b>	: Rerun   Elective   UG
<b>COURSE DURATION</b>	: 8 weeks (29 Jul'19 - 20 Sep'19)
<b>EXAM DATE</b>	: 29 Sep 2019

**PRE-REQUISITES** : Undergraduate students in medical/dental/nursing/AYUSH streams  
Graduate in any discipline

**INDUSTRY SUPPORT** : Government/ private sector, public health service institutions

## COURSE OUTLINE :

National Institute of Epidemiology [NIE], Indian Council of Medical Research [ICMR] is offering online programmes on conduct of human bio-medical research. The programme will be offered as NIE-ICMR e-Certificate – NleCer - Courses.

## ABOUT INSTRUCTOR :

Multifaculty  
National Institute of Epidemiology

## COURSE PLAN

- Week 1** : Conceptualizing a research study | Introduction to health research.  
Formulating research question, hypothesis and objective | Literature review – Dr. P Ganeshkumar
- Week 2** : Epidemiological considerations in designing a research study | Measures of disease frequency | Descriptive study designs | Analytical study designs.
- Week 3** : Epidemiological considerations in designing a research study | Experimental study designs: Clinical trials | Validity of epidemiological studies | Qualitative research methods: An overview.
- Week 4** : Bio-statistical considerations in designing a research study | Measurement of study variables | Sampling methods | Calculating sample size and power.
- Week 5** : Planning a research study | Selection of study population | Study plan and project management | Designing data collection tools.
- Week 6** : Planning a research study | Principles of data collection | Data management | Overview of data analysis.
- Week 7** : Conducting a research study | Ethical framework for health research | Conducting clinical trials.
- Week 8** : Writing a research protocol | Preparing a concept paper for research projects | Elements of a protocol for research studies.



# INTRODUCTION TO ENVIRONMENTAL ENGINEERING AND SCIENCE - FUNDAMENTALS AND SUSTAINABILITY

**PROF. BRAJESH K DUBEY**

Department of Civil Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic High School Math, Physics and Chemistry

**INTENDED AUDIENCE** : Students of all UG Programs

**INDUSTRIES APPLICABLE TO** : AECOM, Ramky, Environmental Resource Management (ERM), SENES/ARCADIS, L&T, Tata-Projects, and all companies involved in any construction projects in the country.

**COURSE OUTLINE :**

The objective of this online course is to provide an overview of the environmental issues that the working professionals should be aware of as per the directive of the Honourable Supreme Court of India. The course will cover basic concepts of ecology, water pollution, water and wastewater quality and treatment, solid and hazardous waste management, soil and noise pollution, sustainability concepts including Environmental Impact Assessment, Life Cycle Assessment, Waste Minimization, Circular Economy and Sustainable Development Issues.

**ABOUT INSTRUCTOR :**

Professor Brajesh Kr. Dubey obtained his Bachelors degree in Civil Engineering (Hons) from Indian Institute of Technology (IIT) Kharagpur, India and PhD in Environmental Engineering Sciences, University of Florida, Gainesville, Florida, USA. He is presently Associate Professor (Integrated Waste Management and Sustainable Engineering) in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than 17 years of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, and Sustainable Engineering and Application of Life Cycle Assessment techniques. Working in the area of Life Cycle Analysis and Sustainable Engineering, he teaches courses in Solid Waste Management, Hazardous Waste Management, Life Cycle Analysis and Environmental Risk Assessment.

**COURSE PLAN :**

**Week 1:** Sustainability Concepts – Innovations and Challenges

**Week 2:** Environmental Measurements from Different Disciplines

**Week 3:** Ecology, Population & Environmental Chemistry

**Week 4:** Physical Process in Environment

**Week 5:** Environmental Biological Concepts

**Week 6:** Environmental Risk Assessments with Concepts of EIA and LCA

**Week 7:** Water – Quantity and Quality

**Week 8:** Water Treatment Basics

**Week 9:** Basics of Wastewater Collection, Treatment & Resource Recovery

**Week 10:** Basics of Solid Waste, Soil and Noise Pollution

**Week 11:** Basics of Air Pollution Issues – Global and Local

**Week 12:** Case Studies and Course Wrap-up





# NEUROSCIENCE OF HUMAN MOVEMENT

**PROF. VARADHAN**

Department of Biomedical Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.TechM.E/M.Tech,M.S, M.Sc,PhD

**PRE-REQUISITES** : Motivation & open-mindedness is the only pre-requisitel

**INDUSTRIES APPLICABLE TO** : Companies/industry/ Educational Institute want to Implement 21st Century Education procedure, Educational Institute want to apply for Accreditation

## COURSE OUTLINE :

Neuroscience of Human Movement will focus on the neural system responsible for movement generation, movement control and learning of actions. The course will start from the very basics of neuroscience and build theory to understand the movement control system in relatively good detail and depth. The successful student of this course will be able to appreciate in-depth, the brain processes that control movement.

## ABOUT INSTRUCTOR :

Dr. Varadhan SKM is an Assistant Professor in Biomedical Engg at IIT Madras. His research interests are in the area of Neural control of movements, Motor learning, and Dexterous object manipulation in the presence of static and dynamic perturbations (See website for more details). He teaches courses on Biomechanics, Neuromechanics, Engg. Mechanics, Biomedical Instrumentation, Quantitative Physiology.

## COURSE PLAN :

**Week 01** : Introduction, Membrane Physiology, Nernst Equation, GHK Equation

**Week 02** : Action Potential, Neuromuscular Junction, Skeletal Muscles, Motor Units

**Week 03** : Receptors, Muscle Spindles, Golgi Tendon Organs, Spinal control

**Week 04** : Monosynaptic, Oligosynaptic & Polysynaptic reflexes, Preprogrammed reactions

**Week 05** : Overview of motor control system, Primary Motor cortex – Part 1

**Week 06** : Primary Motor cortex – Part 2

**Week 07** : Primary Motor Cortex – Part 3, Lesions, Brain Machine interfaces

**Week 08** : Parietal & Pre-motor cortex

**Week 09** : Role of Cerebellum in movement control

**Week 10** : Role of Cerebellum in movement control

**Week 11** : Role of Basal Ganglia in movement control

**Week 12** : Role of Basal Ganglia in movement control



# NUMERICAL METHODS FOR ENGINEERS

**PROF. NIKET KAISARE**

Department of Chemical Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : First or second year undergraduate students in any branch of engineering (or science)

**PRE-REQUISITES** : 12th standard Math background

## COURSE OUTLINE :

The development of fast, efficient and inexpensive computers has significantly increased the range of engineering problems that can be solved reliably. Numerical Methods use computers to solve problems by step-wise, repeated and iterative solution methods, which would otherwise be tedious or unsolvable by hand-calculations. This course is designed to give an overview of numerical methods of interest to scientists and engineers. However, the focus being on the techniques themselves, rather than specific applications, the contents should be relevant to varied fields such as engineering, management, economics, etc.

## ABOUT INSTRUCTOR :

Prof. Niket Kaisare is an Associate Professor of Chemical Engineering in IIT-Madras. He works in the area of modeling, design and control for energy applications. He has over 7 years of research/teaching experience in academia, and three-year experience in Industrial R&D. He uses computational software, including MATLAB, FORTRAN, Aspen and FLUENT extensively in his research and teaching.

## COURSE PLAN :

- Week 01** : Introduction Motivation and applications Computation and Error Analysis Accuracy and precision; Truncation and round-off errors; Binary Number System; Error propagation
- Week 02** : Linear Systems and Equations: 1 Matrix representation; Cramer's rule; Gauss Elimination; Matrix Inversion; LU Decomposition;
- Week 03** : Linear Systems and Equations: 2 Iterative Methods; Relaxation Methods; Eigen Values
- Week 04** : Algebraic Equations: Bracketing Methods Bracketing methods: Bisection, Reguli-Falsi;
- Week 05** : Algebraic Equations: Open Methods and Optimization Open methods: Secant, Fixed point iteration, Newton's method
- Week 06** : Numerical Differentiation Numerical differentiation; higher order formulae
- Week 07** : Integration and Integral Equations Trapezoidal rules; Simpson's rules; Quadrature
- Week 08** : Regression Linear regression; Least squares; Total Least Squares;
- Week 09** : Interpolation and Curve Fitting Interpolation; Newton's Difference Formulae; Cubic Splines
- Week 10** : ODEs: Initial Value Problems – 1 Euler's methods; Runge-Kutta methods; Predictor-corrector methods;
- Week 11** : ODEs: Initial Value Problems – 2 Extension to multi-variable systems; Adaptive step size; Stiff ODEs
- Week 12** : ODEs: Boundary Value Problems Shooting method; Finite differences; Over/Under Relaxation (SOR)



# SYSTEM DESIGN FOR SUSTAINABILITY

**PROF. SHARMISTHA BANERJEE**

Department of Design Engineering  
IIT Guwahati

**TYPE OF COURSE** : Rerun | Core | PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Bdes (final year) & Mdes students

**PRE-REQUISITES** : System Design

**INDUSTRIES APPLICABLE TO** : Product/ Industrial Design and Manufacturing Companies System Design and R&D Industry. Strategic Design Groups of Industry Industries interested in Sustainability

## COURSE OUTLINE :

Design for Sustainability is a design thinking process for widening the boundaries of the objective of design so as to contribute positively to sustainable development. It encompasses four approaches: 1. Selection of resources with low environmental impact; 2. Design of products with low environmental impact; 3. Product-Service System Design for eco-efficiency; 4. Design for social equity and cohesion. This course will discuss these Design approaches, methods and tools alongwith case examples.

## ABOUT INSTRUCTOR :

Sharmistha Banerjee is working as Assistant Professor at Department of Design at IIT Guwahati. She did her Bachelor in Industrial Design from IIT Guwahati and a Master in Integrated Product Design from Technical University of Delft, Netherlands. Her PhD is under progress at IIT Guwahati in the domain of Design for Sustainability applied to agricultural machinery design. She is focused in the area of sustainable product & system development in a collaborative work environment. She has established the Sustainability and Social Innovation Lab alongwith her colleagues at Department of Design which is also part of the International Learning Network on Sustainability, a consortium of more than 150 global universities working in this domain.

## COURSE PLAN :

**Week 01** : Basics - What is sustainability, sustainable development and why do we need it?

**Week 02** : Basics - Evolution of sustainability within Design

**Week 03** : Product Life Cycle Design – Methods & Strategies

**Week 04** : Product Life Cycle Design – Software Tools

**Week 05** : Sustainable Product-Service System Design – Definition, Types & Examples

**Week 06** : Sustainable Product-Service System – Transition Path and Challenges

**Week 07** : Designing for Sustainable Product-Service System – Methods and Tools (contd.)

**Week 08** : Designing for Sustainable Product-Service System – Methods and Tools (contd.)

**Week 09** : Designing for Sustainable Product-Service System – Methods and Tools (contd.)

**Week 10** : Other Design for Sustainability Tools and approaches (contd.)

**Week 11** : Other Design for Sustainability Tools and approaches (contd.)

**Week 12** : Design for Sustainability – Engineering Design Criteria and Guidelines



# CONTROL SYSTEMS

**PROF. C.S. SHANKAR RAM**

Department of Design Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech

**PRE-REQUISITES** : 2nd year undergraduate students in engineering. prefer that they have completed a course on engineering mathematics that teaches complex variables and laplace transform

**INDUSTRIES APPLICABLE TO** : Automotive companies

**COURSE OUTLINE :**

Course Objective: To provide a basic understanding of the concepts and techniques involved in designing control schemes for dynamic systems. Learning Outcomes: At the end of this course, one should possess in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers (such as Proportional-Integral-Derivative) based on stability and performance requirements.

**ABOUT INSTRUCTOR :**

Prof. C. S. Shankar Ram currently working in the Department of Engineering Design at the Indian Institute of Technology Madras, INDIA. My research interests are in the broad areas of Dynamics and Control applied to Automotive Systems and Transportation Systems.

**COURSE PLAN :**

- Week 01** : Introduction to Control, Classification of Dynamic Systems, Closed Loop Control System with Feedback, Mathematical Preliminaries – Complex Variables, Laplace Transform.
- Week 02** : Standard Inputs, Free and Forced Response, Transfer Function, Poles and Zeros.
- Week 03** : Response to various Inputs, Effect of Poles, Notion of Bounded Input Bounded Output (BIBO) stability.
- Week 04** : Effect of Zeros, Closed Loop Transfer Function, Dynamic Performance Specification, First Order Systems.
- Week 05** : Second Order Systems, Unit Step Response of Underdamped Second Order Systems, Concepts of Rise Time, Peak Time, Maximum Peak Overshoot and Settling Time.
- Week 06** : Controllers – Proportional (P), Integral (I) and Derivative (D) Blocks, Examples of PID controller design.
- Week 07** : Routh's Stability Criterion, Use in Control Design, Incorporation of Performance Specifications in Controller Design, Analysis of Steady State Errors.
- Week 08** : Root Locus and its Application in Control Design.
- Week 09** : Frequency Response, Bode Plots, Nyquist Plots.
- Week 10** : Nyquist Stability Criterion, Relative Stability – Gain and Phase Margins.
- Week 11** : Control System Design via Frequency Response – Lead, Lag and Lag-Lead Compensation.
- Week 12** : Case Studies.



# OCEAN ENGINEERING



# OCEAN ENGINEERING

**12 weeks**

01. HSE Practices for Offshore and Petroleum Industries





# HSE PRACTICES FOR OFFSHORE AND PETROLEUM INDUSTRIES

**PROF. SRINIVASAN CHANDRASEKARAN**

Department of Ocean Engineering  
IIT Madras

**TYPE OF COURSE** : Rerun | Core | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.S, B.Sc, M.Sc, PhD

**INDUSTRIES APPLICABLE TO** : Oil and Petroleum Companies, both in India and abroad, Consulting organizations, Safety Executive Teams.

## COURSE OUTLINE :

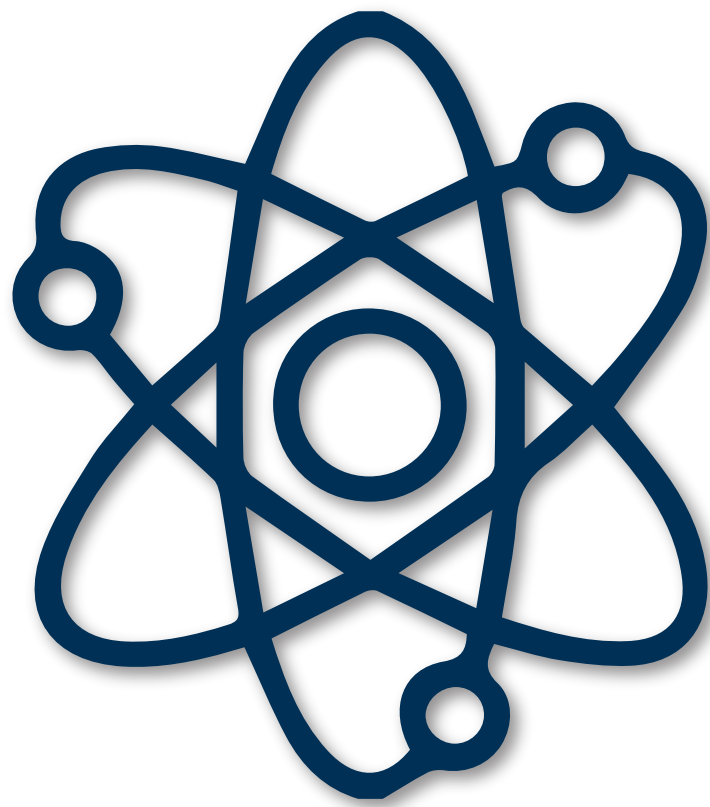
The course will give an overview of the safety and environmental issues in the petroleum industry. It will provide detailed understanding of the methods and techniques to resolve these key issues for making petroleum production and processing, cleaner and safer. This course would educate the participants to identify and assess hazards in any stage of operation, to quantify and manage them as well. This course will also highlight lessons learnt from the past accidents.

## ABOUT INSTRUCTOR :

Prof.Srinivasan Chandrasekaran is currently a Professor in the Dept. of Ocean Engineering, Indian Institute of Technology Madras, India. He has teaching, research and industrial experience of about 23 years during which he has supervised many sponsored research projects and offshore consultancy assignments both in India and abroad. His active areas of research include dynamic analysis and design of offshore platforms, Development of geometric forms of compliant offshore structures for ultra-deep water oil exploration and production, sub-sea engineering, Rehabilitation and retrofitting of offshore platforms, structural health monitoring of ocean structures, seismic analysis and design of structures and risk analyses and reliability studies of offshore and petroleum engineering plants.

## COURSE PLAN :

- Week 01** : Environmental impact and management, Impact of oil and gas industry in marine environment.
- Week 02** : Oil hydrocarbons in marine environment, Chemical disposal of offshore industry and environmental management.
- Week 03** : Dispersion models and atmospheric pollution, Dispersion models continued.
- Week 04** : Hazard assessment, Introduction to HSE.
- Week 05** : Safety assurance, Safety in design and operations.
- Week 06** : Organizing for safety, Hazard classification and assessment.
- Week 07** : Hazard evaluation and control, Hazop, FMEA.
- Week 08** : Dose assessment, safety regulations, Toxic releases- models and methods.
- Week 09** : Chemical risk analysis, Quantitative risk assessment.
- Week 10** : Fire and explosion models, Flammability diagrams.
- Week 11** : Fire and explosion: prevention methods, Event tree and fault tree analyses.
- Week 12** : Process safety management, Software used in HSE.



# PHYSICS



# PHYSICS

## **08 weeks**

- 01. Introduction to Electromagnetic Theory
- 02. Introduction To Statistical Mechanics
- 03. Numerical Methods And Simulation Techniques For Scientists & Engineers
- 05. Theoretical Mechanics
- 04. Solar Photovoltaics Fundamentals, Technology And Applications
- 06. Path Integral and functional methods in Quantum Field theory

## **12 weeks**

- 01. Experimental Physics - II
- 02. Physics of Turbulence
- 03. Solid State Physics
- 04. Computational Physics
- 05. Waves and Oscillations



# INTRODUCTION TO ELECTROMAGNETIC THEORY

**PROF. MANOJ HARBOLA**

Department of Physics  
IIT Kanpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : 1st & 2nd year B. Tech. in Civil, Mechanical, Aerospace and B.Sc. Students.

**COURSE OUTLINE :**

This course introduces students to handling electromagnetic theory using vector calculus. This enables students to handle problems that are more complicated than they are used to from their school days. Due to general nature of the mathematics they learn in this course, what they learn here will help them in their future courses like fluid dynamics that use similar mathematics.

**ABOUT INSTRUCTOR :**

Dr. Manoj Kumar Harbola joined the Department in 2000. He obtained his doctoral degree at the City University of New York, USA, working under the supervision of Prof. Viraht Sahni. Subsequently he carried out postdoctoral research at the University of North Carolina, Chapel Hill, USA before joining the Centre for Advanced Technology, Indore as a Scientist. He is a theoretical physicist, whose chief interest lies in Electronic Structure of Atoms, Molecules and Solids using Density Functional Methods.

**COURSE PLAN :**

- Week 01** : Coulomb's law Divergence of electric field Gauss' law Curl of electric field Stokes' theorem Electrostatic potential.
- Week 02** : Laplace's equation for electrostatic potential Laplace's equation in other fields Uniqueness of solution of Laplace's equation Poisson equation and uniqueness of its solution Method of images for planar surfaces Work and energy in electrostatics.
- Week 03** : Conductors and capacitors Reciprocity theorem Polarization and bound charges Linear dielectrics Electric displacement Fields in dielectrics .
- Week 04** : Magnetic field due to a magnet Magnetic field due to a steady current Divergence and curl of magnetic field Ampere's law The vector potential Magnetization and bound currents.
- Week 05** : Magnetic fields in matter Magnetic field in matter Faraday's law Induced electric field Energy in magnetic field Displacement current.
- Week 06** : Maxwell's equations Work done by electromagnetic field Poynting's theorem Momentum in electromagnetic field Angular momentum in electromagnetic field Electromagnetic waves: the wave equation.
- Week 07** : Wave equation Plane electromagnetic waves Energy carried by electromagnetic waves Pressure due to electromagnetic waves Reflection and transmission of electromagnetic waves Reflection and transmission of electromagnetic waves.
- Week 08** : Review and Problem Solving.



# INTRODUCTION TO STATISTICAL MECHANICS

**PROF. GIRISH S. SETLUR**

Department of Physics  
IIT Guwahati

**TYPE OF COURSE** : New | Core | PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Thermodynamics, Classical mechanics, Quantum mechanics

**INTENDED AUDIENCE** : M.Sc and beginning PhD students and other interested individuals

## **COURSE OUTLINE :**

This is an introductory course in classical and quantum statistical mechanics which deals with the principle of ensembles, Classical, Fermi and Bose ideal gases, Pauli paramagnetism, Debye and Einstein's theory of specific heat and the 1D Ising model.

## **ABOUT INSTRUCTOR :**

Prof. Girish S. Setlur had completed his B.Tech from IIT Bombay and pursued his PhD from University of Illinois at Urbana Champaign, USA. He works in the field of Theoretical Condensed Matter Physics and is interested in understanding and accounting for the properties of everyday bulk materials from a knowledge of the fundamental constituents of the substance and the fundamental physical laws governing those constituents. He is also interested in topological materials, specifically their nonlinear optical properties.

## **COURSE PLAN :**

**Week 1:** Review of thermodynamics, Hamiltonian mechanics of classical and quantum systems.

**Week 2:** Microcanonical ensemble and the concept of entropy. Examples of systems with finite infinitely many degrees of freedom. Counting of states and entropy in quantum systems.

**Week 3:** Canonical ensemble and the concept of temperature. Relation between canonical and microcanonical ensembles and partition functions Thermodynamic potentials and Legendre transformations. Examples from classical and quantum systems.

**Week 4:** Other ensembles and their related thermodynamic potentials Concept of fugacity, pressure of an ideal gas. Equation of state of an ideal classical gas.

**Week 5:** Equation of state of ideal Bose and Fermi gases. Bose Einstein condensation and Fermi degeneracy pressure.

**Week 6:** Non-ideal gas: Van der Waals equation of state. Concept of phase diagram

**Week 7:** Magnetic insulators: Ising model, Potts model Solution on 1D lattice using transfer matrix method. Solution in large dimensions using mean field theory.

**Week 8:** Pauli paramagnetism and temperature dependent susceptibility, electronic contribution to specific heat of solids. Debye and Einstein theory of specific heat of solids.



# NUMERICAL METHODS AND SIMULATION TECHNIQUES FOR SCIENTISTS AND ENGINEERS

**PROF. SAURABH BASU**

Department of Physics

IIT Guwahati

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (26 Aug'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic level Mathematics course

**INTENDED AUDIENCE** : Learners of any discipline of Engineering/Sciences

**INDUSTRIES APPLICABLE TO** : Industry people in the R&D sectors of Fluid Mechanics, Material Science may value the course.

## **COURSE OUTLINE :**

The course contains very important aspects of modern day course curriculum, namely, numerical methods and simulation techniques that are going to be of utmost importance to both undergraduate and graduate level students. Most of the real life problems are unsolvable using known analytic techniques; thus depending on numerical methods is imperative. The course introduces basic numerical methods and the key simulation techniques that are going to be useful to academia and industry alike. Even if the software packages, such as Mathematica, Matlab etc are available for most of the numeric computations, yet one should be aware of the techniques that are inbuilt into the softwares.

## **ABOUT INSTRUCTOR :**

Prof. Saurabh Basu is a Professor at the Department of Physics, IIT Guwahati. His area of expertise is Theoretical Condensed Matter Physics, with special emphasis on the correlated boson and fermion systems, topological insulators. He has about 90 research publications in different refereed international journals.

## **COURSE PLAN :**

**Week 1:** Introduction to Numerical analysis, Importance of error and their calculations, Examples

**Week 2:** Root Finding Method of non-linear equations, Bisection Method, Newton Raphson Method, Secant method, Regula- Falsi method, Practical examples

**Week 3:** Curve fitting method, linear and non-linear fitting, Linear interpolation, Lagrange interpolation method, Newton Interpolation formula, Practical examples

**Week 4:** Numerical differentiation, central difference methods, higher order derivatives, errors, practical examples

**Week 5:** Numerical integration, Simpson's 1/3 rd rule, Simpson's 3/8 th rule, local and global error analysis, practical examples

**Week 6:** Eigenvalue problems, Heun's method, Euler's method, Runge Kutta Method, Gerschgorin disc theorem , Jacobi method, Practical examples

**Week 7:** Simulation Techniques, Random numbers, Monte Carlo Method, Importance Sampling, Metropolis Algorithm, Heat- bath algorithm, practical Examples

**Week 8:** Molecular dynamics, interaction and forces in molecular systems, MD and Verlet algorithm, correlations, practical examples





# THEORETICAL MECHANICS

**PROF.CHARUDATT KADOLKAR**

Department of Physics

IIT Guwahati

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Introduction to Newtonian Mechanics

**INTENDED AUDIENCE** : First year of MSc or 2nd and 3rd year of BE/BTech in Engineering Physics

## **COURSE OUTLINE :**

This course focuses on analytical aspects of classical mechanics and is targeted towards the audience who are interested in pursuing research in Physics. Various formulations of mechanics, like the Lagrangian formulation, the Hamiltonian formulation, the Poisson bracket formulation will be taught in the course. The course also introduces the mechanics of continuous systems and fields.

## **ABOUT INSTRUCTOR :**

Charudatt Kadolkar graduated from IIT Bombay and completed his PhD in Physics, also at IIT Bombay. After completing a post-doctoral fellowship, he joined IIT Guwahati in 1995. He has been teaching Physics at various levels for past 22 years. His primary research interest is condensed matter physics.

## **COURSE PLAN :**

**Week 1:** Motion and Constraints, Generalized Coordinates, D'Alembert's Principle of Virtual Work

**Week 2:** Variational Calculus, Hamilton's Principle, Lagrangian Formulation.

**Week 3:** Application of Lagrangian Formulation, Configuration Space and Phase Space.

**Week 4:** Hamilton's Equations of Motion

**Week 5:** Canonical Transformations, Canonical invariants, Symplectic Approach to CT.

**Week 6:** Poisson Bracket Formulation, Symmetry groups of Mechanical Systems, Liouville's Theorem

**Week 7:** Hamilton Jacobi Theory, Hamilton's Principal Function, Action-Angle variables.

**Week 8:** Lagrangian and Hamiltonian Formulation for Continuous Systems and Fields.



# SOLAR PHOTOVOLTAICS: FUNDAMENTALS, TECHNOLOGY AND APPLICATIONS

**PROF.SOUMITRA SATAPATHI**

Department of Physics  
IIT Roorkee

**TYPE OF COURSE** : New | Core\_Elective | PG/UG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : Under graduate and post graduate engineering students and post graduate science students

**INDUSTRIES APPLICABLE TO** : Renewable energy sectors, Power industries and Green building companies will be interested

## COURSE OUTLINE :

The most important scientific and technical challenges facing humanity in the 21st century are Energy security, Environmental security and Economic security and these can likely be met only through addressing the energy problem with in the next 10–20 years. Meeting global energy demand in a sustainable fashion will require not only increased energy efficiency and new methods of using existing carbon based fuels but also renewable energy. Moreover, rising prices and sporadic shortages of fossil fuels provides the impetus for the present worldwide effort to develop alternative sources of energy. Solar energy is to be a major primary energy source and utilization requires solar capture and conversion. In this course we will discuss about various photovoltaics technologies, different generation of solar cells, device fabrication and characterization techniques and applications in industries.

## ABOUT INSTRUCTOR :

Prof. Soumitra Satapathi is an Assistant Professor in the Department of Physics at Indian Institute of Technology, Roorkee and also the visiting Professor of Physics at University of Massachusetts Lowell, USA. He is also a joint faculty in the Center for Nanotechnology at IIT Roorkee. Before joining to IIT Roorkee, Prof.Satapathi was a postdoctoral research fellow at Tufts University Boston, USA. He received his M.S and Ph.D. degree in Physics from University of Massachusetts Lowell, USA in 2010 and 2012 respectively. He has published more than 20 international journal papers and received several international awards including Marquis Who's Who of America 2011 and BASE Award on Solar Photovoltaic from DST. His research is focused on the development of advanced materials and their use in organic electronics including organic solar cells, LEDs and sensors.

## COURSE PLAN :

- Week 1:** Introduction to course , Review of Semiconductor Physics, Charge carrier generation and recombination, p-n junction model and depletion capacitance , Current voltage characteristics in dark and light
- Week 2:** Device Physics of Solar Cells , Principle of solar energy conversion, Conversion efficiency, Single, Tandem multi-junction solar cells , Numerical solar cell modeling
- Week 3:** Principle of cell design , Crystalline silicon and III-V solar cells , Thin film solar cells: Amorphous silicon , Quantum Dot solar cells , Copper Indium Gallium Diselenide based solar cells
- Week 4:** Introduction to Dye Sensitized Solar Cells , Fabrication of Dye Sensitized Solar Cells' Design of novel dye, Design of solid electrolytes materials, Counter electrode engineering
- Week 5:** Introduction to Organic Solar Cells, Physics of Bulk Hetero junction (BHJ) Solar Cells , Morphology and charge separation in BHJ , Design of low band gap polymers , Novel architecture in BHJ
- Week 6:** Perovskite Solar Cells , Fabrication of perovskite solar cells , Photophysics in perovskite solar cells , Stability in perovskite solar cells , Lead free perovskite solar cells
- Week 7:** Photovoltaic system engineering , Thermo- Photovoltaic generation of electricity , Concentration and storage of electrical energy , Photovoltaics modules, system and application , Green energy building
- Week 8:** Nano materials for photovoltaics , PV panels with nanostructures, Band gap engineering and optical engineering , Photo thermal cells , Energy Economy and management



# PATH INTEGRAL AND FUNCTIONAL METHODS IN QUANTUM PHYSICS

**PROF. URJIT A. YAJNIK**

Department of Physics

IIT Bombay

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)

**EXAM DATE** : 29 Sep 2019

**PRE-REQUISITES** : Relativistic Quantum Mechanics and free scalar field quantisation.

**INTENDED AUDIENCE** : Physics, Engineering Physics, Theoretical Chemistry

## **COURSE OUTLINE :**

Path Integral Method is an important formal development in Quantum Mechanics. The first half of the course is useful for any student of quantum mechanics, providing deeper insights into the theory. The second half of the course discusses the path integral method in its functional form applied to space-time fields and brings out connection of quantised fields to elementary particles.

## **ABOUT INSTRUCTOR :**

Prof. Urjit A. Yajnik is faculty at IIT Bombay since 1989. His primary research interest is in Elementary Particle Physics and Cosmology with Primary teaching interest being mathematical and theoretical physics. He likes to design instructional material so that the essentials of the advanced material become accessible to interested undergraduates.

## **COURSE PLAN :**

**Week 1:** Review of Quantum Basics - I,II&III, Fock-Dirac "second" quantisation I&II

**Week 2:** Time Evolution as Canonical Transformation Time slicing and Path Integral - I,II,III,IV  
Expectation Values

**Week 3:** Interaction with external field -I,II&III functional formalism for relativistic fields -I&II

**Week 4:** Functional method – free fields, Connected diagrams, effective potential - I,II&III

**Week 5:** Functional method – interactions - I&II The S-matrix and cluster decomposition - I,II&III

**Week 6:** The asymptotic condition - I,II Kallen-Lehmann representation - I&II, Effective action -  
Connected diagrams - I

**Week 7:** Effective action - Connected diagrams, Effective action – diagrammatics -I&II, Irreducible  
vertices cluster decomposition

**Week 8:** S-matrix – causal fields -I,IIandIII, Course summary and revision I&II



## EXPERIMENTAL PHYSICS-II

**PROF. AMAL KUMAR DAS**

Department of Physics

IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : Any student of Engineering/ Science stream

**INDUSTRIES APPLICABLE TO** : The industries of electronics, telecommunication and instrumentation

### **COURSE OUTLINE :**

This course is designed in three modules: (I) Experimental Physics-I : Experiments on Mechanics, General properties of matter, Thermal properties of matter, Sound, Electricity and magnetism. (II) Experimental Physics-II : Experiments on Optics and Modern Physics. (III) Experimental Physics-III : Experiments on Solid state physics and Modern Optics.

### **ABOUT INSTRUCTOR :**

After completion of B. Sc (Hons) and M. Sc in Physics in 1994, Dr. Amal Kumar Das did his Ph.D on experimental physics and material science from Institute of Physics, Bhubaneswar. After completing post-doctoral research on experimental physics from Paul Drude Institute, Berlin, Germany, he joined as a Faculty in Department of Physics, Indian Institute of Technology Kharagpur in 2004 and taught different subjects to UG and PG students. Prior to joining here, he taught experimental physics laboratory for four years to B. Sc students in Malda College under North Bengal University, West Bengal.

### **COURSE PLAN :**

**Week 1:** Summary of previous course on Experimental Physics-I

**Week 2:** Basic apparatus : Spectrometer, light source, prism, lens, mirror, grating etc.

**Week 3:** Experiment on reflection, refraction and dispersion

**Week 4:** Experiments on Interference

**Week 5:** Experiments on interference (contd)

**Week 6:** Experiments on Interference (contd)

**Week 7:** Experiments on Diffraction

**Week 8:** Experiments on Diffraction (contd)

**Week 9:** Experiments on Diffraction (contd)

**Week 10:** Experiments on Polarization

**Week 11:** Experiments on Quantum physics

**Week 12:** Experiments on Atomic physics



# PHYSICS OF TURBULENCE

**PROF. MAHENDRA K. VERMA**

Department of Physics

IIT Kanpur

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Basic fluid dynamics, Calculus, Fourier transforms

**INTENDED AUDIENCE** : Advanced UG and PG (Masters & PhD) students

**INDUSTRIES APPLICABLE TO** : Companies working in CFD, turbulence

**COURSE OUTLINE :**

Turbulence is everywhere in the interiors and atmospheres of planets and stars, galaxies, biological systems including human body, engineering flows, etc. In this course, we will cover fundamental aspects of turbulence Kolmogorov's theory of turbulence in spectral and real space; Two-dimensional turbulence; Energy transfers; Enstrophy and kinetic helicity cascades; more complex applications, such as passive scalar, Turbulent thermal convection, and Magnetohydrodynamic turbulence.

**ABOUT INSTRUCTOR :**

Prof. Mahendra Verma received his Ph.D. degree from University of Maryland. Presently he is a Professor at the Physics Department of Indian Institute of Technology Kanpur, India. He is a recipient of Swarnajayanti fellowship, INSA Teachers Award, and Dr. A.P.J. Abdul Kalam Cray HPC Awards. He has authored the books "Introduction to Mechanics", "Physics of Buoyant Flows: From Instabilities to Turbulence", and "Energy Transfers in Fluids Flows: Multiscale and Spectral Perspectives". His research interests include turbulence, Nonlinear dynamics, High-performance computing, and Non-equilibrium statistical physics. He and his group have developed a spectral code TARANG that can simulate variety of fluid flows.

**COURSE PLAN :**

**Week 1:** Introduction; Basic equations of hydrodynamics in real space, Conservation laws

**Week 2:** Fourier Space Description of Hydrodynamics;

**Week 3:** Fourier description (contd), Craya-Herring basis

**Week 4:** Instabilities

**Week 5:** Saturation of nonlinearity, Patterns

**Week 6:** Energy transfers in fluid flows

**Week 7:** Kolmogorov's theory of turbulence (in Fourier space)

**Week 8:** Kolmogorov's theory of turbulence (in real space)

**Week 9:** Enstrophy, Two-dimensional turbulence, Kinetic helicity

**Week 10:** Turbulence with a scalar; Passive scalar;

**Week 11:** Turbulent thermal convection

**Week 12:** Turbulence with a vector, Magneto hydrodynamic turbulence



# SOLID STATE PHYSICS

**PROF. AMAL KUMAR DAS**

Department of Physics  
IIT Kharagpur

**TYPE OF COURSE** : Rerun | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, B.Sc

**INDUSTRIES APPLICABLE TO** : Solid State Physics has the most striking impact on the solid state electronics. The industries of electronics, telecommunication and instrumentation will recognize this course.

**COURSE OUTLINE :**

In universe, matter is observable in everyday life in four states: solid, liquid, gas and plasma. There are other states of matter known to exist only under extreme situations. Matter, whatever the states, is made of atoms. The states are defined in terms of interatomic distance, atomic arrangement and atomic ionization in matter. In solid state of matter, the arrangement of atoms forms different structure of materials. The structure of materials is the key deciding factor for different kind of properties, such as thermal, electrical, optical, magnetic, dielectric etc. In this course we will learn the structure of solid materials and their different physical properties along with underlying physics.

**ABOUT INSTRUCTOR :**

Prof. Amal Kumar Das, Dept. of Physics, IIT Kharagpur. After completion of B.Sc (Hons) from Calcutta University in Physics and M. Sc in Physics with specialization in solid state physics in 1994, I did Ph.D on experimental solid state physics and material science from Institute of Physics, Bhubaneswar. After completing post doctoral research on magnetic properties of solids from Paul Drude Institute, Berlin, Germany, I joined as a Faculty in Department of Physics, Indian Institute of Technology Kharagpur (IIT KGP) in 2004 and teaching different subject to UG and PG students including popular courses, namely solid state devices and physics of semiconductor devices. Prior to join IIT KGP, I taught solid state physics for several years to B. Sc students in an undergraduate college (Malda College under North Bengal University), West Bengal.

**COURSE PLAN :**

- Week 01** : Atom to solid structure
- Week 02** : Crystal symmetry, unit cells and crystal planes
- Week 03** : Real space and reciprocal space of crystals
- Week 04** : X-ray diffraction and determination of crystal structures
- Week 05** : Thermal Properties of Solids
- Week 06** : Free electron theory of solids
- Week 07** : Band structure of solids
- Week 08** : Semiconducting property of solids
- Week 09** : Superconductivity
- Week 10** : Diamagnetism and paramagnetism
- Week 11** : Ferromagnetism and antiferromagnetism
- Week 12** : Dielectrics and Ferroelectrics





# COMPUTATIONAL PHYSICS

**PROF. APRATIM CHATTERJI**  
**PROF. PRASENJIT GHOSH**  
Department of Physics  
IISER PUNE

**TYPE OF COURSE** : New | Elective | PG  
**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)  
**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Basic Statistical Physics and quantum mechanics.

**INTENDED AUDIENCE** : Masters students in physics, engineering physics students and scientists interested in quantum and/OR molecular modelling.

**INDUSTRIES APPLICABLE TO** : Shell, Unilever, TCS

## **COURSE OUTLINE :**

This course aims to give the students competence in the methods and techniques of calculations using computers. At the end of the course the student is expected to have a hands on experience in modeling, algorithm development, implementation and calculation of physical quantities of relevance in interacting many body problems in physics. Both quantum and classical computational tools will be introduced.

## **ABOUT INSTRUCTOR :**

Prof. Apratim Chatterji has 20 years of research experience in molecular modeling of classical statistical mechanics problems and is active in soft matter research using computational techniques. He joined IISER- Pune in 2009.

Prof. Prasenjit Ghosh is interested in understanding microscopic properties of materials using first principles methods quantum mechanics and classical mechanics based computational methods. He joined IISER Pune in 2010 and has 16 years of research experience in this field. Both the instructors have taught this course in IISER-Pune for 5 semesters with the same course content as given above. At IISER Pune the course is offered to 4 th year BS-MS student, Integrated PhD student and PhD students every year.

## **COURSE PLAN :**

**Week 1:** Rapid overview of Fortran programming Language

**Week 2:** Random Number generation and testing, Generation of random numbers with given distribution, Numerical Integration: Deterministic: Trapezoidal method

**Week 3:** Multi-dimensional Integration using stochastic methods

**Week 4:** Lattice Monte Carlo simulations using Ising model to understand phase transitions

**Week 5:** Metropolis algorithm, understanding kinetic barriers, finite size effects, role of thermal fluctuations; Principle of detailed balance, calculating thermodynamic averages

**Week 6:** Determining transition temperature using Binders cumulant

**Week 7:** Solving differential equations

**Week 8:** Linear, non-linear and coupled differential equations

**Week 9:** Solving differential equations Schrodinger eqn. in Quantum Mechanics with Numerov's algorithm and variational principle.

**Week 10:** Classical Molecular Dynamics simulations using Lennard-Jones' potential

**Week 11:** Classical Molecular Dynamics simulations using Lennard-Jones' potential (contd)

**Week 12:** Classical Molecular Dynamics simulations using Lennard-Jones' potential (contd)



# WAVES AND OSCILLATIONS

**PROF. M. S. SANTHANAM**

Department of Physics

IISER Pune

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Higher secondary school level Physics and Mathematics is preferred.

**INTENDED AUDIENCE** : Students of first year B.Sc (Physics / Mathematics ) and first year B.E courses.

## **COURSE OUTLINE :**

In this course, systematic theoretical background to the understanding of wave phenomenon in a wide spectrum of applications will be covered. Emphasis is placed on how theoretical ideas are applied in practice.

## **ABOUT INSTRUCTOR :**

Prof. M. S. Santhanam is an Associate Professor of Physics at the Indian Institute of Science Education and Research, Pune. His research interests are in the areas of Chaos and Nonlinear Dynamics, Quantum Chaos and Statistical Physics. He has obtained Ph.D in Theoretical Physics working at Physical Research Laboratory, Ahmedabad. He had been a post-doctoral fellow at Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.

## **COURSE PLAN :**

**Week 1:** Oscillations in physical systems, Time period and frequency, Harmonic oscillator in one-dimension and its solutions, Superposition of simple harmonic oscillations, Lissajous figures.

**Week 2:** Damped harmonic oscillations and its solutions. Driven and damped oscillator and its solutions. Applications to vibration isolation.

**Week 3:** Impedance, Displacement and velocity resonance, Q-factor of the oscillator.

**Week 4:** Coupled oscillations, Normal modes and frequencies.

**Week 5:** Coupled oscillations of loaded string, Solvable examples of coupled oscillations.

**Week 6:** Wave equation and the transverse waves, Solutions of wave equation, Velocities in wave motion.

**Week 7:** Standing waves, Reflection and transmission of waves at a boundary, Impedance matching.

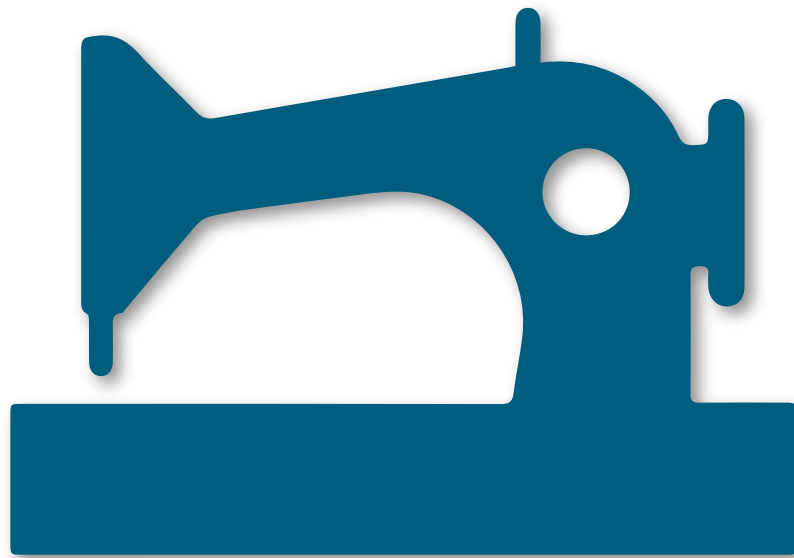
**Week 8:** Longitudinal waves, Sound waves in gases, Longitudinal waves in a solid, Application to periodic structures and earthquakes. Experimental techniques to measure speed of sound.

**Week 9:** Fourier analysis, Wave pulses, Applications of Fourier analysis.

**Week 10:** Waves in optical systems, Laws of reflection and refraction, Rays and wavefronts.

**Week 11:** Turbulent thermal convection

**Week 12:** Introduction to nonlinear oscillations, Waves and solitons.



# **TEXTILE ENGINEERING**



# TEXTILE ENGINEERING

## 8 weeks

01. Yarn manufacture I : Principle of Carding and Drawing

## 12 weeks

- 01. Science of Clothing Comfort
- 02. Science and Technology of Weft and Warp Knitting
- 03. Textile Finishing
- 04. Principles of Combing, Roving preparation & Ring spinning



# YARN MANUFACTURE I : PRINCIPLE OF CARDING AND DRAWING

**PROF. R CHATTOPADHYAY**  
Department of Textile Technology  
IIT Delhi

**TYPE OF COURSE** : Rerun | Core | UG  
**COURSE DURATION** : 8 weeks (29 Jul'19 - 20 Sep'19)  
**EXAM DATE** : 29 Sep 2019

**INTENDED AUDIENCE** : B.E/B.Tech

## COURSE OUTLINE :

Carding and drawing are two fundamental process in yarn manufacture. In carding the fibre tufts are opened, cleaned and separated thoroughly by fast moving pinned surfaces and then reassembled to form a nice 2D array of fibres which is subsequently transformed into an uniform sliver. Drawframe is essentially a stretching device for sliver used to improve mass irregularity of sliver and parallelization of fibres.

## ABOUT INSTRUCTOR :

Prof. R. Chattopadhyay, is working as professor in the department of Textile Technology, IIT Delhi. He has been teaching in the department for last thirty years and has keen interest in yarn manufacturing process, mechanics of yarn structure, process control, application of statistics in textile industry and textile product design.

## COURSE PLAN :

- Week 01** : Objectives of carding process, carding actions, working principle of carding machine, Card feed system, lap and continuous feed systems, design feature of taker-in/ licker-in, waste extraction, opening intensity.
- Week 02** : Design feature of cylinder section, construction, design and working of flats, analysis of carding theory, carding force, fibre shedding, Transfer of fibres from cylinder to doffer, Technological significance of doffing arc, doffing of web, web condensation, Package formation: Forms of packaging, coiling, analysis of can drive.
- Week 03** : Motion transfer in card, draft and production calculations, card setting, significance of setting.
- Week 04** : Card clothing: licker-in, cylinder, doffer clothing; card tooth geometry, Operational load on cylinder, fibre transfer efficiency, carding process.
- Week 05** : Autoleveller in card: principle of autolevelling, type of autoleveller, type of autoleveller, correction length, Fibre configuration in card sliver, mechanism of fibre hook and nep formation, cloudy web, Drawframe: Fundamentals of drafting, draft, ideal drafting, geometrical analysis of fibre movement in drafting.
- Week 06** : Objectives of drawing, Design features and working mechanism of drawframe. Drafting unit, drawing rollers, Drafting roller arrangement and its significance, package formation, Autoleveller in drawframe, Sliver irregularity and its control.
- Week 07** : Theory of drafting, Vasileff's model of drafting, drafting wave, Drafting force, draft vs drafting force, Roller setting: analysis of roller setting, influence of roller setting.
- Week 08** : Drawing process and its influence on fibre configuration in sliver, Draft and production calculation.



# SCIENCE OF CLOTHING COMFORT

**PROF. APURBA DAS**

Department of Textile Technology  
IIT Delhi

**TYPE OF COURSE** : Rerun | Elective | UG/PG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**INTENDED AUDIENCE** : B.E/B.Tech, M.E/M.Tech, M.Sc, Ph.D

**PRE-REQUISITES** : Basic courses on Textiles

**COURSE OUTLINE :**

Clothing comfort is one of the most important attributes of textile materials. A basic understanding of comfort aspects of textile materials would be extremely useful for fibre, yarn and fabric manufacturer, researcher, garment designer, processing industries, garment houses, users of the fabrics for speciality applications and all others related with textile and garment industries. The multidisciplinary nature of the subject, encompassing various concepts of physics, neurosciences, psychological science, material sciences, ergonomics, instrumentation and textile engg. would stimulate the minds for innovation, product design and development and material characterization with scientific approaches.

**ABOUT INSTRUCTOR :**

Prof. Apurba Das is Professor in the Department of Textile Technology, Indian Institute of Technology, Delhi. He has completed his Ph.D. from the same department in the year 1994. He has joined Indian Institute of Technology, Delhi in 2002 as a faculty after serving in the textile industries and in research organization for about 11 years. He has guided many Ph.D., M. Tech., B. Tech. students and presently guiding several Ph.D., M. Tech. and B. Tech. students. He has published more than 260 research papers in journals and conferences, authored and edited 05 books and written chapters in 18 books. He has successfully completed many research and consultancy projects from industries and government funding agencies. He has filed several patent applications. He has developed several instruments for characterization of textile materials.

**COURSE PLAN :**

- Week 01** : Introduction to Clothing Comfort
- Week 02** : Psychology and Comfort
- Week 03** : Neurophysiological Processes in Clothing Comfort
- Week 04** : Tactile Aspects of Clothing Comfort (contd)
- Week 05** : Tactile Aspects of Clothing Comfort (contd)
- Week 06** : Thermal Transmission (contd)
- Week 07** : Thermal Transmission (contd)
- Week 08** : Moisture Transmission (contd)
- Week 09** : Moisture Transmission (contd)
- Week 10** : Moisture Transmission (contd)
- Week 11** : Dynamic Heat and Mass Transmission
- Week 12** : Garment Fit and Comfort





# SCIENCE AND TECHNOLOGY OF WEFT AND WARP KNITTING

**PROF. BIPIN KUMAR**

Department of Textile Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Core | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**PRE-REQUISITES** : Textile Fibers, Yarn Technology

**INTENDED AUDIENCE** : Students and anyone working in Knitting industry.

Knitting

**INDUSTRIES APPLICABLE TO** : Voltas Pvt. Ltd.(Textile Machinery Division),Laxmi Industries  
High Performance Textiles Private Limited, Texzium International Private Limited .

**COURSE OUTLINE :**

This course introduces the process of “weft and warp knitting” including its Science, Engineering, Technology and Design. The contents of the lectures have been systematically arranged to start from the basics of simple knit design, and then progressing towards Engineering of Advanced knitted structures and their Technologies.

**ABOUT INSTRUCTOR :**

Dr. Bipin Kumar is currently working as an Assistant Professor in The Department of Textile Technology at IIT Delhi. Prior to joining IIT Delhi, he worked as Research Assistant Professor (2016-2017) at The Hong Kong Polytechnic University, Hong Kong. He graduated from IIT Delhi, with a PhD in Textile Engineering in 2013. After PhD., he served as Postdoctoral Scholar at The Hong Kong Polytechnic University (2013-2014) and The University of California Davis (2014-2016). He is the first recipient from India to be selected for the Fulbright Postdoctoral Program (2013-14) in the field of textiles. His main research focuses on Textile Fabric Structures and Mechanics. He has over 30 publications in leading refereed SCI journals of materials, textiles and medical fields, 4 Patents, 2 Authored book, 10 book chapters, and over 30 conference proceedings. He holds editorial membership of several international referred journals including AATCC Journal of Research, JEFF, FTEE and CTFTE. For his outstanding contribution in research and teaching, he received several prestigious awards including IIT Delhi Teaching Excellence Award (2018), IEI Young Engineer Award (2018-19), ACP outstanding Material Scientist Award (2014), DST INSPIRE Faculty Award (2016), and Award for Excellence in Postdoctoral Research (2016). Currently, he is involved in several start-up ventures in commercializing smart e-textile products for medical applications.

**COURSE PLAN :**

**Week 1:** Introduction to Knitting

**Week 2:** Flat and Circular Weft Knitting (Single Bed)

**Week 3:** Flat and Circular Weft Knitting (Double Bed)

**Week 4:** Basic and Advanced Weft Knit Construction – Part I

**Week 5:** Basic and Advanced Weft Knit Construction – Part II

**Week 6:** Geometrical Modeling of a Weft Knit Structure

**Week 7:** Process Control in Weft Knitting

**Week 8:** Introduction to Warp Knitting

**Week 9:** Swinging and Shogging Motion Control in Warp Knitting

**Week 10:** Basic Warp Knit Constructions

**Week 11:** Double Bed Warp Knitting

**Week 12:** Technical Applications of Knitting



# TEXTILE FINISHING

**PROF. KUSHAL SEN**

Department of Textile Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Core / Elective | PG/UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 16 Nov 2019

**PRE-REQUISITES** : Should have knowledge of fibres, preferably of preparatory processes and dyeing

**INTENDED AUDIENCE** : Students, Teachers and those working in Textile Industry, especially in man-made fibre industry

**INDUSTRIES APPLICABLE TO** : Textile Industry, Particularly Chemical Processing Industry

**COURSE OUTLINE:**

This course would cover the Science and Application of various finishing processes based on the need and Chemistry of the Fibres, Cellulose based, Protein based and Synthetics. Fundamentals of the techniques and the Chemistry finishing agents, Mechanisms applicable to various finishing techniques. Some introduction to relevant machines and characterization of finished fabrics would also be covered.

**ABOUT INSTRUCTOR :**

Currently a Professor in the Department of Textile Technology, IIT Delhi. Areas of specialization include textile chemical processing, texturing, and structure-property correlations. He had attended lot of conferences and published many papers.

**COURSE PLAN :**

**Week 1:** Introduction , General classification of finishes, Mechanical finishing; Sanforization

**Week 2:** Wrinkle-resist finishing, Need, General approach for obtaining finished product

**Week 3:** Cross-linking agents, Catalysts needed, Process and Evaluation

**Week 4:** Stiffeners and Softeners

**Week 5:** Waterproof, Water repellent, Waterproof breathable finishing

**Week 6:** Flame retardants and Finishing thereof

**Week 7:** Antimicrobial finishing ; Bio-polishing

**Week 8:** Soil repellency and Soil release finishing

**Week 9:** Finishing of wool; Milling, setting, Shrink-resistant finishing, Special finishing of silk

**Week 10:** Energy efficient technology; Low liquor application and foam finishing

**Week 11:** Finishing of synthetics; Heat setting , Antistatic and other special finishing

**Week 12:** Mangles, driers and Stenters



# PRINCIPLES OF COMBING, ROVING PREPARATION & RING SPINNING

**PROF. R CHATTOPADHYAY**

Department of Textile Engineering  
IIT Delhi

**TYPE OF COURSE** : New | Core | UG

**COURSE DURATION** : 12 weeks (29 Jul'19 - 18 Oct'19)

**EXAM DATE** : 17 Nov 2019

**INTENDED AUDIENCE** : Undergraduate students of Textile Technology

## **COURSE OUTLINE :**

The course will focus on three processes : Combing , Roving preparation and Ring Spinning. The construction , design features and working principles of the machines will be looked into. The role of machine and process parameters on process performance will be explained. The interaction between technology and machine design will be discussed. Emphasis will be on “know why” rather than “know how”.

## **ABOUT INSTRUCTOR :**

Dr. R Chattopadhyay, is working as professor in the department of Textile Technology, IIT Delhi, India. He has been teaching in the department for last thirty years and has keen interest in yarn manufacturing processes, mechanics of yarn structure, process control, application of statistics in textile industry and textile product design.

## **COURSE PLAN :**

**Week 1:** Combed Spinning process, Objectives of combing , Consequence of short fibers in cotton , Segregation principle of short fibers from longer ones, Combing operations and its classification, Sequence of operation, Timing diagram

**Week 2:** Pre-combing operation, Comber lap formation, Design features and working principle sliver lap & Ribbon lap machines,

**Week 3:** Mechanism for lap feed, Nipper assembly movement, Detaching roller movement, and cylinder comb Web structure , condensation, sliver guidance & drafting process

**Week 4:** Theory of noil extraction for forward and backward feed machines, Influence of process parameters on combing efficiency Production and draft calculation

**Week 5:** Objects of roving frame, Machine configuration, working principle Drafting system, drafting elements (Cradle, Aprons, Condenser etc.)

**Week 6:** Flyer construction, Presser , Twisting , Flyer top , Twist diameter count relationship  
Science, Computational Fluid Dynamics, Software Development

**Week 7:** Viable speed drive, Differential gear Building motion: Function and Working

**Week 8:** Drive analysis, motion flow, Ring frame : Machine configuration, Various components, Working principle

**Week 9:** Drafting, Drafting elements, drafting angle, Difference between speed frame and ring frame drafting system, break draft and main draft distribution, Twisting and winding principle, Twisting winding equation, Twist flow, Winding tension

**Week 10:** Bobbin building : Bobbin geometry, Nature of ring rail movement, Winding and binding layer, Formation of base and conical bottom. Ring and traveler: Types , Purpose, Traveler number

**Week 11:** Spindle : Construction, Drive, Spinning geometry, Spatial location of elements

**Week 12:** Balloon mechanics, Tension in balloon yarn, balloon size, End breaks, Non uniformity, Causes & Remedies

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