NPTEL

NATIONAL PROGRAMME ON TECHNOLOGY ENCHANCED LEARNING

CERTIFICATES from the

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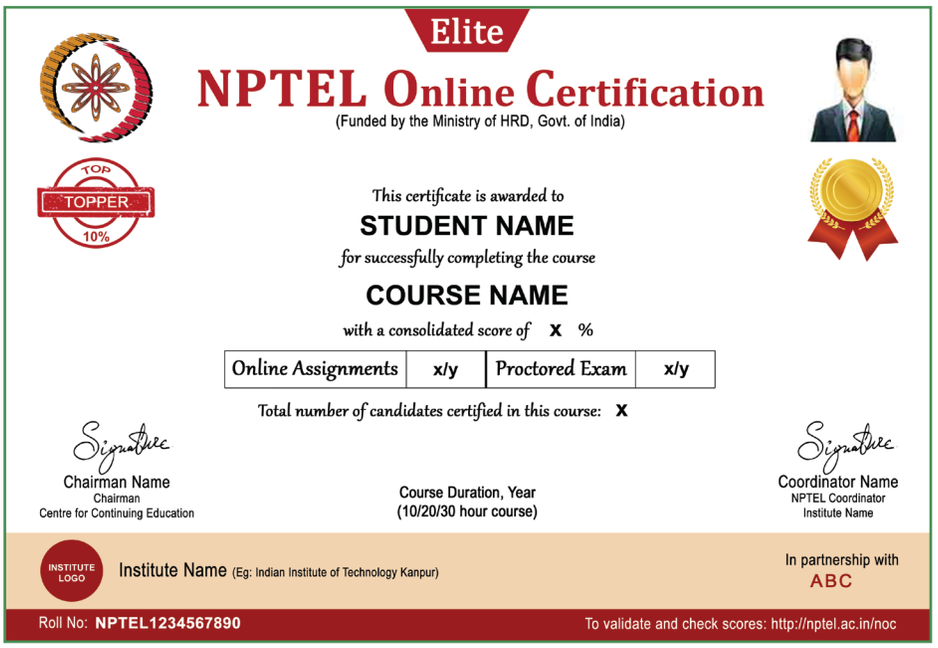
NPTEL IS OFFERING
ONLINE CERTIFICATION COURSES
https://onlinecourses.nptel.ac.in

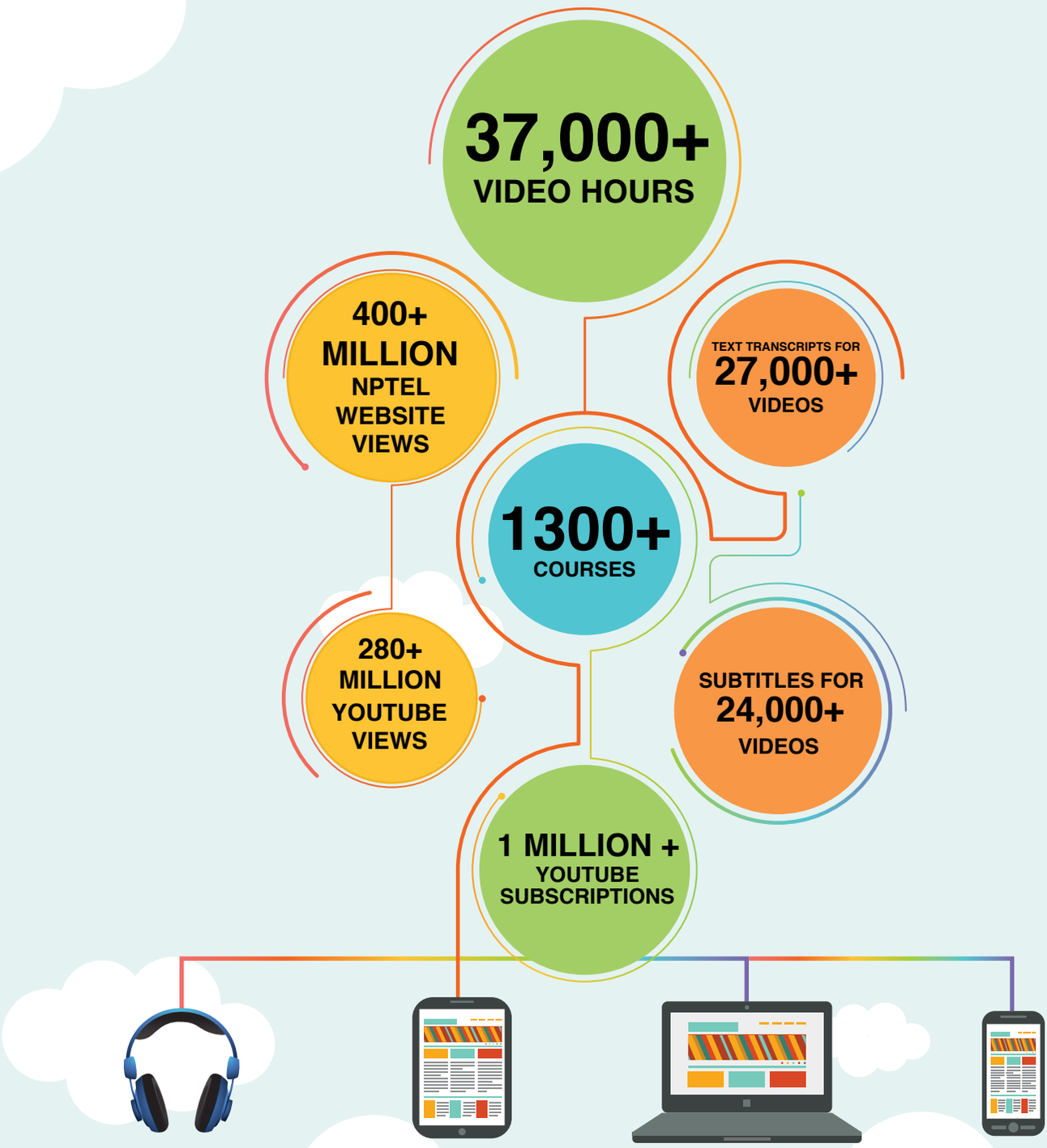


226 COURSES ARE OPEN FOR ENROLLMENT

COURSE START DATES : 22 JANUARY 2018, 05 FEBRUARY 2018
EXAM DATES : APRIL 28 & 29 - 2018

ABOUT NPTEL

The National Programme on Technology Enhanced Learning (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 and 235 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.



NPTEL ONLINE CERTIFICATION

The objective of enabling students obtain certificates for courses is to make students employable in the industry or pursue a suitable higher education programme. 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. The enrolment to and learning from these courses involves no cost. Following these online courses, an in-person, proctored certification exam is conducted across 100+ cities within India and a certificate is provided through the participating institutions and industry, when applicable.

OPEN ONLINE COURSE
(ENROLLMENT IS FREE)

onlinecourses.nptel.ac.in

PROCTORED EXAM
(OPTIONAL FOR A FEE)


Elite

NPTEL Online Certification

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

STUDENT NAME

for successfully completing the course

COURSE NAME

with a consolidated score of X %

Online Assignments x/y | Proctored Exam x/y

Total number of candidates certified in this course: X

Signature

Chairman Name

Chairman

Centre for Continuing Education

Course Duration, Year

(10/20/30 hour course)

Signature

Coordinator Name

NPTEL Coordinator

Institute Name

Institute Name (Eg: Indian Institute of Technology Kanpur)

In partnership with

ABC

Roll No: NPTEL1234567890

To validate and check scores: http://nptel.ac.in/noc

CERTIFICATE

e-verifiable, from IITs

STATISTICS ON OPEN ONLINE COURSES FROM MARCH 2014 TILL DECEMBER 2017

514
COMPLETED COURSES

2.7 MILLION+
ENROLLMENTS ACROSS COURSES

1.82 LAKH+
NUMBER OF EXAM REGISTRATIONS

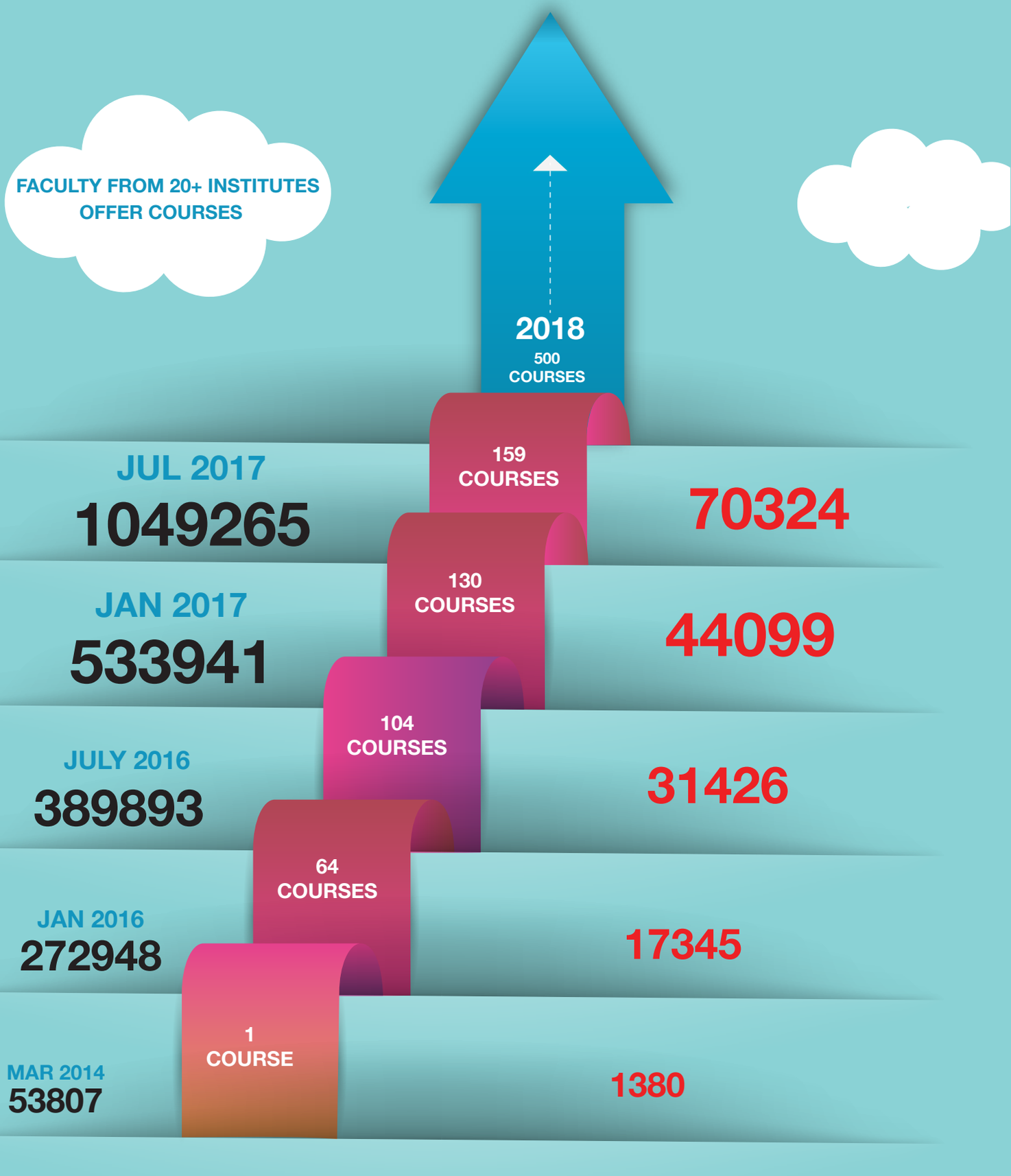
NPTEL LOCAL CHAPTER COLLEGES

ANDAMAN & NICOBAR ISLANDS	01
ANDHRA PRADESH	112
ARUNACHAL PRADESH	01
ASSAM	06
BIHAR	04
CHHATTISGARH	23
DELHI	09
GOA	02
GUJARAT	47
HARYANA	17
HIMACHAL PRADESH	03
JAMMU AND KASHMIR	03
JHARKHAND	12
KARNATAKA	70
KERALA	72
MADHYA PRADESH	37
MAHARASHTRA	260
MANIPUR	01
MEGHALAYA	02
MIZORAM	01
ODISHA	13
PONDICHERRY	11
PUNJAB	21
RAJASTHAN	31
SIKKIM	02
TAMILNADU	250
TELANGANA	41
TRIPURA	04
UTTAR PRADESH	101
UTTARAKHAND	23
WEST BENGAL	77
KABUL, AFGHANISTAN	01
GRAND TOTAL	1261*

To encourage more students across colleges to participate in NPTEL online certification courses, we motivate colleges to set up NPTEL Local Chapter which also serves as a way for NPTEL to partner with them.

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

NPTEL ONLINE CERTIFICATION



AEROSPACE ENGINEERING

AEROSPACE ENGINEERING

4weeks

01. Aircraft Maintenance

8weeks

01. Fundamentals Of Combustion (Part - 1)
02. Introduction To Airplane Performance

AIRCRAFT MAINTENANCE

AEROSPACE ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Introduction to Airplane Performance
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin, Cessna.

COURSE OUTLINE

This course offers the introduction to the aircraft systems like hydraulics system, landing gear, fuel system, electrical systems, 50,100, 200, 500 hours inspection, etc.

ABOUT INSTRUCTOR

Prof. A.K. Ghosh is a faculty of Aerospace Engg. Department of IIT Kanpur. He is also 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 : Indian Aircraft Rules, Civil Aviation Requirement, Car 66, Aircraft System

Week 2 : Hydraulic system, Fuel system, Electrical system, Landing gear

Week 3 : Aircraft structure, Aircraft Inspection, Special Inspection, Daily Inspection

Week 4 : 50 hours inspection, 100 hours inspection, 200 hours inspection, 500 hours inspection, 5 year inspection

AEROSPACE ENGINEERING

FUNDAMENTALS OF COMBUSTION (PART - 1)

TYPE OF COURSE : New
PRE-REQUISITES : Engineering Thermodynamics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This is an introductory course on Fundamentals of Combustion. The objective of this course is to impart knowledge on fundamentals of combustion to both UG and PG students. In this course, fundamentals aspect namely thermochemistry, chemical kinetics, transport phenomena including mass transfer required for understanding of intricate combustion process are to be covered extensively.

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.

COURSE PLAN

Week 1 : Introduction to Combustion

Week 2 : Thermodynamics of combustion

Week 3 : Themochemistry

Week 4 : Chemical Equilubrium keintics

Week 5 : Chemical Kinetics

Week 6 : Types of reactions and Introduction to Physics of combustion

Week 7 : Transport Phenomena

Week 8 : Conservation Equations

AEROSPACE ENGINEERING

INTRODUCTION TO AIRPLANE PERFORMANCE

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

COURSE OUTLINE

This course is designed to provide an integrated introductory treatment of airplane performance with flavor of aircraft design and flight testing.

ABOUT INSTRUCTOR

Prof. A.K. Ghosh is a faculty of Aerospace Engg. Department of IIT Kanpur. He is also 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 : General Introduction: Airplane Performance Characteristics, George Cayley: Concept of Lift and Drag, Introduction to airplane and its components, Hansa 3 Aircraft and its Primary Systems, Concept of Lift: Aerofoil, Wing, and Complete Aircraft, Drag Polar

Week 2 : Revision, Standard Atmosphere: Description and Modelling, Measuring Instruments: Altimeter, Airspeed Indicator, Equations of Motion: Static Performance, Thrust Required, Power Required: Cruise, Excess Thrust and Power: Climb Angle and Rate of Climb

Week 3 : Review, Thrust Required: A Closer Look, Modelling of CL: Dimensional Analysis, A Closer Look: Point Mass Model, Dimensional Analysis, Estimation of Drag Polar Through Flight Test, Estimation of Rate of Climb

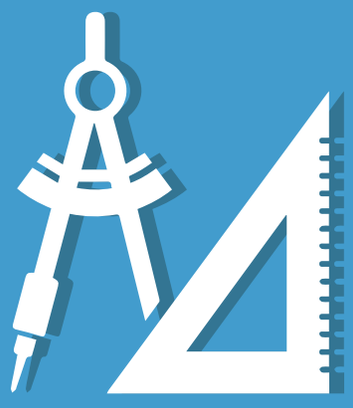
Week 4 : Revision, Range and Endurance, Range and Endurance(Continued), Gliding Flight, Accelerated Flight, V-n Diagram

Week 5 : Revision, V stall: Cruise and Manoeuvre, Flaps: High Lift Devices to Reduce Take off / Landing Distance, Take off: Warm-up Lecture, Take off Performance, Take off Performance (Continued)

Week 6 : Revision, Landing Performance, Landing Performance (Continued), Challenges in Take-off and Landing: Single and Twin Engines, Introduction to Static Stability, Positioning of Centre of Pressure for Static Stability

Week 7 : Revision, Stability and Control: Designer's Perspective, Stability and Control: Designer's Perspective (Continued), Longitudinal Control: Elevator, Stability: Wing and Tail Contribution, Stability: Wing and Tail Contribution (Continued)

Week 8 : Control: Elevator, Control: del_E Required, Control: del_E Required (continued), Design Basics: Wing Loading & Thrust Loading, Design Basics: Sweep & Dihedral, Revision



ARCHITECTURE

ARCHITECTURE

4weeks

01. Principles and Applications of Building Science
02. Visual Communication Design for Digital Media

8weeks

01. Housing Policy & Planning
02. Architectural Conservation And Historic Preservation

ARCHITECTURE

PRINCIPLES AND APPLICATIONS OF BUILDING SCIENCE

TYPE OF COURSE : Rerun

INTENDED AUDIENCE : UG students of Engineering and Architecture ; Design and Construction industry professionals

COURSE DURATION : 4 weeks

INDUSTRY SUPPORT : Design and Construction Firms, Architecture Firms, Construction companies. It can be used as a part of induction, course for recruitsin design and construction firms.

COURSE OUTLINE

Design and construction professionals require a command on fundamental principles of building physics in order to ensure functional efficiency in the built environments. The course provides a one-stop solution to design/construction industry professionals, students of architecture and engineering disciplines to understand these principles and learn their practical applications. The course comprises of 10 modules which cover climate responsive design of buildings, thermal comfort and energy efficiency, building acoustics and noise control and visual quality and day lighting. The participants will engage in a series of experiential learning modules - involving basic tutorials, animated examples, applied case studies and do-it-yourself exercises.

ABOUT INSTRUCTOR

Prof. E. Rajasekar is an Assistant Professor at the Department of Architecture and Planning IIT Roorkee, India. He is an Architect with post-graduation in Building Technology and Construction Management and PhD on Thermal comfort and building performance from IIT Madras. He is a Shastri Indo - Canadian Institute Doctoral Fellow.He specializes in the field of building performance assessment focused on the thermal,acoustics and lighting parameters.He carries a rich research and industry experience in this field and has published more than 20 technical papers in peer-reviewed journals and conferences. He is a USGBC LEED accredited professional and a GRIHA certified professional.

COURSE PLAN

Week 1 : Solar geometry, climate responsive building design, thermal comfort

Week 2 : Bio climatic design, building envelop, glazing systems, energy efficiency

Week 3 : Fundamentals of building acoustics, Quality indicators, Acoustic materials, Noise control

Week 4 : Visual quality in built environment, Effective day lighting design, Integrated design appro

ARCHITECTURE

VISUAL COMMUNICATION DESIGN FOR DIGITAL MEDIA

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Any User Experience design, Interaction design and Visual design companies.

COURSE OUTLINE

The course will impart knowledge on the different aspects of visual communication design, emphasizing on virtual media platform. In contemporary visual design pedagogy, virtual media technology is an emerging paradigm. The course will emphasize on understanding of visual cognition, which is the key factor to achieve user-friendly design. Usage of contemporary technology like, eye tracking will also be introduced as user testing tool. The course will enable the students to learn visual design in virtual media through a methodological approach.

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 form 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 PhD 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 and socio-cultural sustainability, way-finding design, visual narratives, etc.

COURSE PLAN

Week 1 : Introduction to Visual Design
Introduction to Virtual Media Technology

Week 2 : Applications of Visual Design in Virtual Media Paradigm
Design Thinking and Visual Cognition

Week 3 : Contemporary Trends in Virtual-Media
Visual Design Methodology (continues to week 4)

Week 4 : Visual Design Methodology
Case Studies of Visual Design in Virtual Media Technology

ARCHITECTURE

HOUSING POLICY & PLANNING

TYPE OF COURSE : Rerun
PRE-REQUISITES : No pre-requisite. Prior relevant knowledge is desirable.

COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Ministry of Housing and Poverty Alleviation and, Department of Housing at each state government, Development Authorities and Housing boards, Joint venture companies in housing, Private developers of social housing

COURSE OUTLINE

'Housing for All' is a primary aim of Government of India for long. It has formulated Housing for All mission with a Sub-mission focused on 'technology' to enhance the social housing delivery. Government has also been creating an enabling environment for private players through bringing reforms in land and financial sectors to increase overall housing supply. As a result, housing market is facing a constant change.

ABOUT INSTRUCTOR

Prof. Uttam K. Roy is an Architect and City Planner (with specialization in Housing) with more than sixteen years of academic, research and professional experience in the field of housing and urban planning and currently serving as **Assistant Professor** at the **Department of Architecture and Planning, IIT Roorkee.** He has served as HUDCO chair faculty in Kolkata and has been instrumental in planning of New Town, Kolkata and many municipal towns prior to the present responsibility. His broad interest area is housing and city planning. He is a 'Recognized Trainer' (RT) of Design of Training (D.O.T) by DOPT, Government of India and delivered more than fifty short term courses including Training of Trainers (TOT) courses. He is having a keen interest in teaching pedagogy/ andragogy and uses innovative methods of teaching.

COURSE PLAN

Week 1 : Introduction Learning Objective

Week 2 : Legal, Policy Framework and Land for Housing

Week 3 : Affordability, Delivery Systems and Housing finance

Week 4 : Planning Framework for Housing&Infrastructure

Week 5 : Planning for Social Infrastructure&Housing Strategy for Cities

Week 6 : Planning for Major Formal Housing typologies

Week 7 : Planning for Informal and Special Housing Typologies

Week 8 : Housing Development and Management

ARCHITECTURE

ARCHITECTURAL CONSERVATION AND HISTORIC PRESERVATION

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : PWD, CPWD, Archeological Survey & Tourism Department

COURSE OUTLINE

This course is designed to address Historic Preservation and Conservation as an approach that establishes a link between past, present and future. To familiarize the students with the status of conservation movement, various agencies involved in the field of conservation worldwide and their policies.

ABOUT INSTRUCTOR

Prof. Sanghamitra Basu, Ph D , MA (Conservation Studies , IAAS , York. UK), Post Graduate (Urban Planning , School of Planning and Architecture , New Delhi), B Arch (Hons.) , is currently an **Associate Professor** in the **Department of Architecture & Regional Planning, Indian Institute of Technology (IIT) , Kharagpur, India** . She has 33 years' experience in teaching at undergraduate and post graduate levels. She has been active in research and consultancy projects in the field of historic preservation, sustainable tourism, heritage management , participatory planning , housing and neighbourhood planning, GIS application and architectural pedagogy. She has several publications in journals, chapters in books, monograph and papers presented in international and national conferences.

COURSE PLAN

Week 1 : Understanding Heritage. Types of Heritage. Heritage conservation- Need, Debate and purpose. Defining Conservation, Preservation and Adaptive reuse. Distinction between Architectural and Urban Conservation. Ethics of conservation , Significance and Value Assessment.

Week 2 : History of Conservation Movement, International agencies like ICCROM , UNESCO and their role in Conservation, World Heritage Sites , Selection criteria , Case Studies , Endangered sites Inviscid Flows and Reynolds Transport Theorem.

Week 3 : Monument conservation and the role of Archeological Survey of India –role of INTACH – Central and state government policies and legislations – inventories and projects- select case studies of sites such as Hampi, Golconda, Mahabalipuram - craft Issues of conservation.

Week 4 : Listing of monuments- documentation of historic structures- assessing architectural character –historic structure report- guidelines for preservation, rehabilitation and adaptive re-use of historic structures- Case studies, seismic retrofit and disabled access/ services additions to historic buildings-heritage site management.

Week 5 : Over view of urban history of India - understanding the character and issues of historic cities – select case studies of towns - historic districts and heritage precincts.

Week 6 : New building in historic settings. Townscape analysis, Visual Integration heritage impact assessment.

Week 7 : Interpretation and Presentation of Historic Sites. urban conservation and heritage tourism, Heritage Trail.

Week 8 : Conservation as a planning tool.- financial incentives and planning tools such as Transferable Development Right (TDR)- conservation project management, Community participation (contd.)

BIOTECHNOLOGY & BIOSCIENCES

BIOTECHNOLOGY & BIOSCIENCES

4weeks

01. Demystifying The Brain
02. Principles Of Downstream Techniques In Bioprocess
03. Bioreactors
04. Introduction to Dynamical Models in Biology
05. Introduction to Professional Scientific Communication
06. Bio-electrochemistry
07. Bio-energetics Of Life Processes
08. Human Molecular Genetics

8weeks

01. Introductory Mathematical Methods for Biologists
02. Medical Biomaterials
03. Introduction To Proteomics
04. Interactomics
05. Bioenergy

12weeks

01. Bio-Informatics
02. Aspects Of Biochemical Engineering

DEMYSTIFYING THE BRAIN

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : New
PRE-REQUISITES : Only college level general science background in required
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course presents the contemporary computational perspective of the brain function using few or no equations. Therefore, it is accessible to people coming from both biological sciences and engineering sciences.someone from the 'hard' sciences) it presents neuroscience in an engineering-style without using too much biology jargon.

ABOUT INSTRUCTOR

Prof. Srinivas Chakravarthy is a faculty of Department of Biotechnology, IIT Madras. His research interests are in computational neuroscience, computational cardiology, Biomedical engineering and pattern recognition. He did his MS & PhD from University of Texas, USA.

COURSE PLAN

Week 1 : History of neuroscience,Brain through evolution

Week 2 : Neurons and neural signaling Networks that learn

Week 3 : Organization of the nervous system Maps in the brain

Week 4 : Memories and holograms,Emotions in the brain,Theories of Consciousness

BIOTECHNOLOGY & BIOSCIENCES

PRINCIPLES OF DOWNSTREAM TECHNIQUES IN BIOPROCESS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of physics/chemistry/Maths, Mass and heat balance, and thermodynamics
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : None

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,Cell Breakage

Week 2 : Solid Liquid Separation, Pre-treatment and Filters/centrifuge, Liquid-Liquid Extraction, Liquid-Liquid extraction (continued)

Week 3 : Adsorption,Reversed micellar and aqueous two phase extraction, Membranes,Membranes (continued)

Week 4 : Precipitation and crystallization,Product stabilization, drying, Lyophilisation,Electrophoresis / SDS PAGE, Chromatography, Chromatography (continued),Chromatography (continued), Chromatography (continued),Future trends, Other downstream operations/Summary of the course

BIOREACTORS

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Ability to appreciate simple mathematical analysis
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	All biotech and pharma industries (Biocon, Sanofi-Pasteur, Dr. Reddys, …)

COURSE OUTLINE

Bioprocesses are used by any biotechnology/pharma industry to produce biological products that are widely used. This course, bioreactors, will consider the heart of any bioprocess. It will present all aspects that are relevant for an appreciation of all relevant aspects of bioreactors. This course is expected to be of interest to students who want to learn about bioreactors, teachers who want to better understand the basis of their material, as well as industry personnel who are looking to better understand the principles and apply them to creatively solve their existing challenges.

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.

COURSE PLAN

Week 1 : Introduction

Week 2 : Two important outcomes of a bioprocess: biomass (cells) and bio-products

Week 3 : Common bioreactor operation modes

Week 4 : Factors that affect bioreactor performance

Week 5 : The cell-view of a bioreactor

INTRODUCTION TO DYNAMICAL MODELS IN BIOLOGY

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : Rerun

PRE-REQUISITES : Must have studied Mathematics at 10+2 level. Have studied graduate-level Biochemistry and Molecular Biology. Knowledge of Computer Programming will be helpful but not a necessity.

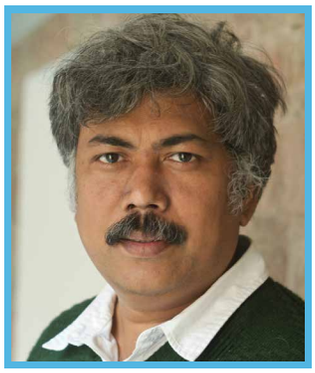
COURSE DURATION : 4 weeks

INDUSTRY SUPPORT : Bio-pharma industries use cellular level as well organism level mathematical models. This course would help to initiate biologists to such modeling.

COURSE OUTLINE

Mathematical modeling has become an integral part of different fields of biology, from ecology to cell biology. This course will introduce students of biology to elementary mathematical concepts and tools for dynamical models. The course will focus on modeling using ordinary differential equations (ODEs). We will start with basic mathematical concepts of ODE-based models and then connect those with experimental biology. Mathematical models will be on cellular and molecular processes in biology, like cell signaling, and transcriptional networks. Students will learn basics of analytical techniques, graphical techniques, and numerical simulation.

ABOUT INSTRUCTOR



Prof. Biplab Bose, is an Associate Professor, in the Department of Biosciences and Bioengineering at IIT Guwahati. He has developed an elective course on Systems Biology and has taught this course, for last nine years, to B. Tech, M. Tech, and Ph. D students at IIT Guwahati. He is interested in understanding the design principles of molecular communication in cells. His research group at IIT Guwahati works on molecular network motifs, cellular information processing, and non-genetic heterogeneity.

COURSE PLAN

Week 1 : L1: Introduction to mathematical modeling in biology
L2: How to start modeling?
L3: Basic concepts of modeling using ODEs: Modeling the spread of infectious disease
L4: Basic concepts of modeling using ODEs: Modeling population growth
L5: Numerical solution of ODE-based models - I; L6: II

Week 2 : L1: Simulating ODE-based models: Introduction to JSim
L2: Simulating ODE-based models: Examples of simulation in JSim
L3: Steady state and stability analysis: Understanding steady state
L4: Steady state and stability analysis: Stability of steady states
L5: Phase plane analysis - I; L6 : II

Week 3 : L1: Concepts of bifurcation; L2: Bifurcation in Biological systems
L3: Modeling molecular processes in cell
L4: Modeling molecular processes-I: Ligand-receptor binding; II-Enzymatic reaction; III: Transcription and translation

Week 4 : L1: Modeling a signal transduction circuit: Negative feedback
L2: Modeling a signal transduction circuit: Positive feedback
L3: Modeling a signal transduction circuit: Incoherent feedforward
L4: Modeling transcriptional circuits – I; L5 : II
L6: Online resources for mathematical modeling in biology

BIOTECHNOLOGY & BIOSCIENCES

INTRODUCTION TO PROFESSIONAL SCIENTIFIC COMMUNICATION

TYPE OF COURSE : New
PRE-REQUISITES : Basic level of understanding on concept & methodology in scientific research
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : This course is meant for professional development, and hence applicable to all R&D related industries and academia

COURSE OUTLINE

The objective of this course is to introduce under-graduate and post-graduate students to the different aspects of professional science communication including written communication, oral communication, reading and ethics in communication.

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. He has been serving on the editorial boards of journals, and offers courses on professional and scientific communication at IIT Kanpur.

COURSE PLAN

Week 1 : Introduction to Professional Scientific Communication / Discussion of creativity, research ideas and where to find them / Inductive reasoning versus deductive reasoning

Week 2 : Hypothesis, reasoning and testing the hypothesis / Peer review process / Structure of a scientific report

Week 3 : Structure of a scientific report - continued / Title, abstract, methods, results and discussion

Week 4 : Schematic diagrams, figures, tables and flow charts – rationale and usage / Ethics in biomedical research / Different forms of writing: scientific report, proposal, and reviews / Presentations – thumb rules and good practice

BIO - ELECTROCHEMISTRY

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE	:	New
PRE-REQUISITES	:	10+2 in science
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	Biosensor industry, Bio-electrochemical process industry, MEMS fabrication industry working towards biosensor development

COURSE OUTLINE

Bio-electro-chemistry is an interdisciplinary subject which falls at the cross-road of basic electrochemistry and its application in biochemistry, analytical chemistry, medicinal chemistry, bio-energy devices and biosensors. The subject has a broad horizon and myriad of applications; yet the governing principles are the basic laws of electrochemistry. Here we will be discussing the basic principles of electrochemistry and the myriad of applications of these principals in biology with special reference to bio-sensors, bio-fuel cells and diagnostics.

ABOUT INSTRUCTOR

Prof. Mainak Das, is a faculty at the Department of Biological Science & Design, Indian Institute of Technology, Kanpur. He works in the areas of bio-electricity, green energy, physiology, and sensor.

COURSE PLAN

Week 1 : Fundamentals of electrochemistry with special references to bio-electrochemistry

Week 2 : Electrodes & potentiometry

Week 3 : Redox titrations

Week 4 : Electro-analytical techniques

BIO - ENERGETICS OF LIFE PROCESSES

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : New
PRE-REQUISITES : 10+2 in science
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Bio-mimetics design, Solar panel development, Biosensor industry, Bio-electrochemical process industry

COURSE OUTLINE

Bioenergetics is a fundamental process in the evolution. The primitive self assembly of molecules to the supra-assembly of large polymers are govern by the basic laws of energetics. In this course, we will be discussing the basic energy harvesting processes which govern the self assembly of biomolecules and their utilization to generate energy to run the biological machinery of evolution.

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 Bioenergetics

Week 2 : Chemosynthesis and energy dynamics

Week 3 : Photosynthesis & photosynthetic electron transfer

Week 4 : Mitochondrial electron transport chain and ATP synthesis

HUMAN MOLECULAR GENETICS

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : Participants are expected to have at least class12 level understanding in genetics.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Medical and pharma companies, paramedic clinical centers, educational institutes, and hospitals.

COURSE OUTLINE

This is an introductory course designed primarily for students in the undergraduate or master's programs interested in biomedical research, genetic counseling, medicine, and clinical genetics. This course is expected introduce the rapid advancements in our understanding the role of human genome in health and disease. We would introduce key concepts of inheritance of human traits, pedigree analysis, and chromosome organization. Molecular biology tools used for understanding the genome, gene structure and gene mutations, gene mapping and gene cloning strategies will also be covered. Objectives and outcome of human genome project and the HapMap project will also be discussed at the end.

ABOUT INSTRUCTOR

Prof. S. Ganesh teaches biology, genetics and human molecular genetics 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 1 : Fundamentals of central dogma (DNA, RNA and proteins; mutations), Chromosome structure and function (organization; structure-function relationship; chromosome abnormalities).

Week 2 : Genes in pedigree (Mendelian pedigree patterns, complications to pedigree patterns), DNA cloning and hybridization techniques (vector based cloning; nuclei acid hybridizations; PCR-based DNA analyses)

Week 3 : Mutation and instability of human DNA (mutation and polymorphism; pathogenic mutations, repeat expansions), Molecular pathology (types of mutations; animal models for human disease)

Week 4 : Identifying human disease genes (functional cloning versus positional cloning; mutation screening), Complex diseases; The Human Genome and HapMap projects

BIOTECHNOLOGY & BIOSCIENCES

INTRODUCTORY MATHEMATICAL METHODS FOR BIOLOGISTS

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

It is an introductory mathematics course for biology students with the aim of training them to do quantitative analysis of biological systems. Students will be trained on how to use the language of mathematics to describe biological processes, how to write down simple mathematical equations for various phenomena occurring in biology.

ABOUT INSTRUCTOR

Prof. Ranjith Padinhateeri completed his MSc and PhD in Physics from IIT Madras. **He is currently a faculty at Department of Biosciences & Bioengineering at Indian Institute of Technology Bombay.** During PhD he studied statistical mechanics of DNA. After PhD he did post-doctoral research in University of Illinois Chicago, USA, Northwestern University. Evanston, USA, and Institute Curie, Paris, France. He does his research in the broad area of biological physics. Prof. Ranjith Padinhateeri does theoretical studies to understand various biological phenomena using a variety of tools from physics, including equilibrium and non-equilibrium statistical mechanics, polymer physics, and soft-matter theory. He tackles research problems using a combination of computational and analytical methods. His specific areas of interest include Nucleosome dynamics, Chromatin assembly, DNA mechanics and self-assembly of proteins

COURSE PLAN

Week 1 : Introduction, Graphs and Functions

Week 2 : Functions and its Derivatives, Computing Derivatives of Curves

Week 3 : Plotting Curves , Numerical Calculation of Derivatives, Partial Derivativest

Week 4 : Integration, Graphical Understanding

Week 5 : Vectors : Position and Movement in 2D, Cell Symmetry : Use of Polar Coordinates

Week 6 : Gradient, Forces and Flows , Understanding Diffusion

Week 7 : Introduction to Fourier series , Fourier Transform

Week 8 : Basics of bio-statistics

MEDICAL BIOMATERIALS

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of physics,chemistry and mathematics.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Implants,devices,biomaterials industries.

COURSE OUTLINE

Biomaterial is any natural or synthetic material used to replace or augment a part of the body so that it improves the human health by restoring the function of the natural living tissue or organ. It should be biocompatible and should not cause any adverse systemic reaction to the host. It could be a polymer,metal,ceramic or combination of these. It may have to be in contact or remain in the body for few hours or for rest of the life of the person.

ABOUT INSTRUCTOR

Prof. Mukesh Doble is a Professor at the Department of Biotechnology at IIT Madras. Has previously worked in Imperial chemical Industries(ICI) and General Electric(GE) for 20 years . Areas of research are Biomaterials, Biopolymers and Drug design. Published 270 papers and 10 books and filed 10 patents (including two US). Has delivered on line video courses in Downstream processes and Biostatistics.

COURSE PLAN

Week 1 : Introduction to Biomaterials
Background history
History
Properties (Mechanical and Physico-chemical); Properties (Mechanical and Physico-chemical)

Week 2 : Mechanical properties; Mechanical properties
Resorbability, biodegradation; Resorbability, biodegradation
Biofilm

Week 3 : Biofilm; Biofilm; Biofilm
Material characterization - Analytical instruments
Analytical instruments

Week 4 : Analytical instruments; Analytical instruments
Biological responses, compatibility, cytotoxicity
Proteins, Tissue and blood Response
Cell-biomaterial interaction

Week 5 : Animal trials (in vivo); Animal trials
Metals-types, classifications, applications
Metals - properties; Metals - properties

Week 6 : Metals - properties; Metals
Polymers-types, classifications, applications
Polymers; Polymers

Week 7 : Blends/composites
Biopolymers; Hydrogels
Preparation of different morphologies (with experiments)
Surface modifications (with experiments)

Week 8 : Ceramics; Drug delivery systems/encapsulation
Biomaterials for cardiovascular/pulmonary/ophthalmological applications
Biomaterials for urinary/dental/skin applications
Sterilization of implants, device failures, unique issues, conclusion

BIOTECHNOLOGY & BIOSCIENCES

INTRODUCTION TO PROTEOMICS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Any B.Sc. Or M.Sc.The target audiences of this course are required to have a basic introduction to biology
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course introduces 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.

ABOUT INSTRUCTOR

Prof. Sanjeeva Srivastava is the Group Leader for the Proteomics Laboratory at the Indian Institute of Technology Bombay (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 1 : Basics of proteins and proteomics : Introduction to amino acids, Introduction to proteins, Protein folding & misfolding, Introduction to proteomics, Lab session – Protein-protein interaction using label-free biosensors

Week 2 : Gel-based proteomics : Sample preparation and pre-analytical factors, Sample preparation: Pre-analytical factors (contd.), Sample preparation: Protein extraction and quantification, One-dimensional electrophoresis, Introduction to 2-DE

Week 3 : Two-dimensional gel electrophoresis (2-DE) : 2-DE: Second dimension, staining & destaining, 2-DE: Gel analysis, 2-DE Applications, 2-DE Applications (contd.) & Challenges, Lab session - Protein/peptide pre-fractionation using offgel fractionator & data analysis

Week 4 : Difference in gel electrophoresis (DIGE) & Systems Biology : 2D-DIGE: Basics, 2D-DIGE: Data analysis, 2D-DIGE: Applications, Systems biology and proteomics – I, Systems biology and proteomics - II

Week 5 : Basics of mass spectrometry : Fundamentals of mass spectrometry, Chromatography technologies, Liquid chromatography, Mass spectrometry: Ionization sources, Mass spectrometry: Mass analyzers

Week 6 : Basics of mass spectrometry and sample preparation : MALDI sample preparation and analysis, Hybrid mass spectrometry configurations, Lab session - Demonstration of Q-TOF MS technology, In-gel & in-solution digestion, Lab session - Sample preparation: tissue sample preservation technology

Week 7 : Quantitative proteomics : Introduction to quantitative proteomics, SILAC: In vivo labelling, iTRAQ: In vitro labelling, TMT: In vitro labelling, Quantitative proteomics data analysis

Week 8 : Advancement in Proteomics : Proteomics applications, Challenges in proteomics, OMICS and translational research, Lab session – Targeted proteomics using triple quadrupole mass spectrometry, Lab session–Targeted proteomics: multiple reaction monitoring

INTERACTOMICS

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : B.Sc. or M.Sc. basic Biology and Biochemistry background.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : GE Healthcare, Pall Corporation, BioRad, Molecular Devices, Promega and other companies dealing with interactomics based.

COURSE OUTLINE

Proteins are the key effectors of any living system and are largely responsible for the functioning of a cell. Intricate cell signaling and molecular triggers are dependent on interactions involving proteins at the cellular level. It is due to this very reason that, in an age where clinical biology is thriving to make an impact in global health-care and biomedical diagnostics, there has been a surge of interest in the area of Interactomics. Interactomics essentially involves the study of interactions between biomolecules, particularly proteins and the consequences of those interactions in a biosystem.

ABOUT INSTRUCTOR

Prof. 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 1 : Introduction to interactomics, An overview of label-free technologies, An overview of surface plasmon resonance (SPR), An overview of surface plasmon resonance imaging, Basics of SPR: Surface chemistry

Week 2 : Basics of SPR: Experimental design, Protein immobilization for protein-protein interaction studies, Protein-protein interaction study: Binding analysis, Protein-protein interaction study: Kinetic analysis, Protein-small molecule interaction study: Immobilization & binding analysis

Week 3 : Protein-small molecule interaction study: Kinetic analysis, SPR: Interactive Session-I, SPR: Interactive Session-II, an overview of ellipsometry and interferometry techniques, An introduction to BioLayer Interferometry (BLI) and its applications in protein research

Week 4 : Kinetic analysis of protein-protein interaction using BLI, Label-free quantification of proteins using BLI, Diffraction-based biosensors I, Diffraction-based biosensors II, Nanotechniques in proteomics I, Nanotechniques in proteomics II

Week 5 : High throughputplatforms of interactomics: Protein arrays, Conventional label based detection techniques for Protein microarrays, Novel detection techniques for Protein microarrays, Recombinational cloning and its application for Protein microarrays, An introduction to Cell-free protein synthesis

Week 6 : Cell-free synthesis based protein microarrays: PISA and NAPPA, Cell-free synthesis based protein microarrays: MIST, DAPA and Halotag Arrays, Digging deeper into NAPPA: Basic Workflow, Digging deeper into NAPPA: Surface Chemistry, Printing and Assessment, Application of cell free expression protein microarrays in biomarker discovery

Week 7 : Application of cell free expression protein microarrays in immunological studies, Basics of microarray image scanning, Software for Image scanning and data processing, Microarray Data Analysis: Part I, Microarray Data Analysis: Part II

Week 8 : Application of protein microarray in biomarker discovery-I, Application of protein microarray in biomarker discovery-II, Systems biology and networks, Challenges in proteomics proteomics: multiple reaction monitoring

BIOENERGY

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : Has cleared 10+2 with science
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : 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

BIOTECHNOLOGY & BIOSCIENCES

BIOINFORMATICS: ALGORITHMS AND APPLICATIONS

TYPE OF COURSE : New
PRE-REQUISITES : Basic knowledge on Biology and any computer language would be helpful
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Cognizant, TCS

COURSE OUTLINE

Bioinformatics is an interdisciplinary field of science for analyzing and interpreting vast biological data using computational techniques. In this course, we aim to give a walkthrough of the major aspects of bioinformatics such as the development of databases, computationally derived hypothesis, algorithms, and computer-aided drug design. During the first section of the course, we will focus on DNA and protein sequence databases and analysis, secondary structures and 3D structural analysis. The second section will be devoted to applications such as prediction of protein structure, folding rates, stability upon mutation, and intermolecular interactions. Further, we will cover computer-aided drug design using docking and QSAR studies. This course is designed to nurture skills and knowledge required for aspiring students, young biologists and research scholars to develop algorithms and tools in bioinformatics.

ABOUT INSTRUCTOR

Prof. M Michael Gromiha is an Associate Professor at Indian Institute of Technology (IIT) Madras, India. Received his Ph.D in Physics from Bharathidasan University, India and served as STA fellow, RIKEN Researcher, Research Scientist and Senior Scientist at Computational Biology Research Center, AIST, Japan till 2010. He is teaching courses on bioinformatics, protein structure and function, protein interactions: computational techniques, big data analysis and handling computational biology lab. His main research interests are structural analysis, prediction, folding and stability of globular and membrane proteins, protein interactions and development of bioinformatics databases and tools. He has published over 200 research articles, 40 reviews, 5 editorials and a book on Protein Bioinformatics: From Sequence to Function by Elsevier/Academic Press.

COURSE PLAN

Week 1 : Introduction, DNA sequence analysis, DNA Databases
Week 2 : Protein structure and function, protein sequence databases, sequence alignment
Week 3 : PAM matrix, Global and local alignment, BLAST: features and scores
Week 4 : Multiple sequence alignment, Conservation score, phylogenetic trees
Week 5 : Protein sequence analysis, hydrophobicity profiles, non-redundant datasets
Week 6 : Protein secondary structures, Ramachandran plot, propensity, secondary structure prediction
Week 7 : Protein tertiary structure, Protein Data Bank, visualization tools, structural classification, contact maps
Week 8 : Protein structural analysis, protein structure prediction
Week 9 : Protein stability, energetic contributions, database, stabilizing residues, stability upon mutations
Week 10 : Protein folding rates, proteins interactions, binding site residues
Week 11 : Computer aided drug design, docking, screening, QSAR
Week 12 : Development of algorithms, awk programming, machine learning techniques, applications using WEKA

ASPECTS OF BIOCHEMICAL ENGINEERING

BIOTECHNOLOGY & BIOSCIENCES

TYPE OF COURSE : New
PRE-REQUISITES : Mathematics in 10+2
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : IFB Agro Industry; IOC; ONGC, Dr. Reddy's Laboratories Biocon, United Beverages, Ranbaxy Lab. Ltd, Phizer India.

COURSE OUTLINE

Biochemical Reaction Engineering mostly deals with the most complicated life systems as compared to Chemical Reaction Engineering. To describe the behavior of any life system in terms of mathematical form is the basic essence of biochemical reaction engineering. The present course in true sense is an interdisciplinary subject since biologist, physicist, chemist, technologist and mathematician all join hand in hand to develop realistic models. This specialized subject comprises of transport processes, sophisticated advanced control system besides conventional biology, physics and mathematics. Production of biomolecules can be done broadly in two different ways namely, using enzymes and microbial cells. The present course is designed to cater all the above aspects of the subject. Students undergoing this course will be initially able to differentiate between conventional chemical reaction engineering and biochemical reaction engineering. They also develop the expertise to do the design of any biochemical process which will be very much useful for the industries.

ABOUT INSTRUCTOR

Prof. Debabrata Das pursued his doctoral studies from **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 CO2 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 1 : Kinetics of homogeneous chemical reactions
Week 2 : Reactor analysis
Week 3 : Kinetics of enzyme catalyzed reactions in free and immobilized processes
Week 4 : Kinetics of enzyme catalyzed reactions in free and immobilized processes (continued)
Week 5 : Kinetics of substrate utilization, product formation and biomass production
Week 6 : Kinetics of substrate utilization, product formation and biomass production (continued)
Week 7 : Design and analysis of bioreactors
Week 8 : Transport phenomena in Bioprocess system
Week 9 : Air and medium sterilization.
Week 10 : Downstream processes
Week 11 : Downstream processes (continued)
Week 12 : Process control of the biochemical processes

CHEMICAL ENGINEERING

CHEMICAL ENGINEERING

4weeks

01. Inductive couple plasma atomic emission spectrometry (icp-aes) for pollution monitoring
02. Mechanical Operations
03. An Introduction to Cardiovascular Fluid Mechanics
04. Introduction To Process Modeling In The Membrane Separation Process
05. Measurement Technique in Multiphase Flows

8weeks

01. Thermodynamics Of Fluid Phase Equilibria
02. Chemical Applications Of Symmetry And Group Theory
03. Engineering Thermodynamics
04. Waste to Energy Conversion
05. Multiphase Microfluidics
06. Soft Nano Technology
07. Multiphase Flows

12weeks

01. Rheology of Complex Materials
02. Heat Transfer
03. Chemical Process Instrumentation
04. Fluidization Engineering
05. Transport Processes I: Heat and Mass Transfer
06. Applied Time-Series Analysis

INDUCTIVE COUPLE PLASMA ATOMIC EMISSION SPECTROMETRY (ICP-AES) FOR POLLUTION MONITORING

CHEMICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : 10+2 +3 years of BE/BSc, Basic knowledge of differential calculus and integration
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Chemical industries, Pollution Control

COURSE OUTLINE

Now a days Inductive couple plasma atomic spectrometry (ICP - AES) is the most preferred technique for the almost all metal ion analysis. The course material consists of : Introduction to pollution control monitoring, Atomic structure, Introduction to Atomic emission Spectroscopy, Interaction of electromagnetic radiation with matter, Instrumentation for inductively coupled plasma atomic emission spectrometry, Applications of ICP - AES for metal ion analysis, 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 and 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 ICP - AES.

Week 4 : Instrumentation for ICP - AES and Application of ICP - AES for chemical analysis.

MECHANICAL OPERATIONS

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : 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. Mechanical Operations deal with Science and Technology of particulate matter, which is a multidisciplinary field including Materials Science, Environmental, Biomedical, Aerospace, Agricultural, Chemistry, Microbiology and Cell Science, Pharmacy and Medicine.

ABOUT INSTRUCTOR

Prof. 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 fields of study are Process Integration, Energy Management and Modeling and Simulation. She has almost 9 years of experience in teaching and research. During this period she has supervised 1 Ph.D. and 14 M.Tech theses. At present 6 Ph.D and 3 M.Tech theses are in pipe line. She has published 29 and 24 research papers in different refereed journals and conferences, respectively. She has taught the course Mechanical Operations six times in her 9 years of teaching career.

COURSE PLAN

Week 1 : Introduction
Characterization of a single particle
Characterization of collection of particles

Week 2 : Fine grain size distribution
Effectiveness of screen
Industrial screening equipment
Size reduction

Week 3 : Laws of comminution
Examples of laws of comminution
Size reduction equipment

Week 4 : Particle dynamics
Particle dynamics – Examples
Classification and Jigging

CHEMICAL ENGINEERING

AN INTRODUCTION TO CARDIOVASCULAR FLUID MECHANICS

TYPE OF COURSE : New

PRE-REQUISITES : A basic course in fluid mechanics at UG level, A UG course in Mathematics covering Ordinary Differential Equations

COURSE DURATION : 4 weeks

INDUSTRY SUPPORT : GE Healthcare, Johnson and Johnson and other biomedical companies

COURSE OUTLINE

This course aims to provide an overview of the important problems in human circulatory system. The course would provide introduction to cardiovascular systems and important fluid flow problems in large arteries. The goal is to provide students with the necessary background to apply the knowledge of fluid mechanics to analyse the flow behavior in biological systems in general and human circulatory system in particular. It is hoped that with this course, the students would be able to develop a perspective towards the design and development of diagnostics and medical device development.

ABOUT INSTRUCTOR

Prof. Raghvendra Gupta is an Assistant Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati. His research interest lies in understanding transport phenomena in complex systems. He has been teaching an elective course on Biofluid Mechanics for last two years.

COURSE PLAN

Week 1 : Introduction, Motivation, Organisation of Cardiovascular System

Week 2 : Blood: Its constituents and rheology

Week 2-3 : Blood Flow in Arteries-1: Hagen Poiseuille Flow, Flow Bifurcation, Flow in Curved tubes

Week 3-4 : Blood Flow in Arteries-2: Pulsatile Flow in Rigid Tubes, Womersley Solution

Week 4 : Blood Flow in Arteries-3: Wave Propogation in Blood Vessels

CHEMICAL ENGINEERING

INTRODUCTION TO PROCESS MODELING IN THE MEMBRANE SEPARATION PROCESS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic understanding of physics, mathematics and chemistry
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : CSIR institutes and laboratories, water purification industries, membrane manufacturing industries.

COURSE OUTLINE

Separation processes are integral unit operation in most of the modern chemical, pharmaceutical and other process plants. Among the separation processes, some are standard and conventional processes, like, distillation, absorption, adsorption, etc. These processes are quite common and the relevant technologies are well developed and well studied. On the other hand, newer separation processes, like, membrane based techniques are gaining importance in modern days plants. The present course is designed to understand the basic process modeling in this novel separation technique.

ABOUT INSTRUCTOR

Prof. Sirshendu De is a professor of the Department of Chemical Engineering at the Indian Institute of Technology Kharagpur. His research interests include membrane separations, transport processes and flow through micro-channels. He has over 200 international journal publications/peer reviewed articles, over 50 conference presentations (national and international). He is the holder of 15 patents (national and international), has authored 7 books and 4 of his developed technologies have been transferred to the industry. He is the winner of prestigious Shanti Swarup Bhatnagar Prize in Engineering Science and a fellow of Indian National Academy of Engineering and National Academy of Science India. Presently he is the INAE Chair Professor and Head of the Chemical Engineering Department, IIT Kharagpur.

COURSE PLAN

Week 1 : Fundamentals of Separation processes and introduction of membrane system.

Week 2 : Modeling of osmotic pressure controlling membrane filtration

Week 3 : Gel layer controlling and resistance in series modeling.

Week 4 : Membrane module design and modeling of dialysis.

CHEMICAL ENGINEERING

MEASUREMENT TECHNIQUES IN MULTIPHASE FLOWS

TYPE OF COURSE : New

PRE-REQUISITES : Must have studied Mathematics at 10+2 level. Have studied graduate-level Fluid Mechanics. Knowledge of Computer Programming will be helpful but not a necessity.

COURSE DURATION : 4 weeks

INDUSTRY SUPPORT : IOCL, BPCL, OIL, HPCL, ONGC

COURSE OUTLINE

Multiphase flow reactors are heart of many process industries. However, the flow dynamics of these reactors are not well understood mainly because of complex flow physics involved. In this course, different techniques available for monitoring and mapping of multiphase flow reactors will be discussed in detail. Techniques will be divided in two parts: Invasive, in which some probe will be intruded inside the vessel to measure the velocity and/or phase fraction and in Second part non-invasive techniques will be discussed in which measurement will be performed without disturbing the flow. The basic principle, equations, post processing methods, advantages and limitations of each technique will be discussed in detail.

ABOUT INSTRUCTOR

Prof. Rajesh Kumar Upadhyay, is serving as Associate Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati. He has joined the IIT Guwahati as an Assistant Professor in July 2010 after completing his PhD from IIT Delhi. During his PhD he has worked on development of Radioactive particle tracking technique and implemented the same on different multiphase flow reactors like gas-liquid, gas-solids and gas-liquid-solids system. He has used several flow measurement techniques since he has joined IIT Guwahati and has expertise in radiation based technique.

COURSE PLAN

Week 1 : Introduction to Multiphase flow Measurement Techniques: Invasive and Non-Invasive

Week 2 : Invasive technique for volume fraction and velocity measurements: Pitot tube, Pressure probe, Hotwire Anemometry, Optical fiber probe

Week 3 : Invasive technique for volume fraction and velocity measurements: Laser Doppler Anemometry, Particle Image Velocimetry, Positron Emission Particle Tracking, Radioactive Particle Tracking

Week 4 : Non-invasive techniques for Volume fraction Measurements: Electrical Capacitance Tomography, Computed Tomography, Magnetic Resonance Imaging, Ultrasonic Methods

CHEMICAL ENGINEERING

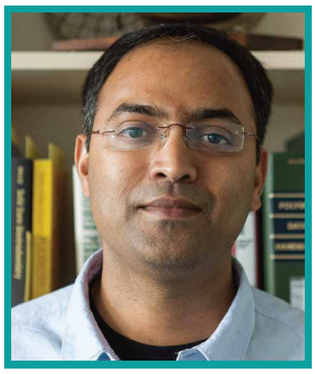
THERMODYNAMICS OF FLUID PHASE EQUILIBRIA

TYPE OF COURSE : New
PRE-REQUISITES : An introduction course on Thermodynamics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All engineering based industry

COURSE OUTLINE

The goal of this course to introduce molecular thermodynamics as a practical tool for engineering applications. In particular, the course would present the first year graduate student or senior undergraduate student a broad introduction to the thermodynamics of phase equilibria typically encountered in designing chemical products and processes. The course is suitable for those students who have completed their course in undergraduate thermodynamics. It would be further useful if the student has also done the first undergraduate course on chemical engineering thermodynamics.

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.** Dr. Singh's current 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. He is a recipient of prestigious awards such as Humboldt Fellow for experienced researcher, Young Engineers of Indian National Academy of Engineers, Amar-Dye Chem award and BRNS Young Scientist Award. He is also an elected member of National Academy of Sciences, Allahabad.

COURSE PLAN

Week 1 : Introduction, Review of first Law for closed and open systems, Properties of ideal gas and real fluids

Week 2 : Thermodynamics calculus, thermodynamics derivatives, Euler's theorem for homogeneous functions, Legendre's transformations, Derivative in terms of measurable properties, elementary statistical mechanics

Week 3 : Thermodynamics of Phase Equilibria, Open systems, Ideal Mixtures, Equilibrium in a Heterogeneous Closed System, Fugacity

Week 4 : Thermodynamic Properties from Volumetric Data, Thermodynamic Properties with P, T as Independent Variable, Fugacity of Liquids and Solids, Thermodynamic Properties with V, T as Independent Variables, Approaches to Phase Equilibria Calculations.

Week 5 : Intermolecular forces, corresponding states, Osmotic systems

Week 6 : Fugacity in Gas Mixture, Virial equation of state, fugacities from Virial equation, Fugacities at high densities, Solubilities of solids and liquids in compressed gases

Week 7 : Fugacities in Liquid Mixure: Excess function

Week 8 : Fugacities in Liquid Mixure: Models and Theory of Solution

CHEMICAL ENGINEERING

CHEMICAL APPLICATIONS OF SYMMETRY AND GROUP THEORY

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic knowledge of quantum mechanics would be helpful.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Not Applicable

COURSE OUTLINE

The aim of this course is to provide a systematic treatment of symmetry in chemical systems within the mathematical framework known as group theory. Once we have classified the symmetry of a molecule, group theory provides a powerful set of tools that provide us with considerable insight into many of its chemical and physical properties. Some applications of group theory that will be covered in this course include:

1. Predicting whether a given molecule will be chiral, or polar;
2. Examining chemical bonding and visualizing molecular orbitals;
3. Predicting whether a molecule may absorb light of a given polarisation, and which spectroscopic transitions may be excited if it does;
4. Investigating the vibrational motions of the molecule, etc.

ABOUT INSTRUCTOR

Prof. Manabendra Chandra is an Assistant Professor in the Department of Chemistry at IIT Kanpur. His area of specialization is experimental physical chemistry.

COURSE PLAN

Week 1 : Introduction; Mathematical definition of a group, Symmetry operations and symmetry elements

Week 2 : Symmetry classification of molecules – point groups, symmetry and physical properties: Polarity, Chirality etc

Week 3 : Combining symmetry operations: 'group multiplication' Review of Matrices, Matrix representations of groups with examples

Week 4 : Properties of matrix representations: Similarity transforms, Characters of representations, Irreducible representations (IR) and symmetry species, character tables

Week 5 : Reduction of representations: The Great Orthogonality Theorem; Using the GOT to determine the irreducible representations spanned by a basis

Week 6 : Symmetry adapted linear combinations, bonding in polyatomics, constructing molecular orbitals from SALCs, calculating and solving the orbital energies and expansion coefficients

Week 7 : Molecular vibrations : determining the number of vibrational normal modes, determining the symmetries of molecular motions, Molecular vibrations using internal coordinates

Week 8 : Spectroscopy –Group theory and molecular electronic states, electronic transitions in molecules, vibrational transitions in molecules, Raman scattering. Summary of the course

ENGINEERING THERMODYNAMICS

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun

PRE-REQUISITES : An introductory background in chemistry, physics and Maths (calculus) will be needed. Thus, the course is ideal for first or second year engineering students.

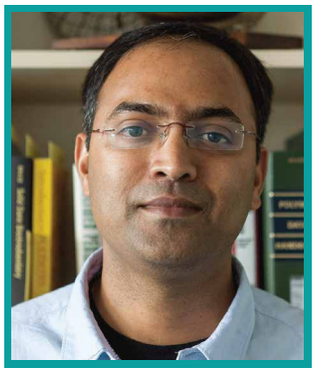
COURSE DURATION : 8 weeks

INDUSTRY SUPPORT : All engineering Based industry

COURSE OUTLINE

This course provides an introduction to the most powerful engineering principles -Thermodynamics: the science of energy and its transformation from one form to another form. The subject is widely applicable in several branches of engineering and science. The objective of this course is to introduce systematic different tools needed to analyze energy systems from various daily lives to large scale engineering applications. More specifically, we will cover the topics of mass and energy conservation principles; first law analysis of closed and open systems; understanding second law of thermodynamics and entropy; exergy; properties of pure substances; power generation and refrigeration on thermodynamic cycles; thermodynamic relation, combustion and reaction.

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.** Dr. Singh's current 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 90 peer reviewed articles in international journals of repute. He is a recipient of prestigious awards such as Humboldt Fellow for experienced researcher, Young Engineers of Indian National Academy of Engineers, Amar-Dye Chem award and BRNS Young Scientist Award. He is also an elected member of National Academy of Sciences, Allahabad.

COURSE PLAN

Week 1 : Introduction to Energy and Energy transfer

Week 2 : Properties of Pure Substances

Week 3 : Energy analysis of closed system

Week 4 : Mass and Energy Analysis of open systems

Week 5 : The second law of thermodynamics and entropy

Week 6 : Exergy Analysis

Week 7 : Power & Refrigeration Cycles

Week 8 : Thermodynamic Potentials I Law Application to Chemically Reacting Systems

WASTE TO ENERGY CONVERSION

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : BE in Chemical, Mechanical, Environmental Eng., Biotech.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course deals with the production of energy from different types of wastes through thermal, biological and chemical routes. 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 wastes for energy production.

ABOUT INSTRUCTOR

Prof. 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 (Water /wastewater treatment through adsorption, electrocoagulation and biological processes including phytoremediation, microbial fuel cells, oil from algae, energy from coal, biomass and wastes, life cycle assessment). He has handled number of R&D projects sponsored by Industry, Govt. of India and International Agencies.

COURSE PLAN

Week 1 : Introduction, characterization of wastes.

Week 2 : Energy production form wastes through incineration, energy production through gasification of wastes.

Week 3 : Energy production through pyrolysis and gasification of wastes, syngas utilization.

Week 4 : Densification of solids, efficiency improvement of power plant and energy production from waste plastics.

Week 5 : Energy production from waste plastics, gas cleanup.

Week 6 : Energy production from organic wastes through anaerobic digestion and fermentation, introduction to microbial fuel cells.

Week 7 : Energy production from wastes through fermentation and transesterification.

Week 8 : Cultivation of algal biomass from wastewater and energy production from algae.

MULTIPHASE MICROFLUIDICS

CHEMICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : A basic course in Fluid Mechanics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Thermax, General Electric, Syrris, Blacktrace/Dolomite

COURSE OUTLINE

With the advancement in manufacturing technology in past few decades, the trend towards miniaturization has accelerated in several industries. In chemical process industries, the viability of compact heat exchangers, microreactors for process intensification is being explored because of small diffusion lengths, high interfacial area density and relatively safe operation. Most of these equipments involve multiphase flows and their design requires a fundamental understanding of heat, mass and momentum transport in multiphase flow in microchannels. This course is aimed at introducing the students to the fundamental principles as well as recent developments in the area of multiphase flow at the small scale.

ABOUT INSTRUCTOR

Prof. Raghvendra Gupta is assistant professor in Department of Chemical Engineering at Indian Institute of technology Guwahati, India. His research interests are in the area of multiphase flows, microfluidics and biofluid mechanics.

COURSE PLAN

Week 1 : Introduction: Motivation, applications, definitions, size effects

Week 2 : Interfacial Phenomena: Capillarity, wetting and dewetting behavior, Contact line dynamics

Week 3 : Gas liquid and liquid-liquid flow in microchannels: Flow regimes; pressure drop and phase distribution

Week 4 : Transport processes in Taylor Flow in microchannels

Week 5 : Bubble and droplet generation; annular and slug-annular flow regimes

Week 6 : Gas-solid flow in microchannels; Inertial microfluidics; multiphase microreactors

Week 7 : Condesation, evaporation and boiling in microchannels

Week 8 : Experimental and computational techniques to study multiphase flow in microchannels

SOFT NANO TECHNOLOGY

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic Knowledge of Fluid Mechanics will be helpful
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The fabrication of large area polymer structures with feature sizes ranging from few microns down to the molecular level is key to various technologically important areas, examples of which include molecular electronics, flexible display screens, optical sensors, structural colour, reusable super adhesives, super hydrophobic and self-cleaning surfaces, scaffolds for tissue engineering etc. The meso scale, which ranges from a few nm to few microns, interfaces the molecular and the macroscopic worlds. Thus, it becomes possible to observe simultaneous signatures of molecular interactions as well as macroscopic effects at these length scales, often giving rise to exciting new phenomena. The success of the desired applications, harvesting theextraordinary scientific phenomena occurring at these length scales, dependsstrongly on the availability of suitable, easy to implement patterning techniquesthat can create defect-free structures over large areas followed by their accurate characterization.

ABOUT INSTRUCTOR

Prof. Rabibrata Mukherjee is presently an Associate Professor in the Department of Chemical Engineering at IIT Kharagpur, where he joined in May 2009. Prior to joining IIT Kharagpur, he was a Scientist at Central Glass & Ceramic Research Institute, Kolkata for 12 years. A B.Tech.fromJadavpur University in 1994 and M Tech from IIT Kharagpur in 2003, Rabibrata obtained his PhD in 2007 from IIT Kanpur, under the guidance of Prof. Ashutosh Sharma. For his PhD thesis he won the prestigious Shah Schulman Best PhD thesis award in colloids and interfacial science from IIChE in 2008. His present research interest includes: instability and dewetting of thin polymer films, soft lithography, polymer blends, nano fluidics, organics solar cells, super-hydrophobicity etc.

COURSE PLAN

Week 1 : Introduction to Patterning of Thin Films
Application of Nano Patterned Films and Surfaces
Basic Concepts of Wetting: Cassie and Wenzel Regimes
Basic Concepts of Surface Tension

Week 2 : Different Nano Fabrication Regimes including self assembly
Micelle formation
Introduction to Photo Lithography

Week 3 : Discussion on Photo Lithography: Photo Resists
Spin Coating
Exposure
Development

Week 4 : Nano Imprint Lithography

Week 5 : Soft Lithography: Introduction; Different Techniques

Week 6 : Soft Lithography Techniques

Week 7 : Basic Concepts of Atomic Force Microscopy

Week 8 : Different Imaging Modes of Atomic Force Microscopy

MULTIPHASE FLOWS

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : IOCL, BPCL, OIL, HPCL, ONGC

COURSE OUTLINE

Multiphase flow reactors are critically important in many industries like, chemical, petroleum, petrochemicals, food, pharmaceuticals etc. The performances of these reactors largely depend on the interactions of different phases involved. In this course basic of Multiphase flow along with different flow regime map and pressure drop, and volume fraction calculation will be covered. Further, the interaction between different phases at different scales will be discussed. Modelling methods used for multiphase flow reactors will be covered. Finally, different type of multiphase flow reactors will be introduced and their functioning, advantage and disadvantages and challenges along with future direction of research will be discussed.

ABOUT INSTRUCTOR

Prof. Rajesh Kumar Upadhyay is serving as Associate Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati. He has joined IIT Guwahati as an Assistant Professor in July 2010 after completing his PhD from IIT Delhi. During his PhD, he has worked on development of Radioactive particle tracking technique and implementation of the same on different multiphase flow reactors like gas-liquid, gas-solids and gas-liquid-solids system. He has taught Multiphase Flow in IIT Guwahati as an elective course to UG, PG and PhD students for four consecutive years.

COURSE PLAN

Week 1 : Multiphase flow introduction, Fundamental definitions and terminology used

Week 2 : Flow-pattern map for fluid-fluid (gas-liquid and liquid-liquid) and flow regime map for fluid-solids flows

Week 3 : Pressure drop and Volume fraction calculation for Homogeneous regimes: Using momentum balance equation from equation of motion and empirical correlations

Week 4 : Pressure drop and Volume fraction calculation for Segregated/Separated regimes: Using equation of motion and empirical correlations.

Week 5 : Multiphase Interactions: Drag, lift, virtual mass force, Basset force, one way, two way, three-way and four-way coupling and mathematical formulation of the same.

Week 6 : Modelling Methods for Multiphase Flows: Mixture Model, Euler-Euler Model and Euler-Lagrangian Model

Week 7 : Multiphase Reactors: Bubble Column, Fluidized bed

Week 8 : Multiphase Reactors: Binary Fluidized Bed and Circulating Fluidized bed

CHEMICAL ENGINEERING

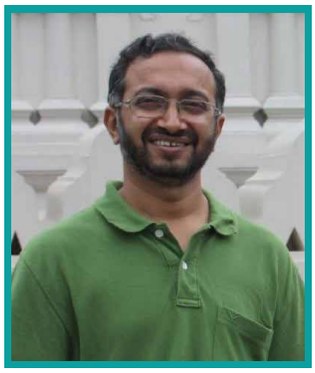
RHEOLOGY OF COMPLEX MATERIALS

TYPE OF COURSE : New
PRE-REQUISITES : Fluid Mechanics or solid mechanics course at the undergraduate level
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Food products, Personal care products, Plastic processing industries, Paints and emulsions, Adhesives, Inks, Biomaterials, crude oil recovery and transport.

COURSE OUTLINE

Non-Newtonian fluids are encountered in various engineering applications. This course introduces concepts required to analyze the behaviour of such fluids. Since micro-structural features of materials are responsible for non-Newtonian nature, this course describes the most commonly used classes of material systems and their rheological behaviour.

ABOUT INSTRUCTOR



Prof. Abhijit P. Deshpande is a Professor of Chemical Engineering at IIT Madras. His focus is on obtaining the understanding of polymeric systems, more specifically their aggregation and gelation behaviour. Rheology is used as a probing tool to investigate polymer blends, sulfonated polymers, crosslinked hydrogels, supramolecular / living polymers and polymeric composites in his group. His teaching interests include specialized courses in fluid mechanics, rheology and continuum mechanics; and core chemical engineering courses such as mass transfer and thermodynamics.

COURSE PLAN

Week 1 : Flow phenomena in complex materials and microstructure; Complex materials; Applications of rheology, with some example material systems

Week 2 : Stress, strain rate, velocity gradient; Kinematics for simple flows

Week 3 : Rheometric flows; Rheometers general review

Week 4 : Tensors and index notation; Viscous fluids; Stress relaxation

Week 5 : Maxwell model; Oscillatory shear

Week 6 : Relaxation time spectrum; Generalized Maxwell model; Time temperature superposition; Solidlike materials

Week 7 : General linear viscoelastic material linear response; Review of material functions

Week 8 : Survey polymers; Survey glass-rubber transition

Week 9 : Survey multiphase systems; Experimental artifacts fluid mechanics of cone/plate geometry

Week 10 : Strain and convected rate; Normal stress, stress growth

Week 11 : Yield stress fluids Hershel Belkley model, thixotropic fluids Structural Model

Week 12 : Terms in nonlinear models; Microscopic origin of stress

HEAT TRANSFER

CHEMICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Linear algebra, Fluid Mechanics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Reliance, HPCL, BPCL, RCF, Other chemical & 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. Ganesh Viswanathan is an Associate Professor in Department of Chemical Engineering at Indian Institute of Technology Bombay, Mumbai. He completed his Ph.D in Chemical Engineering from University of Houston, Houston and Postdoctoral Fellowship at Mount Sinai School of Medicine, New York. He conducts research in systems biology of signaling networks and nonlinear dynamics of reactors.

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: Plane and cylindrical wall
Extended surfaces I - Introduction; II - General formulation; Extended surfaces III - Uniform crosssectional area

Week 3 : Extended surfaces IV – Varying crosssectional area; 2D Plane wall
Transient analyses I - Lumped capacitance method; II – Validity of Lumped capacitance method
III – Semi-infinite solid

Week 4 : Lecture 16: Introduction to convective heat transfer; Heat and mass transport coefficients
Momentum,thermal and concentration boundary layers; Laminar and Turbulent flows,and Momentum balance
Energy and mass balances,and Boundary layer approximations

Week 5 : Order of magnitude analyses; Transport coefficients
Relationship between momentum,thermal and concentration boundary layers
Reynolds and Colburn analogies; Introduction to forced convection

Week 6 : Flow past flat plate I – Similarity solution ; II - Correlations
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

Week 8 : Introduction to Free/Natural convection; Heated plate in a quiescent fluid I; II, Boiling I; Boiling II

Week 9 : Condensation I, II ; Introduction to radiation; Spectral intensity; Spectral properties and 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
Radiation exchange between Diffuse, gray surfaces in an enclosure
Resistances - Oppenheim matrix method; Resistances - Examples; Examples, Volumetric radiation

Week 12 : Introduction to Heat exchangers; Parallel flow heat exchangers; Logmean temperature difference
Shell and tube heat exchanger; Epsilon-NTU method

CHEMICAL PROCESS INSTRUMENTATION

CHEMICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Indian Oil Corporation Ltd, Tata Chemicals, etc. Haldia Petrochemicals Ltd., Hindustan Petroleum

COURSE OUTLINE

This course covers the key aspects of chemical process instrumentation. The course will provide a comprehensive introduction to principles and practices of measurement of important chemical process variables such as temperature, pressure, flow, level, concentration, etc. This is primarily intended for the undergraduate students from chemical, instrumentation, and allied engineering disciplines.

ABOUT INSTRUCTOR

Prof. Debasis Sarkar is currently an Associate Professor at Chemical Engineering Department of Indian Institute of Technology Kharagpur. He received his BTech from Calcutta University, Master of Engineering from Indian Institute of Science, Bangalore, and PhD from Indian Institute of Science, Bangalore, all in Chemical Engineering. He was a Postdoctoral Fellow at University of Western Ontario, Canada. Prior to joining IIT Kharagpur, he worked with ICES Singapore and HBTI Kanpur. His current research interests are in applications of process systems engineering approaches for crystallization engineering and biosystems engineering. His teaching interests include, among others, optimization techniques, instrumentation and process control, advanced heat transfer.

COURSE PLAN

Week 1 : General principles and representation of instruments
Week 2 : Performance characteristics of instruments and data analysis: 1 Theorem
Week 3 : Performance characteristics of instruments and data analysis: 2
Week 4 : Transducer elements
Week 5 : Pressure measurement: Moderate and high pressure measuring instruments
Week 6 : Pressure measurement: High vacuum measuring instruments
Week 7 : Temperature measuring instruments: 1
Week 8 : Temperature measuring instruments: 2
Week 9 : Flow measurement
Week 10 : Level measurement
Week 11 : Measurement of concentration, density, viscosity, and pH
Week 12 : Control valve, Piping and instrumentation diagram

FLUIDIZATION ENGINEERING

CHEMICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Petroleum industries

COURSE OUTLINE

This course is intended for learners who find themselves involved ranging from pure academic interest to direct industrial necessity in problems concerning the fluidized state. This course mainly covers the basic principles of fluidization phenomena and introduces the learner to the fundamental and practical aspects of basic fluidization operations for industrial application. This course may also be useful for who are doing research in multiphase system in chemical, metallurgical, and mining engineering programs.

ABOUT INSTRUCTOR

Prof. S. K. Majumder is a Professor in the Chemical Engineering Department, Indian Institute of Technology Guwahati, India. He has completed his Ph.D. in Chemical Engineering from Indian Institute of Technology Kharagpur. 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, 8A Kapteinsvigein, London, UK.

COURSE PLAN

Week 1-2 : Introduction: The phenomenon of fluidization; Advantages and disadvantages of fluidized beds; Industrial applications of fluidized beds

Week 3 : Characteristics of solids: Classification of solids; Flow characteristics and its outline in the different types of fluidization.

Week 4-5 : Flow pattern of fluidization system: Flow patter, flow pattern transition, flow pattern map, Frictional pressure drop and its model to analyze, Solid movement, mixing, segregation and staging

Week 6 : Gas distribution: Type of gas distributors in small and large scale industries, Design of distributor

Week 7 : Bubbling fluidized beds: Gas dispersion and gas interchange in bubbling beds, mixing characteristics

Week 8 : Entrainment and elutriation from fluidized beds

Week 9 : Attrition: Attrition mechanism and its analysis by model

Week 10-11 : Mass transfer phenomena: Particle to gas mass transfer phenomena and its analysis by model in two and three phase system and modeling

Week 12 : Heat Transfer phenomena: Heat transfer between fluidized beds and surfaces and modeling
Design of fluidized bed reactors: Design for physical operation, catalytic and non-catalytic systems

CHEMICAL ENGINEERING

TRANSPORT PROCESSES I: HEAT AND MASS TRANSFER

TYPE OF COURSE : Rerun
PRE-REQUISITES : Engineering mathematics including ordinary differential equations, complex variables. Undergraduate course in Unit Operations.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Chemical industries, Pollution Control

COURSE OUTLINE

Physical and chemical transformations of raw materials to products are accomplished in unit operations which involve mixing, heating/cooling, reactions and flow. The efficiency of these processes is critically dependent on the transport of heat and mass carried along with flowing fluid, and across solid/fluid interfaces. The transport across interfaces is entirely due to molecular diffusion, which is the transport in a stationary fluid due to gradients in concentration or temperature. The combination of convection (transport by flowing fluids) and diffusion determine the rate of transport, and the overall efficiency, in unit operations. In this course, we will obtain a physical understanding of how the balance between convection and diffusion determines the overall transport rates in chemical processes, and gives rise to many of the empirical correlations used in chemical engineering design.

ABOUT INSTRUCTOR

Prof. V. Kumaran completed his B. Tech in Chemical Engineering at IIT Madras in 1987, and received his PhD from Cornell University, USA, in 1992. After a two year postdoctoral assignment at the University of California, Santa Barbara, USA, **he joined the Department of Chemical Engineering at the Indian Institute of Science, Bangalore, where he is now a Professor.** His areas of research are fluid mechanics, statistical mechanics and dynamics of complex fluids.

COURSE PLAN

Week 1 : Dimensional Analysis
Week 2 : Diffusion.
Week 3 : Transport in one dimension.
Week 4 : Spherical & cylindrical coordinates
Week 5 : Pressure & body forces in fluid flow
Week 6 : Conservation equations.
Week 7 : Diffusive transport I.
Week 8 : Diffusive transport II.
Week 9 : Forced convection.
Week 10 : Forced & natural convection.
Week 11 : Natural convection.
Week 12 : Transport in turbulent flows.

APPLIED TIME-SERIES ANALYSIS

CHEMICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of probability and statistics; View MOOC videos on "Intro to Statistical Hypothesis Testing"
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Gramener, Honeywell, ABB, GyanData, GE, Ford, Siemens, and all companies that work on Data Analytics

COURSE OUTLINE

The course introduces the concepts and methods of time-series analysis. Specifically, the topics include (i) stationarity and ergodicity (ii) auto-, cross- and partial-correlation functions (iii) linear random processes - definitions (iv) auto-regressive, moving average, ARIMA and seasonal ARIMA models (v) spectral (Fourier) analysis and periodicity detection and (vi) parameter estimation concepts and methods. Practical implementations in R are illustrated at each stage of the course. The subject of time-series analysis is of fundamental interest to data analysts in all fields of engineering, econometrics, climatology, humanities and medicine. Only few universities across the globe include this course on this topic despite its importance. This subject is foundational to all researchers interested in modelling uncertainties, developing models from data and multivariate data analysis.

ABOUT INSTRUCTOR

Prof. Arun K. Tangirala is a Professor in the Department of Chemical Engineering, IIT Madras. He specializes in process systems engineering with research in data-driven modelling, process control, system identification and sparse optimization. Dr. Tangirala has conducted several courses, workshops on time-series analysis, applied DSP and system identification over the last 12 years. He is the author of a widely appreciated classroom text on "Principles of System Identification: Theory and Practice".

COURSE PLAN

Week 1 : Introduction & Overview; Review of Probability & Statistics – Parts 1 & 2
Week 2 : Introduction to Random Processes; Stationarity & Ergodicity
Week 3 : Auto- and cross-correlation functions; Partial correlation functions
Week 4 : Linear random processes; Auto-regressive, Moving average and ARMA models
Week 5 : KModels for non-stationary processes; Trends, heteroskedasticity and ARIMA models
Week 6 : Fourier analysis of deterministic signals; DFT and periodogram
Week 7 : Spectral densities and representations; Wiener-Khinchin theorem; Harmonic processes; SARIMA models
Week 8 : Introduction to estimation theory; Goodness of estimators; Fisher's information
Week 9 : Properties of estimators; bias, variance, efficiency; C-R bound; consistency
Week 10 : Least squares, WLS and non-linear LS estimators
Week 11 : Maximum likelihood and Bayesian estimators.
Week 12 : Estimation of signal properties, time-series models; Case studies

CHEMISTRY

CHEMISTRY

4weeks

01. Metal Mediated Synthesis - I
02. Organometallic Chemistry

8weeks

01. Introduction To Molecular Thermodynamics

12weeks

01. Chemistry Of Main Group Elements
02. Transition Metal Organometallic Chemistry: Principles To Applications
03. A Study Guide In Organic Retrosynthesis: Problem Solving Approach
04. Introduction to Chemical Thermodynamics and Kinetics
05. Biochemistry
06. Quantum Computing

CHEMISTRY

METAL MEDIATED SYNTHESIS - I

TYPE OF COURSE : New
PRE-REQUISITES : Advance Organic and Inorganic Chemistry
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : All Pharmaceutical Industries

COURSE OUTLINE

The course covers an advance level of organometallic chemistry. Recent development of cross coupling reactions and their applications in organic synthesis, starting from small molecule to naturally and pharmaceutically important compounds, has been described in the prescribed course. In this course, a brief overview about the carbine chemistry and oxidative cyclization is also portrayed.

ABOUT INSTRUCTOR

Prof.Debabrata Maiti, Department of Chemistry, Indian Institute of Technology, Bombay has done BSc (Chemistry), MSc (Chemistry, IIT B) and received his Ph.D. from Johns Hopkins University (USA) in 2008. After postdoctoral studies at Massachusetts Institute of Technology (MIT), he joined the Department of Chemistry at IIT Bombay in 2011. His research and teaching interests include organometallic chemistry, the development of new and sustainable synthetic methodologies and mechanistic insight.

COURSE PLAN

Week 1 :
Lecture 1: Assymetric Hydrogenation
Lecture 2: Transition metal carbenes,Fischer and Schrock carbenes
Lecture 3: Olefin metathesis
Lecture 4: Alkyne metathesis
Lecture 5: Cyclopropanation reaction

Week 2 :
Lecture 6: Catalytic cyclopropanation reaction,Introduction to cross coupling reaction
Lecture 7: Kumada Coupling reaction
Lecture 8: Suzuki coupling reaction
Lecture 9: Stille coupling reaction
Lecture 10:Assymetric Suzuki coupling reaction

Week 3 :
Lecture 11: Sonogashira coupling reaction
Lecture 12: Heck coupling reaction
Lecture 13: Assymetric Heck reaction,Introduction to Buchwald-Hartwig coupling reaction
Lecture 14: Buchwald-Hartwig coupling reaction
Lecture 15: Role of Ligands its influence in Buchwald-Hartwig coupling reaction

Week 4 :
Lecture 16: Oxidative cyclization process
Lecture 17: Application of oxidative cyclization in natural product synthesis
Lecture 18: Synthesis of reactive metallacycle intermediate via-Beta-abstraction and their applications
Lecture 19: Kulinkovich Reaction and its mechanism
Lecture 20: Pauson–Khand reaction

CHEMISTRY

ORGANOMETALLIC CHEMISTRY

TYPE OF COURSE : Rerun
PRE-REQUISITES : UG General Chemistry
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : All Pharmaceutical Industries

COURSE OUTLINE

The basic principles of organometallic chemistry will be discussed in this course. The modern chemistry is merged into one from classical organic chemistry and traditional inorganic chemistry. We will shed light on activation of small molecule by metal-ligand complex. We will discuss the stepwise mechanism of insertion of metal into organic molecules and elimination by different pathway. Only catalytic amount of metal can produce the large number of molecules those include drug, natural products, pharmaceuticals, our daily needs, etc. in gigantic quantity.

ABOUT INSTRUCTOR

Prof.Debabrata Maiti, Department of Chemistry, Indian Institute of Technology,Bombay has done BSc (Chemistry), MSc (Chemistry, IIT B) and received his Ph.D. from Johns Hopkins University (USA) in 2008. After postdoctoral studies at Massachusetts Institute of Technology (MIT), he joined the Department of Chemistry at IIT Bombay in 2011. His research and teaching interests include organometallic chemistry, the development of new and sustainable synthetic methodologies and mechanistic insight.

COURSE PLAN

Week 1 :
Lecture 1: Introduction of Organometallic Chemistry
Lecture 2: Counting of Electrons
Lecture 3: Ligand Substitution Reactions
Lecture 4: Oxidative Addition [1.Concerted Mechanism]
Lecture 5: Oxidative Addition[2.SN2 Mechanism]

Week 2 :
Lecture 6: Oxidative Addition[3.Radical Mechanism]
Lecture 7: Reductive Elimination
Lecture 8: Migratory Insertion & Elimination Reactions
Lecture 9: Migration & Insertion Reactions
Lecture 10: Alpha-Migratory Insertion & Alpha-Elimination Reactions

Week 3 :
Lecture 11: Beta-Migratory Insertion
Lecture 12: Beta-Elimination Reaction
Lecture 13: Alpha-Abstraction & Beta-Abstraction
Lecture 14: 4-Center Reactions [2+2]
Lecture 15: External Attack by a Ligand & Reductive Coupling

Week 4 :
Lecture 16: Hydrogenation Reaction
Lecture 17: Hydrogenation Reaction [Dihydride Catalyst]
Lecture 18: Stereoselective Hydrogenation Reaction
Lecture 19: Carbonylation Reaction [1.Monsanto Acetic Acid Process 2.Hydroformylation 3.Hydrocarboxylation]
Lecture 20: Carbonylation Reaction [1.Hydroformylation 2.Hydrocarboxylation 3.Hydrocyanation]

CHEMISTRY

INTRODUCTION TO MOLECULAR THERMODYNAMICS

TYPE OF COURSE : New
PRE-REQUISITES : Introduction to (1) quantum mechanics (2) probability and statistics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Chemical and pharmaceutical industries
Software development for molecular modeling

COURSE OUTLINE

This course is designed to use fundamental concepts of statistical mechanics in simple real world problems. Starting from simple molecular models of systems like solids, liquids and gases, the students would learn how to obtain their thermodynamic properties that are usually measured in experiments.

ABOUT INSTRUCTOR

Prof. Srabani Taraphder is a theoretical chemist. Department of Chemistry, Indian Institute of Technology, Kharagpur, Her research interest is focused on the physics of biochemical reactions. She uses principles of quantum and statistical mechanics to carry out computer simulation studies of chemical reactions catalyzed by enzymes.

COURSE PLAN

Week 1 : Review of mathematical methods and classical thermodynamics
Week 2 : Introduction to micro- and macroscopic states, ensembles
Week 3 : Microcanonical ensemble and application to simple non-interacting systems
Week 4 : Canonical ensemble and application to simple non-interacting systems
Week 5 : Monatomic and diatomic ideal gases
Week 6 : Heat capacity of solids – Einstein and Debye model
Week 7 : Introduction to classical statistical mechanics and application to real gases and liquids
Week 8 : Molecular thermodynamics of simple chemical reactions and transition state theory

CHEMISTRY OF MAIN GROUP ELEMENTS

CHEMISTRY

TYPE OF COURSE : New
PRE-REQUISITES : 12th Grade Chemistry Knowledge
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : This course is very useful for those working in Pharmaceutical Industries.

COURSE OUTLINE

This course on "Chemistry of Main Group Elements" focuses on the chemistry of s- and p-block elements, structure and bonding concepts and systematic understanding of their chemical reactivity. Organometallic chemistry of main group elements with special emphasis on their applications in organic synthesis is also included in the discussion. Various applications of main group elements and their compounds is also added into the lectures.

ABOUT INSTRUCTOR

Prof. M.S. Balkrishna joined the Department of Chemistry, IITB in 1996. He taught inorganic chemistry, molecular spectroscopy, organometallic chemistry of main group elements to UG, PG and Ph.D. scholars. His Research interests: Main group and transition metal chemistry, Organophosphorus chemistry, homogeneous catalysis and biological applications of copper(I) complexes. He Published 170 research papers and supervised 18 Ph.D. and at present 10 doctoral students and 2 PDFs are working in the group.

COURSE PLAN

Week 1 : Basic concepts of chemistry, Ionization energy, electron affinity and electronegativity, Periodic trends among main group elements, Classification of compounds of main group elements

Week 2 : Introductions to s- and p-block element-Hydrides, Oxides, (also sulphides, selenides) and Halides. Introduction to structure and bonding concepts starting from Lewis dot structures

Week 3 : Valence shell electron pair repulsion theory (VSEPR), Basic concepts of VSEPR, Molecules with non-bonding pairs of electrons, Molecules with multiple bonds, Molecules and ions with more than six electron pairs, Dative bonds and resonancs, Bent's rule and problems, worked examples

Week 4 : Molecular Orbital Theory, Examples of diatomic, triatomic and polyatomic molecules, Chemistry of hydrogen.

Week 5 : Chemistry of s-block elements: Chemistry of alkali metals, Chemistry of alkaline earth metals

Week 6 : Chemistry of p-block elements: Group 13 elements, Wade's rules and Group 14 elements

Week 7 : Application of main group elements and their compounds

Week 8 : Group 15 elements and Group 16 elements

Week 9 : Group 17 elements and Group 18 elements

Week 10 : Organometallic chemistry of main group elements: s-Block elements

Week 11 : Organometallic chemistry of main group elements: p-Block elements

Week 12 : Applications of main group elements and their compounds and summary

TRANSITION METAL ORGANOMETALLIC CHEMISTRY: PRINCIPLES TO APPLICATIONS

CHEMISTRY

TYPE OF COURSE : New
PRE-REQUISITES : UG General Chemistry
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Reliance, Dupont, BASF, BAYER, DOW Chemicals

COURSE OUTLINE

This course would cover all aspects of Organometallic Chemistry, starting from the principles to its applications.

ABOUT INSTRUCTOR

Prof. Prasenjit Ghosh is a Professor of Inorganic Chemistry at Indian Institute of Technology Bombay (IIT Bombay), India.He received his PhD in bioinorganic chemistry under the supervision of Professor Gerard Parkin from Columbia University, New York, in 1998. Following two post-doctoral stints in the laboratories of Dr. R. Morris Bullock(Brookhaven National Laboratory, 1998–2001) and Professor Guillermo C. Bazan (University of California, Santa Barbara, 2001–2003), he joined the Department of Chemistry at IIT Bombay as an Assistant Professor in 2003 and was finally promoted to Professor in June, 2012. He received the CRSI Bronze Medal (2014) of the Chemical Research Society of India and The Distinguished Lectureship Award (2011) of the Chemical Society of Japan among many others in the recent years. He is an Editorial Advisory Board member of the ACS journal Organometallics from 2017 for a three-year period and of Polyhedron since 2011.

COURSE PLAN

Week 1 : History of organometallic compounds, polarity and reactivity of M–C bonds, reactivity of organometallic compounds, 18 Valence Electron rule and classification. Tutorial with problem solving.

Week 2 : 18 Valence Electron rule and classification, reactivity and types of organometallic compounds, sigma- donor ligands, preparation of sigma- alkyl compounds, preparation and properties of sigma- alkyl compounds. Tutorial with problem solving.

Week 3 : Properties of sigma- alkyl compounds, β–elimination in sigma- alkyl compounds, β–elimination in detail, TM sigma- alkyl complexes and its application.Tutorial with problem solving.

Week 4 : C–H activation in details, characterization of C–H activation, bonding in C–H activation. Tutorial with problem solving.

Week 5 : C–C bond activation in detail, transition metal perfluoroalkyl (RF–TM) complexes, preparation of transition metal perfluoroalkyl (RF–TM) complexes.Tutorial with problem solving.

Week 6 : C–F activation, transition metal alkenyl complexes, transition metal aryl complexes, transition metal alkyne complexes, transition metal carbene complexes.Tutorial with problem solving.

Week 7 : Transition metal carbene complexes: preparations, transition metal carbene complexes: properties, transition metal carbene complexes: reactivities.Tutorial with problems solving.

Week 8 : Reactivity of Schrock type carbene complexes and transition metal carbynes, transition metal carbynes: preparation, transition metal carbynes: properties.Tutorial with problems solving.

Week 9 : Properties of transition metal carbynes, transition metal carbonyls and bonding properties of transition metal carbonyls. Tutorial with problem solving.

Week 10 : Transition metal carbonyls: reactivities, carbonyl metallates, transition metal carbonyl hydrides, application of carbonyl metallates and metal halides, application of metal halides and metal alkenes.Tutorial with problem solving.

Week 11 : Transition metal olefin complexes, transition metal olefin complexes: reactivity, bonding properties in olefin complexes, transition metal diolefin complexes.Tutorial with problem solving.

Week 12 : Transition metal diolefin complexes, transition metal alkyne complexes, transition metal alkyne complexes: reactivity, Summary: transition metal organometallic chemistry: principles to applications.Tutorial with problem solving.

A STUDY GUIDE IN ORGANIC RETROSYNTHESIS: PROBLEM SOLVING APPROACH

CHEMISTRY

TYPE OF COURSE : New
PRE-REQUISITES : Basic Organic Chemistry; Stereochemistry
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Pharmaceutical Industry

COURSE OUTLINE

Organic synthesis of small molecules is the most challenging and intriguing area of research in the chemical science related disciplines. In the early 20th century, the field of synthetic organic chemistry, while established in many respects, was to continue a sharp path of progress and advancement for over a century to reach the level of power and sophistication that it possesses today. This is a unique tool for accessing new chemical entities with great biological potential, which seems to be impossible to access from natural sources due to its scarce availability. In this coursework I will try to address various aspects of organic synthesis through a problem/puzzle solving approaches so that students can learn in an interactive manner and excel in competitive exams.

ABOUT INSTRUCTOR

Prof. Samik Nanda, Department of Chemistry, Indian Institute of Technology, Kharagpur, after finishing my PhD in the field of "asymmetric synthesis with the help of enzymes" I was very much interested to carry out an independent research career in the field of asymmetric total synthesis of natural products. Since last ten years the research focus of my group was focused on the central theme of "asymmetric synthesis". We tried to explore many well developed asymmetric synthesis protocols to access our desired target molecules. We have also developed few in-house evolved asymmetric processes which were also successfully employed to access many enantiopure small organic molecules.

COURSE PLAN

Week 1 : Introductory remarks: Why to study organic synthesis? Historical perspectives of organic synthesis. Establishing a visual dialogue with the target molecules (imagination, creativity and execution).

Week 2 : Retrosynthetic disconnections: The basis for retrosynthetic analysis and terminologies, Transform based strategies, Substrate/precursor based strategies.

Week 3 : Retrosynthetic disconnections: Functional group based strategy (concept of redundant functionality) and mechanism based strategy (including biomimetic pathways)

Week 4 : Retrosynthetic disconnections: Consideration of symmetry elements in synthetic planning; Local symmetry and pseudo symmetry. Synthesis of symmetrical molecules and concoctive species.

Week 5 : Retrosynthetic disconnections: Stereochemical strategies Strategies to create new chiral center/s in a organic molecule (Resolution, Desymmetrization, Substrate directed approach, Chiron approach, Absolute asymmetric synthesis)

Week 6 : Retrosynthetic disconnections: Enantiodivergent and enantioconvergent approaches and case studies (meso trick and C2-trick).

Week 7 : Synthetic equivalents: Concepts of synthetic equivalents (formyl/acyl anion, enolate, homoenolate, Conjunctive species, Linchpin strategy and other related species) and its application in total synthesis.

Week 8 : Fragmentation reactions (Overbred intermediates) and molecular rearrangements and its application in organic synthesis

Week 9 : Stereochemistry and conformational analysis: Concepts and application of A1,2/A1,3 strain. Baldwin's cyclization rule.

Week 10 : Protecting groups: Selective protection and deprotection of various functional groups and its application in total synthesis

Week 11 : Few important name reactions and their applications in organic synthesis (Several name reactions based on Substitution/displacement strategy, Reductive strategy, Oxidative strategy, Coupling reactions, Cyclization reactions

Week 12 : Total synthesis of few natural products: Longifolene (Corey/ Oppolzer); Isocomene (Pirrung); Hirsutene and Δ9(12) Capnellene (Curran), Taxol (Nicolaou); Epothiolone A & B (Nicolaou).

INTRODUCTION TO CHEMICAL THERMODYNAMICS AND KINETICS

CHEMISTRY

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course will cover classical thermodynamics and kinetics developed to explain a variety of macroscopic physico-chemical phenomena with applications in Chemistry. This course is designed as an introductory level course to the broad area of thermodynamics and kinetics and the lectures will be pitched at the level of undergraduates (both freshman and sophomore level).

ABOUT INSTRUCTOR

Prof. Arijit Kumar De, Department of Chemistry, IISER Mohali, completed his BSc (2003) with Chemistry major from University of Calcutta (WB, India) and MSc (2005) in Chemistry from IIT Kanpur (UP, India). He pursued his PhD with Debabrata Goswami at IIT Kanpur (2005-2010). He was a postdoctoral fellow at Lawrence Berkeley National Lab and University of California Berkeley (CA, USA) with Graham R. Fleming (2010-2014). In 2014, he joined IISER Mohali (PB, India) as an Assistant Professor in the Department of Chemical Sciences.

COURSE PLAN

Week 1 : Review of states of matter, Equations of state for ideal and real gases, Heat capacities at constant volume and pressure. Introduction to Thermodynamics, Laws of thermodynamics, Zeroth law.

Week 2 : First law, Concept of work and heat, Work done in reversible and irreversible processes.

Week 3 : Concept of enthalpy, Joule's experiment and Joule-Thompson experiment, Thermochemistry.

Week 4 : Second law, Concept of entropy, Carnot cycle, Clausius inequality, Concept of maximum work.

Week 5 : Gibbs and Helmholtz free energies, Maxwell's relations, Chemical potential, Gibbs-Helmholtz equation, Gibbs-Duhem equation.

Week 6 : Phase equilibrium, Clapeyron equation and Clausius-Clapeyron equation,Phase rule, Phase diagrams of one and two-component systems.

Week 7 : Thermodynamics of mixtures, Partial Molar Properties, Ideal, Ideal-dilute and Real Solutions, Colligative properties.

Week 8 : Chemical equilibrium, Equilibrium constant, van't Hoff equation, Le Chatelier's principle.

Week 9 : Equilibrium electrochemistry, Types of electrochemical cells, Standard electrode potential, Nernst equation, Liquid junction potential.

Week 10 : Introduction to chemical kinetics, rate laws for elementary reactions of different orders, competing reactions.

Week 11 : Mechanisms of composite reactions, steady state and rate determining step approximations, homogeneous (acid-base catalysis and enzyme catalysis) and heterogeneous catalysis (Langmuir adsorption isotherm).

Week 12 : Temperature dependence of rate constant, Introduction to gas-phase chemical reaction dynamics, Maxwell-Boltzman distribution of molecular speeds and its application in collision theory, Unimolecular reactions.

BIOCHEMISTRY

CHEMISTRY

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic concepts in Chemistry and Biology
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course is an introductory course that will focus on basic concepts in biochemistry. The course deals with an understanding of biological macromolecules: proteins, carbohydrates, lipids, and nucleic acids. The structure and functional roles of the macromolecules will be studied in addition to fundamentals of enzyme chemistry: kinetics, mechanisms, inhibition, structure and mechanism. The course will also touch upon the basics of membrane transport and bioenergetic principles. After completion of the course, the students should be able to understand the chemical properties and three-dimensional structure of these biological macromolecules in relationship to their biological function.

ABOUT INSTRUCTOR

Prof. Swagata Dasgupta, Department of Chemistry, IIT Kharagpur, completed her B.Sc. (hons) in chemistry from Presidency College, Kolkata. She obtained her M.Sc. from IIT Kanpur and Ph.D. from RPI, USA. She joined IIT Kharagpur in 1995 and started research in the areas of protein–protein, protein-small molecule interactions and protein structure analyses. The unique feature of her work is the blend of experimental protein chemistry with in-depth structural analysis. She is the recipient CRSI (Chemical Research Society of India) bronze medal (2016) and the darshan ranganathan memorial lecture award of CRSI (2013). She was elected Fellow of the West Bengal Academy of science and technology (2014).

COURSE PLAN

Week 1 : Amino Acids
Week 2 : Protein Structure
Week 3 : Protein Structure (continued)
Week 4 : Enzymes
Week 5 : Enzymes (continued)
Week 6 : Enzyme mechanisms
Week 7 : Nucleic acids
Week 8 : Lipids and Membranes
Week 9 : Vitamins and Coenzymes
Week 10 : Carbohydrates
Week 11 : Bioenergetics
Week 12 : Metabolism

QUANTUM COMPUTING

CHEMISTRY

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Intel, Microsoft Research

COURSE OUTLINE

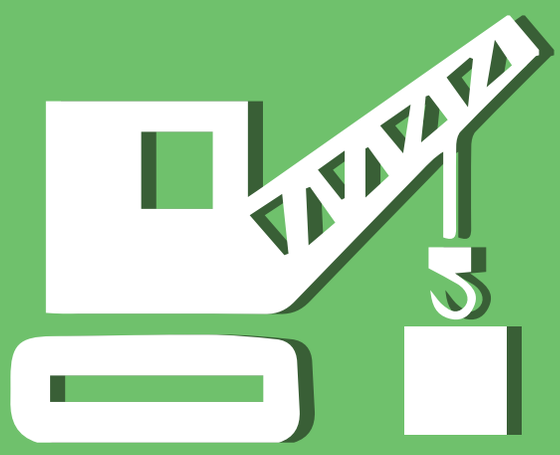
Quantum computing exploits the quantum mechanical nature of matter to simultaneously exist in multiple possible states. Building up on the digital binary logic of bits, quantum computing is built on the basis of interacting two-level quantum systems or 'qubits' that follow the laws of quantum mechanics. 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

• Quantum Measurements Density Matrices; • Positive-Operator Valued Measure
• Fragility of quantum information: Decoherence; • Quantum Superposition and Entanglement
• Quantum Gates and Circuits; • No cloning theorem & Quantum Teleportation
• Bell's inequality and its implications; • Quantum Algorithms & Circuits
• Deutsch and Deutsch–Jozsa algorithms; • Grover's Search Algorithm
• Quantum Fourier Transform; • Shore's Factorization Algorithm
• Quantum Error Correction: Fault tolerance; • Quantum Cryptography
• Implementing Quantum Computing: issues of fidelity; • Scalability in quantum computing
• NMR Quantum Computing; • Spintronics and QED approaches
• Linear Optical Approaches; • Nonlinear Optical Approaches; • Limits of all the discussed approaches
•How promising is the future?



CIVIL ENGINEERING

CIVIL ENGINEERING

4weeks

01. Electronic Waste Management - Issues And Challenges
02. Digital elevation models and applications
03. Introduction to Geographic Information Systems
04. Photogeology In Terrain Evaluation (Part - 1)

8weeks

01. Hydration, Porosity & Strength of Cementitious Materials
02. Digital Land Surveying And Mapping(DLS&M)
03. Sustainable Engineering Concepts And Life Cycle Analysis
04. Earth Sciences For Civil Engineering Part - I & II

12weeks

01. Applied Environmental Microbiology
02. Mechanics Of Materials
03. Soil Mechanics/Geotechnical Engineering I
04. Energy Efficiency, Acoustics and daylighting in Building
05. Mineral Resources: Geology, Exploration, Economics And Environment
06. Introduction To Mineral Processing
07. Water economics & Governance

CIVIL ENGINEERING

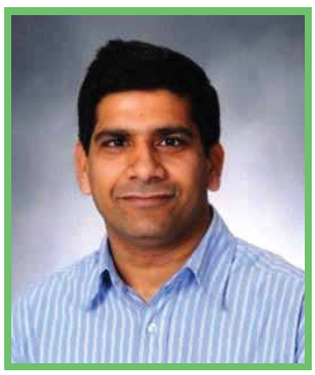
ELECTRONIC WASTE MANAGEMENT - ISSUES AND CHALLENGES

TYPE OF COURSE : New
PRE-REQUISITES : Environmental Science
Introduction to Environmental Engineering
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : E Parisaraa – Bangalore, Ecoreco Recycling – Mumbai
Earth Sense – Telangana, Attero Recycling – Noida
EWRI-Bangalore, WEEE Recycle – New Delhi
J. S. Pigments Limited – Kolkata.

COURSE OUTLINE

This course will discuss the overall scenario of E-Waste management in India in comparison with other countries around the globe. At first, the present scenario of E-Waste management in India (mostly informal) will be discussed along the role of various stakeholders. Then, the effects of recycling and management of Electronic Waste on human health, environment and society will also be presented. This will be followed by the risk assessment owing to pollutants released from E-Waste recycling in soil, air and water. The possible option of extraction of Rare-Earth Minerals will also be discussed in this course.

ABOUT INSTRUCTOR



Prof. Brajesh Kr. 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. He has been resource person for several municipal solid waste management training programs including that for electronics waste and has delivered lectures on this subject at several universities in USA, Canada, New Zealand, China and India. Dr. Dubey has authored/co-authored more than 160 publications in his area of expertise and have presented at several national and international conferences.

COURSE PLAN

Week 1 : Overview of the course

Week 2 : Exposure pathway of pollutants emitted from Recycling of E-Waste

Week 3 : E-Waste Management Rules of India (2011 and 2016 Rules)

Week 4 : E-waste Management: Case Studies and Unique Initiatives from around the World

CIVIL ENGINEERING

DIGITAL ELEVATION MODELS AND APPLICATIONS

TYPE OF COURSE : New

PRE-REQUISITES : Current students of engineering, post graduate science students and PhD students should have basic knowledge of GIS.

COURSE DURATION : 4 weeks

INDUSTRY SUPPORT : Geoinformatics companies, e.g NIIT, ESRI India, Leica Geoinformatics, 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, in the proposed course 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

Prof. Arun K. Saraf, Department of Civil Engineering, Indian Institute of Technology, Roorkee is a Ph. D. (Remote Sensing) from University of Dundee, United Kingdom. He teaches courses on Geographic Information Systems (GIS), Advanced GIS, Remote Sensing, Geomorphology 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 1 : Concept of digital elevation model (DEM) and how it is represented? Various techniques to generate digital elevation models-1 Various techniques to generate digital elevation models-2 Various techniques to generate digital elevation models-3 Importance of spatial resolution with DEMs

Week 2 : How to assess quality of a DEM? Integration of DEMs with satellite data Common derivatives of DEMs -Slope and aspect Triangulated Irregular Network (TIN) and its derivatives Shaded relief models and their applications

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-2 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

CIVIL ENGINEERING

INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Students of engineering and post graduate science students.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Geoinformatics companies, e.g NIIT, ESRI India, Leica Geoinformatics, MapmyIndia etc.

COURSE OUTLINE

The proposed course provides basic understanding about GIS Technology. Presently, GIS is being used extensively in various domains including in civil engineering, water resources, earth sciences, transportation engineering, navigation etc. Google Earth and Google Map are very popular custom designed user friendly GIS products which are widely used for various purposes including in navigation etc.

ABOUT INSTRUCTOR

Prof. Arun K. Saraf, Department of Civil Engineering, Indian Institute of Technology, Roorkee is a Ph. D. (Remote Sensing) from University of Dundee, United Kingdom. He teaches courses on Geographic Information Systems (GIS), Advanced GIS, Remote Sensing, Geomorphology 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 1: What is Geographic Information Systems?
Different components of GIS
Different types of vector data
Raster data models and their types
TIN data model

Week 2 : 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 3 : Pre-processing of spatial datasets
Different map projections
Spatial interpolation techniques
Different types of resolutions
Digital Elevation Model (DEM)

Week 4 : Quality assessment of freely available DEMS
GIS analysis-1
GIS analysis-2 and applications
Errors in GIS
Key elements of maps

CIVIL ENGINEERING

PHOTOGEOLOGY IN TERRAIN EVALUATION (PART – 1)

TYPE OF COURSE : New
PRE-REQUISITES : Basic knowledge of Earth Science or Physical Geography is recommended.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : None

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, Department of Civil Engineering Indian Institute of Technology, Kanpur earned his Ph. D in 1998 from M. S. University Baroda, Vadodara, Gujarat (Geology), did Post-Doctorate (Japan Society for Promotion of Science) from (1999-2001) Hiroshima University, Japan. Joined IIT Kanpur in 2001. Area of Specialization: Active Tectonics, Paleoseismology and Paleo-tsunami, Current Areas of Research: Active fault mapping and Paleoseismological studies along NW Himalaya and Kachchh, Paleo-Tsunami studies in Andaman & Nicobar Islands Collaboration with Japan, US and France – related to earthquake and tsunami studies. Research Projects: Active tectonic investigation along northwestern Himalayan foothill zone, sponsored by DST, Active fault mapping and paleoseismic investigations in Kachchh region. Gujarat, by OYO International Japan. Active Tectonic investigations around South-Middle Andaman and Car Nicobar Islands, A&N Islands, sponsored by INCOIS, Hyderabad, MoES.

COURSE PLAN

Week 1 : Introduction to Photogeology and its Applications,Aerial Photography/ Satellite Imaging and their Applications, Aerial/ Satellite Photographs and Exercise on handling photographs,Principles of Stereoscopy and Exercise on creating 3D image using Stereoscope

Week 2 : 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 3 : 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 4 : 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

CIVIL ENGINEERING

HYDRATION, POROSITY & STRENGTH OF CEMENTITIOUS MATERIALS

TYPE OF COURSE : Rerun

PRE-REQUISITES : No prerequisites. Only the fundamental knowledge of Chemistry, Physics and Mathematics at the level of first year of Engineering courses will be required.

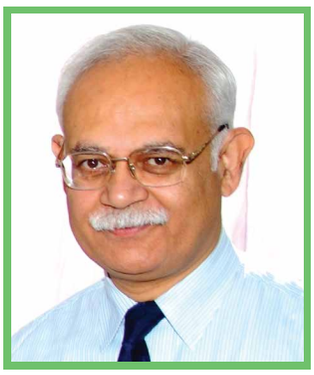
COURSE DURATION : 8 weeks

INDUSTRY SUPPORT : Cement, concrete and construction industry

COURSE OUTLINE

Cement and concrete is the backbone of infrastructure development and it is important that engineers have a clear understanding of issues involved not only with cement, hydration and strength development, but also porosity, permeability and durability. With the basic framework using Ordinary Portland Cement, the course focuses on developing the subject in light of advances in chemical and mineral admixtures. Though the subject matter is approached from the point of view of the concrete science, the fact that paste made with OPC alone or in combination with other cementitious materials, is almost never used in the field. Illustrative examples from actual applications will be included to show the applications of the scientific principles.

ABOUT INSTRUCTOR



Prof. 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.

Prof. K.V. Harish is currently working as an Assistant Professor at the Department of Civil Engineering, IIT Kanpur. He completed his Ph. D in 2011 at the Glenn Department of Civil Engineering, Clemson University, South Carolina, USA. During his doctoral studies, he was a recipient of ACI-BASF Foundation Student Fellowship for the academic year 2010-2011. He completed his Bachelors and Masters studies in India and is a University Rank Holder in both degrees. After Masters education, he worked as a Scientist in Structural engineering research center, CSIR Campus for 2 years. His research interests include microstructure of cement based materials, development of high- and ultra-high performance concretes, repair and rehabilitation of concrete structures, sustainable concretes. During the last three years, he has been teaching both undergraduate and graduate courses such as Design of Reinforced Concrete Structure, Special Concretes, Durability of Concrete Structures and Construction Management.

COURSE PLAN

Week 1 : General

Week 2 : Introduction

Week 3 : Portland Cement Based Paste System

Week 4 : Portland Cement Based Paste System (Contd.)

Week 5 : Mineral Admixtures

Week 6 : Mineral Admixtures (Contd.)

Week 7 : Paste & Concrete

Week 8 : Paste & Concrete (Contd.)

CIVIL ENGINEERING

DIGITAL LAND SURVEYING AND MAPPING(DLS&M)

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of Physics and mathematics upto 12th standard and familiarity with use of computer
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : http://dir.indiamart.com/impcat/topographic-survey-services.html

COURSE OUTLINE

The objective of the course is to provide basics of digital surveying and mapping of earth surface using total station, GPS and mapping software. The course starts with introduction to land surveying followed by fundamentals of total station and its working & measurements for land surveying. Then, fundamentals, working & measurements using GPS for land surveying will be discussed. Followed by mapping fundamentals, digital surveying procedure, working, data reduction etc. Finally, the course will deals with working and demonstration of a digital land surveying and mapping of an area.

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 31 years. He is pioneer in introducing courses on GPS surveying in the UG & PG curriculum of Engineering education in India, since 1999. He has conducted many short term courses on Surveying for the building professionals as early as 2000. He has published TWO books on Surveying – Elementary Engineering Surveying and Introduction to GPS Surveying. He is member of different National and International technical associations.

COURSE PLAN

Week 1 : Fundamentals of Land Surveying & GPS
Week 2 : Global Positioning System (GPS)
Week 3 : Global Positioning System (GPS)
Week 4 : Total station(ts)
Week 5 : Ts & digital land surveying (dls)
Week 6 : Dls& digital mapping (dm)
Week 7 : Dm & digital data manipulation (ddm)
Week 8 : Digital land surveying and mapping (dls&m)

CIVIL ENGINEERING

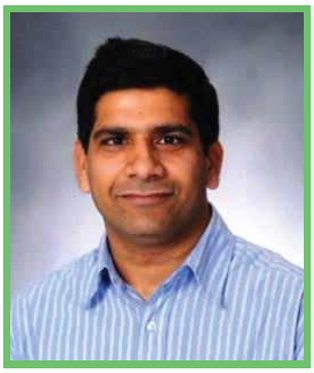
SUSTAINABLE ENGINEERING CONCEPTS AND LIFE CYCLE ANALYSIS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Environmental Sciences
Introduction to Environmental Engineering
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Larsen and Toubro, Tata Group of Industries
Ramky Group of Industries , IF&LS Environment

COURSE OUTLINE

This course will introduce students to the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society. Students will understand the concepts and the scientific method as it applies to a systems-based, trans-disciplinary approach to sustainability, and will be prepared to identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues. The basic concepts of life cycle assessment (LCA) will be discussed, along with life cycle inventory (LCI) and life cycle impact assessment (LCIA) including the social and economic dimensions.

ABOUT INSTRUCTOR



Prof. Brajesh Kr. Dubey is 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. He has been resource person for LCA and delivered lectures at several universities in USA, Canada, New Zealand, China and India. He has also conducted training programs in the Integrated Waste Management areas including that for Electronics Waste.

COURSE PLAN

Week 1 : An Introduction to Sustainability Concepts and Life Cycle Analysis (Introduction, Material flow and waste management, What it all means for an engineer? Water energy and food nexus)

Week 2 : Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Example Chemicals and Health Effects, Character of Environmental Problems)

Week 3 : Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools)

Week 4 : Life Cycle Assessment – Detailed Methodology and ISO Framework (Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework)

Week 5 : Life Cycle Inventory and Impact Assessments (Unit Processes and System Boundary Data Quality, Procedure for Life Cycle Impact Assessment, LCIA in Practice with Examples, Interpretation of LCIA Results)

Week 6 : Factors for Good LCA Study (ISO Terminologies, LCA Steps Recap, Chemical Release and Fate and Transport, and Green Sustainable Materials)

Week 7 : Design for Sustainability (Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis)

Week 8 : Case Studies (e.g., Odour Removal for Organics Treatment Plant, Comparison of Hand Drying Methods, Biofuels for Transportation, Kerosene Lamp vs. Solar Lamp, Bioplastic etc.).

CIVIL ENGINEERING

EARTH SCIENCES FOR CIVIL ENGINEERING PART - I & II

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic knowledge of geology is recommended.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course introduces the student to basic principles of geosciences, geological hazards and their applications in civil engineering. The first 4-week modules of this course will help the student to have better understanding towards interior of the earth, earth system and its process. The next 4 week modules will cover geological hazards and environmental impact, active faults and its related hazard in India, importance of geological structures in dams and tunnels, fluvial geomorphology and ground water, tsunami, landslide and flood hazard, mapping, monitoring and management of hazards.

ABOUT INSTRUCTOR

Prof. Javed Malik Department of Civil Engineering Indian Institute of Technology, Kanpur earned his Ph. D in 1998 from M. S. University Baroda, Vadodara, Gujarat (Geology), did Post-Doctorate (Japan Society for Promotion of Science) from (1999-2001) Hiroshima University, Japan. Joined IIT Kanpur in 2001. Area of Specialization: Active Tectonics, Paleoseismology and Paleo-tsunami, Current Areas of Research: Active fault mapping and Paleoseismological studies along NW Himalaya and Kachchh, Paleo-Tsunami studies in Andaman & Nicobar Islands Collaboration with Japan, US and France – related to earthquake and tsunami studies. Research Projects: Active tectonic investigation along northwestern Himalayan foothill zone, sponsored by DST, Active fault mapping and paleoseismic investigations in Kachchh region. Gujarat, by OYO International Japan. Active Tectonic investigations around South-Middle Andaman and Car Nicobar Islands, A&N Islands, sponsored by INCOIS, Hyderabad, MoES.

COURSE PLAN

Week 1 : Introduction to Geosciences in Civil Engineering,Introduction to Geosciences in Civil Engineering,Plate Tectonics and Continental Drift,Plate Tectonics and Continental Drift,Rock-forming Minerals and their properties

Week 2 : Rock-forming Minerals and their properties,Rock types and their properties,Rock types and their properties,Rock types and their properties,Rock types and their properties

Week 3 : Seismology and the internal Structure of the Earth,Seismology and the internal Structure of the Earth,Geological Structure Geological Structures,Geological Structures

Week 4 : Introduction to Geological Hazards,Introduction to Geological Hazards,Introduction to Geological Hazards, Environmental impacts of Geological hazards,Environmental impacts of Geological hazards

Week 5 : Active faults and its related hazard in India,Active faults and its related hazard in India,Active faults and its related hazard in India,Active faults Mapping and Applications,Active faults Mapping and Applications

Week 6 : Tsunami and related hazard,Tsunami and related hazard,Tsunami and related hazard,Landslide and Subsidence, Landslide and Subsidence

Week 7 : Landslide and Subsidence,Flood and related hazard,Flood and related hazard,Flood and related hazard, Groundwater

Week 8 : Applications of Earth Sciences in Civil Engineering,Applications of Earth Sciences in Civil Engineering,Civil Engineering applications – geological considerations in Rivers,Civil Engineering applications – geological considerations in Dams, Civil Engineering applications – geological considerations in Tunnels

CIVIL ENGINEERING

APPLIED ENVIRONMENTAL MICROBIOLOGY

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : GMBH, Thermax India, GE Water, Siemens Water, SFC Environmental Technologies Pvt. Ltd., Voltas Ltd

COURSE OUTLINE

This course prepares the student to address pressing environmental challenges by developing a fundamental understanding of the microbial communities and processes in natural and built environments. It lays and builds upon the foundation of basic microbiology, microbial energetics, and diversity, to applying tools provided by microbiology ranging from traditional to state of art for addressing relevant environmental concerns. It provides an indepth exploration of the diverse role microbes and microbial communities and includes topics such as: cell structure and elements, microbial energetics and diversity, ecology and population dynamics, environmental microbial processes including biogeochemical cycling, and microbes involved in biodeterioration and bioremediation.

ABOUT INSTRUCTOR

Prof. Gargi Singh is currently working at the interface of microbiology and environmental engineering at IIT Roorkee to address environmental challenges of pathogen ingress in water distribution network and environmental proliferation of antibiotic resistance. In her doctoral research, she applied molecular biology tools including quantitative polymerase chain reaction, isolation, selection, high-throughput sequencing on pyrosequencing and Illumina based platforms, and metagenomics to investigate biodegradation of petroleum and nanocellulose, and sequestration of heavy metals. She is also faculty member of Centre of Nanotechnology at IIT Roorkee, where she is currently teaching environmental statistics and environmental implications of nanotechnology.

COURSE PLAN

Week 1 : Introduction; cell elements and composition Cell and its composition, cytoplasmic membrane Prokaryotic cell division Microbes and their environmental niches Historical roots of microbiology Nucleic acids and amino acids DNA structure, replication, and manipulation Protein and its structure Regulation Microbial nutrition Microscopy: Light microscopy, 3D Imaging, AFM, Confocal scanning laser microscopy

Week 2 : Microbial energetics and diversity Stoichiometry and bioenergetics Oxidation-reduction NAD, energy-rich compounds and energy storage Mathematics of microbial growth Glycolysis Respiration Citric-acid cycle Catabolic Alternatives Phototrophy, Chemolithotrophy, anaerobic respiration (Nitrate and Sulfate reduction; Acetogenesis; Methanogenesis; Metal, Chlorate, and organic electron acceptors)

Week 3 : Microbial metabolism and functional diversity of bacteria Prokaryotic diversity Classical taxonomy Origin of life Tree of life Major catabolic pathways Catalysis and enzymes Energy conservation Sugars and polysaccharides, amino acids, nucleotides, lipids

Week 4 : Microbial ecosystems Population, guilds, and communities Environments and microenvironments Microbial growth on surfaces Environmental effects on microbial growth

Week 5 : Environmental genomics and microbial ecology; genetic exchange Environmental genomics Microbial ecology Horizontal and vertical gene transfer: Replication, Transformation Transduction

Week 6 : Microbial symbiosis and virus, Mutation and its rate ,Genetic recombination, Population dynamics ,Virus ,Viroid, Prion, Application of environmental microbes

Week 7 : Investigations in environmental microbiology: sampling, detection, isolation, taxonomic and functional annotation and quantification; Introductory bioinformatics and data analysis Microbial sampling Culture based and culture independent tools Molecular biology tools: Cloning, amplification, sequencing,Case study

Week 8 : Bioremediation and wastewater microbiology, Bioremediation and examples, Acid mine drainage, Enhanced metal recovery, Wastewater microbiology

Week 9 : Drinking water microbiology, Drinking water microbiome and treatment, Microbial instability ,Water borne microbial diseases

Week 10 : Solid waste microbiology and antimicrobial resistance, Landfills, Leachate, Anaerobic degradation phases, Antimicrobial resistance

Week 11: Epidemiology and biosensors ,Public health, Epidemics, Biosensors ,Wearable biosensors

Week 12 : Built microbiology, exposomes and bioinformatics, Exposure routes ,Microbes living around us ,Exposomes Basic bioinformatics, Bioinformatics tools available online

MECHANICS OF MATERIALS

CIVIL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Engineering Mechanics, Basic Calculus
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This first course in mechanics of deformable bodies introduces the four concepts - Force, stress, strain, displacement - and the four equations that connect them, namely equilibrium equations, constitutive relation, compatibility condition and strain displacement relation.Systematic procedure to solve problems of engineering interest is outlined. In particular, force and displacement relation of structural elements subjected to uniaxial stress, bending, twisting and inflation is studied. Estimation of possible modes of failure of these structural elements and the failure load is outlined.

ABOUT INSTRUCTOR

Saravanan.U is a Professor in the Department of Civil Engineering, Indian Institute of Technology, Madras, He regularly teaches this Mechanics of Materials course to undergraduate students in their third semester. He has authored a NPTEL web course on advanced solid mechanics. He is passionate about students learning solid mechanics in the correct way. The instructor's research interest is in mechanics of deformable solids in which he has published more than 30 international peer reviewed journal articles.

COURSE PLAN

Week 1 : Mathematical Preliminaries

Week 2 : Concept of Force, Displacement and stress

Week 3 : Transformation of stress and equilibrium equation

Week 4 : Concept of strain

Week 5 : Constitutive relation, strain energy and potential

Week 6 : Displacement due to uniaxial loading, temperature and bending

Week 7 : Stresses and deflection in homogeneous beams loaded about one principal axis

Week 8 : Stresses and deflection in beams loaded about principal axis

Week 9 : Stresses and deflection in beams not loaded about principal axis

Weel 10 : Stresses and displacement due to torsion

Week 11 : Thick and thin walled pressure vessels

Week 12 : Failure modes

CIVIL ENGINEERING

SOIL MECHANICS / GEOTECHNICAL ENGINEERING I

TYPE OF COURSE : New
PRE-REQUISITES : Engineering Mechanics, Solid Mechanics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Most of the Civil Engineering companies

COURSE OUTLINE

Broadly Geotechnical Engineering encompasses two distinct segments: Soil Mechanics and Foundation Engineering. Soil Mechanics deals with study of physical properties of soils, and the relevance of these properties as they affect soil strength, stability, and drainage. Foundation engineering deals with (i) selection of foundation type based on building site conditions and site constraints, (ii) determining size and reinforcement of the foundation and (iii) finally construction of foundation element. This course will focus on the first, soil mechanics. Soil Mechanics is the basis for all geotechnical applications.. One has to learn basic principles of geotechnical engineering through soil mechanics and it is a core course for civil engineering in every college/university across the globe. Every aspect of soil mechanics starting from origin of soil to stability of soil slopes will be covered in great detail under this course.

ABOUT INSTRUCTOR

Prof. Dilip Kumar Baidya presently Professor in Civil Engineering at IIT Kharagpur, graduated in Civil Engineering in 1987 from Bengal Engineering College Sibpur and obtained ME and Ph D from IISc Bangalore in the year 1989 and 93, respectively. Has 25 years of experience in teaching and research and guided more than 25 M Tech dissertations and 7 Ph D theses on Geotechnical Engineering. Published more than 100 papers in National/international journals and conferences out of which 3 papers received best paper award. Visited different countries for presenting papers in the international conferences and served 2 years as Faculty members in the University of West Indies, Trinidad and Tobago.

COURSE PLAN

Week 1 : Origin of soil and its Classification

Week 2 : Three-phase diagram & Weight volume relationship

Week 3 : Index properties

Week 4 : Soil Compaction

Week 5 : Seepage and Permeability

Week 6 : Effective stress concept

Week 7 : Boussinesq's theory and Vertical Stress distribution

Week 8 : Shear strength of soil I

Week 9 : Shear strength of soil II

Week 10 : Compressibility of soil

Week 11 : Consolidation settlement and time rate of settlement

Week 12 : Introduction to Stability of slopes

CIVIL ENGINEERING

ENERGY EFFICIENCY, ACOUSTICS & DAYLIGHTING IN BUILDING

TYPE OF COURSE : New
PRE-REQUISITES : BE/BSc. Level Physics & Mathematics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : All Industry involved in Building design and construction. L&T, TERI etc. CPWD and all other PWDs. Dr. Fixit Institute

COURSE OUTLINE

The objective of this course is to expose the students to the concepts functional design of building for thermal aspects and energy efficiency; especially in tropical climates i.e. in Indian context. Further objective is to make the student capable of performing fenestration design for natural ventilation and daylighting & design of space for external and internal noise control.

ABOUT INSTRUCTOR

Prof. B. Bhattacharjee, Department of Civil Engineering, Indian Institute of Technology, Delhi, B.Tech(IIT KGP:1978), M.Tech. (IITD:1982) and Ph.D. (IITD:1990) Field Experience: M/s Gammon India Limited:1978-80. 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. He has been teaching a similar course in IITD for last 31 years (Building Science[3-0-0])

COURSE PLAN

Week 1 : Environmental Factors: Factors and their representation, tropical environments and site environments, etc.

Week 2 : Human response to environment: Factors affecting human comfort, Human response to thermal environment, noise, visual environment etc.; Comfort indices

Week 3 : Response of building to thermal environment: Processes of heat exchange of building with environment; Effect of solar radiation; Thermal properties of material and sections and their influence

Week 4 : Steady and periodic heat transfer in buildings

Week 5 : Heat flow computations: Transmission matrix, Admittance method, etc.-1

Week 6 : Heat flow computations: Transmission matrix, Admittance method, etc.-2

Week 7 : Structural control and design for energy efficiency: Selection of envelope elements, Orientations, shape, Glasses and shading devices

Week 8 : Natural ventilation: Purpose of ventilation, Mechanisms, Fenestration Design for natural ventilation

Week 9 : Noise and Building: Basic acoustics and noise, Planning, Sound in free field, protection against external noise

Week 10 : Internal noise sources and protection against air borne & structure borne noise.

Week 11 : Day lighting: Lighting principles and fundamentals

Week 12 : Sky, Indian sky, daylight prediction and design of fenestration.

MINERAL RESOURCES : GEOLOGY, EXPLORATION, ECONOMICS & ENVIRONMENT

CIVIL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Introductory Geology (Physical Geology) Course
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Mining and Exploration Companies

COURSE OUTLINE

This course may be looked as a first level course on Mineral Resources of the Earth that has the following broad components: Conceptualization of ore formation as intimately linked to fundamental earth processes operating at different scales; parallelism between evolution of the crust and different deposit types through geologic ages; fundamental processes (magmatism, sedimentation, weathering/erosion, fluid activities) and morphology of resultant deposits. Use of basic knowledge of ore geology in mineral exploration, case studies of discovery of some world class deposits; appraisal of mineral resources. Economics of exploitation of mineral resources – international trade, price and policies, Environmental impact of resource exploitation

ABOUT INSTRUCTOR

Prof. M. K. Panigrahi, Department of Geology and Geophysics, Indian Institute of Technology, Kharagpur, is well known in the Indian Earth Science circle as an expert in Economic Geology and has contributed significantly to mineralization of copper, tin and gold in India. He has been teaching various courses in Economic Geology for the last 22 years & instructs a course on Mineral Resources with Lab to the 3rd Year students of Applied Geology and Exploration Geophysics that he thought would be good to disseminate to a larger population of students.

COURSE PLAN

Week 1: Introduction; Space - time distribution of mineral deposits; Spatial distribution of mineral deposits in the context of present day global tectonics.

Week 2 : Magmatic processes, Characteristics and Morphology of Deposits resulting from magmatism

Week 3 : Sedimentary processes – characteristics and morphology of resultant deposits

Week 4 : Hydrothermal processes - characteristics of hydrothermal ore fluids, sources, solubility of metals and mechanism of transport and deposition from fluids, characteristics of hydrothermal deposits

Week 5 : Hydrothermal processes associated with felsic magmatism, sedimentary basins, metamorphism, volcanism on the sea floor and volcanic islande – resultant deposits and their morphology

Week 6 : Introduction to Mineral Exploration – the four stage architecture (reconnaissance, detailed survey, target identification, exploratory drilling), Mineral deposits and mineral resource potentials of India

Week 7 : Geological, geochemical and geophysical methods of mineral exploration, Application of remote sensing in mineral exploration

Week 8 : Case studies of discoveries of important deposits across the world.(Gold, Diamond, porphyry copper, VMS, Uranium)

Week 9 : Economic classification of Mineral Resources; Elements of Mineral Economics; demand-supply relationships and changing global scenario, international trade, policies and cartels,

Week 10 : National Mineral Policy and Law of the Sea, Mineral resources in National Economy.

Week 11 : Mineral deposit project evaluation; estimation of ore reserve (conventional and geostatistical methods),

Week 12 : Environmental Impact of Mineral Resource Exploitation – exploration, mining, processing and post-processing scenarios.

CIVIL ENGINEERING

INTRODUCTION TO MINERAL PROCESSING

TYPE OF COURSE : New
PRE-REQUISITES : +2 Science
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Tentatively all mining companies like , NMDC, CIL, SAIL, IREL, UCIL, HZL , HCL, GMDC, APMDC, MPSMC, RSMML, HINDALCO etc. and equipment manufacturing companies like Weir Minerals Tega Industries, METSO, FL-Smidth, AllMinerals etc.

COURSE OUTLINE

Mineral processing is the first process that most ores undergo after mining in order to provide a more concentrated material for the procedures of extractive metallurgy. Although the primary operations are comminution and concentration, but there are other important operations in a modern mineral processing plant, including sizing, sampling and bulk material handling. This course is intended to provide a detailed understanding of the afore-mentioned operations.

ABOUT INSTRUCTOR

Prof. Arun Kumar Majumder is an Associate Professor in the Department of Mining Engineering of IIT Kharagpur. He is a PhD in Mineral Processing from the University of Queensland, Australia. Prior to joining the Department of Mining Engineering at IIT, Kharagpur in 2010, he had served AMPRI (CSIR), Bhopal since 1990 at various levels. He has carried out extensive and in-depth modeling work on complex coal and mineral processing unit operations. These models are developed based on sound fundamental concepts and they have strong industrial relevance too. The most significant aspect of his work is the identification of many problems at their roots first and then providing solutions elegantly. He has set up a new mineral engineering laboratory at IIT, Kharagpur with financial supports from industries.

COURSE PLAN

Week 1 : Importance of Mineral Processing

Week 2 : Particle Characterization

Week 3 : Comminution 1

Week 4 : Comminution 2

Week 5 : Industrial Screening

Week 6 : Movement of Solids in Fluids

Week 7 : Hydrocyclone

Week 8 : Gravity Concentration

Week 9 : Flotation

Week 10 : Bulk Material Storage and Handling

Week 11 : Slurry Transportation

Week 12 : Iron Ore Washing

CIVIL ENGINEERING

WATER ECONOMICS AND GOVERNANCE

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Jal Boards of various cities Companies working in water management sector, such as JUSCO, CH2MHill, Veolia Water, Phonix, WABAG etc

COURSE OUTLINE

Freshwater is fundamental to life, livelihood, and sustainable development. The issues related to the management of freshwater, are highly sensitive due to conflicts between financial, environmental, social and political viewpoints, and often needs multi-level governance involving various stakeholders.

ABOUT INSTRUCTOR

Prof. Manoj Kumar Tiwari, Department of School of Water Resources, Indian Institute of Technology, Kharagpur 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 coauthored several papers in apex international journals, and has presented his research in various top ranked conferences across the globe. Dr. Tiwari has over 7 years of teaching experience with both UG as well as PG level course.

COURSE PLAN

Week 1: Introduction: General outline; Water availability and uses: national and international scenario; Challenges in water management.

Week 2: Water Rights: Need of water rights; Water and sanitation in international law; Right to Water; Entitlements and criteria.

Week 3: Water Sustainability: Concept of sustainable water uses; The Dublin statement; Sustainable water management with economical, engineering, ecological and social viewpoints; Stakeholders' participation.

Week 4: Valuing Water: The use and non-use values of water; Valuation methods; Non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments.

Week 5: Water Pricing - Approach and Models: Significance of water pricing; Average and marginal cost pricing; Shortrun marginal cost pricing; Water pricing models - flat rate, uniform rate, increasing block tariff and seasonal rate models.

Week 6: Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, efficiency verses fairness in supply, development decisions verses capacity restrictions; Water pricing practices in India and abroad; relevant case studies.

Week 7: Economics of Water Projects: Economics of sectoral water allocation; Capital budgeting in water projects; Costs concepts of capital budgeting; Financial evaluation of water projects.

Week 8: Economic Evaluation Methods: Methods of project evaluation; Payback Period; Discounted Payback Period; Net Present Value; Internal Rate of Return; Average Rate of Return; Benefit-Cost Ratio.

Week 9: Water Governance: Elements and dimensions of water governance; Building blocks; Effective water governance schemes; Benchmarking water governance; Indicators of good governance.

Week 10: Water Governance in India: National water policies and water acts; Water regulatory authorities; Power and roles of central and state regulatory authorities; Legal and regulatory framework for hydro projects; Institutional arrangement and administrative controls of water service; Interstate water management initiatives; Stakeholders' participation; NGOs and social movements

Week 11: Water Disputes Management: Interstate and intrastate water disputes resolutions practices; Judiciary involvements; Tribunals for water disputes resolutions; Treaties and bilateral agreements; Environmental issues and disputes related to water resources projects; relevant case studies.

Week 12: Global Water Diplomacy: International freshwater agreements; Global water treaties and transboundary water agreements between the countries on international water resources; Multi-national water disputes and their resolution mechanisms; relevant case studies.

COMPUTER SCIENCE & ENGINEERING

COMPUTER SCIENCE & ENGINEERING

4weeks

01. Real time operating system
02. An introduction to Probability in computing

8weeks

01. Programming, data structures & algorithms using python
02. Introduction to haskell programming
03. Programming, data structures and algorithms using C
04. Database management system
05. Design and analysis of algorithms
06. Cloud computing
07. Data mining
08. Data science for Engineers
09. Introduction to human computer interaction
10. Information security - IV
11. Introduction to modern application development
12. Introduction to human computer interaction
13. Advanced graph theory
14. Wireless adhoc & sensor networks
15. AI : constraint satisfaction
16. Optimization Techniques for Digital VLSI Design

12weeks

01. Computer organization & architecture : a pedagogical aspect
02. Social network
03. Embedded systems design
04. Vlsi physical design
05. Cryptography and network security
06. Introduction to internet of things
07. Problem solving through programming in c
08. Synthesis of digital systems
09. Artificial intelligence : knowledge representation & reasoning
10. Introduction to machine learning
11. Reinforcement learning

REAL TIME OPERATING SYSTEM

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	C Programming, Operating Systems
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

In several software applications, especially in embedded application, the operating system is required to support the application to meet the timing constraints. The operating system achieves this by deploying suitable scheduling algorithms. A major problem arises, when the real-time tasks share resources. Priority inversions can take place in this case, unless suitable techniques are deployed. Starting with a brief introduction to real-time operating systems, we first discuss the important real-time task/thread scheduling algorithms and resource sharing protocols. An effort towards standardization of real-time operating systems has come to be known as POSIX-RT. We review POSIX-RT requirements. Besides, we review several commercial and open source real-time operating systems.

ABOUT INSTRUCTOR

Prof. Rajib Mall is Professor, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, West Bengal. He has more than a two decades of teaching experience in the areas of program analysis and testing. He has written five text books and over 150 refereed research papers.

COURSE PLAN

Week 1: Introduction

Week 2: Characteristics of real-time systems

Week 3: Modelling time constraints

Week 4: Basic concepts in real-time operating systems

COMPUTER SCIENCE & ENGINEERING

AN INTRODUCTION TO PROBABILITY IN COMPUTING

TYPE OF COURSE : New
PRE-REQUISITES : A course on design and analysis of algorithms is a required prerequisite.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : All companies that use machine learning, data science, data mining, and other randomized algorithm design.

COURSE OUTLINE

With the advent of machine learning, data mining, and many other modern applications of computer science, we are increasingly seeing the influence of probability theory on computer science. This course is aimed at providing a brief introduction to probability theory to CS students so that they can grasp recent CS trends more easily.

ABOUT INSTRUCTOR

Prof. John Augustine Department of Computer Science and Engineering Indian Institute of Technology Madras, earned his PhD in theoretical computer science in 2006 from the Donald Bren School of Information and Computer Science, University of California, Irvine, USA. Since then, his career has spanned both academia and industry. In 2011, he joined the Department of Computer Science and Engineering at IIT Madras, where he is currently an associate professor. His research interests are in designing and analyzing algorithms for foundational problems. In the last few years, he has been interested in designing randomized algorithms for distributed computing environments and employing probabilistic techniques to analyze them.

COURSE PLAN

Week 1 : A brief axiomatic introduction to discrete probability theory – Karger's Mincut

Week 2 : Random Variables – Quicksort

Week 3 : Markov's and Chebyshev's Inequalities – Randomized Median

Week 4 : Chernoff Bounds – Parameter Estimation & Quicksort Revisited

COMPUTER SCIENCE & ENGINEERING

INTRODUCTION TO MODERN APPLICATION DEVELOPMENT

TYPE OF COURSE : Rerun
PRE-REQUISITES : Fundamentals of JavaScript, the programming language of the Web, & Intro to JS: Drawing & Animation
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Technology companies like Amazon, Flipkart, Ola, PayTM, e-commerce companies, etcetera and also start-ups, where technology platforms are used to offer services.

COURSE OUTLINE

This course will cover the basics of the Internet, building a web application, databases, performance and security, and building a mobile application. In addition, the course will have an extensive set of Practical Tutorials which will help students get a feel for real-world development. IMAD offers opportunities for internships at Hasura for the course toppers, thus helping the best students hone their application development skills in the real world.

ABOUT INSTRUCTOR

Prof. Gaurav Raina Department of Computer Science & Engineering, IITMadras, is a faculty in the Department of Electrical Engineering at IIT Madras. His interests span from performance modelling of large scale systems like the Internet and transportation networks, to financial technologies.

Prof. Tanmai Gopal is the CTO & co-founder of Hasura, a core-tech startup. He is also a technology advisor to several early stage startups and is a passionate advocate for real-world programming education. He comes from a computer vision background with a Bachelors and a Masters in Computer Science from IIT Madras.

COURSE PLAN

The course content will be covered in 8 weeks. Each week of theoretical lectures will be followed by a practical, hands-on tutorial covering the concepts discussed in the previous week. These lectures will consist of programming experiments and assignments which will help the student gain a practical understanding of the ideas discussed before. The topics covered over the 8 weeks will be -

Introduction to the Internet
Building a web application
Databases
Performance and security
Building a mobile application

ADVANCED GRAPH THEORY

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Discrete Mathematics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Companies like Microsoft Research, Google,Facebook, LinkedIn and also start-ups are most eager to apply graph technology.

COURSE OUTLINE

Advanced Graph Theory focuses on problem solving using the most important notions of graph theory with an in-depth study of concepts on the applications in the field of computer science. This course provides an in-depth understanding of Graphs and fundamental principles and models underlying the theory, algorithms, and proof techniques in the field of Graph Theory. Emerging applications of Graph Theory in Computer Science domain will be covered for significant impact. Upon completing this course, students will have intimate knowledge about how the graph theory play an important role to solve the technology driven and research oriented problems.

ABOUT INSTRUCTOR

Prof. Rajiv Misra is an Associate Professor in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelor's of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile,Adhoc and Sensor Networks, Distributed Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 60 papers in high quality journals and conferences, and 2 book chapters.

COURSE PLAN

Week 1 : Basic Concepts: Graphs and digraphs, Incidence and adjacency matrices, isomorphism, the automorphism group.

Week 2 : Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger s theorem; Paths and Cycles:Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, The Travelling Salesman problem, diameter and maximum degree, shortest paths.

Week 3 : Trees: Equivalent definitions of trees and forests, Cayleys formula, the Matrix-Tree theorem, minimum spanning trees;

Week 4 : Matchings: Berges Theorem, perfect matchings, Halls theorem, Tuttes theorem, Konigs theorem, Petersens theorem, Algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tuttes f-factor theorem;

Week5 : Extremal problems: Independent sets and covering numbers, Turans theorem, Ramsey theorems; Colorings:Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number

Week 6 : Vizings theorem; Graphs on surfaces: Planar graphs, duality, Eulers formula, Kuratowskis theorem, toroidal graphs, 2-cell embeddings, graph on other surfaces;

Week 7 : Directed graphs: Tournaments, directed paths and cycles, Connectivity and strongly connected digraphs, branchings; Networks and flows: Flow cuts, Max flow min cut theorems, perfect square;

Week 8 : Selected topics: Dominating sets, The reconstruction problem, Intersection graphs, Perfect graphs, Random graphs.

WIRELESS ADHOC & SENSOR NETWORKS

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic concepts on Data Communications & Networking
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Wireless communication technologies are undergoing rapid advancements. The lastfew years have experienced a steep growth in teaching and research in the areas of wireless ad hoc and sensor networks. These networks have emerged to be attractive in many civilian and military applications and they hold great promises for our future. The attractiveness of ad hoc networks, in general, is attributed to their characteristics/features such as ability for infrastructure-less setup, minimal or no reliance on network planning and the ability of the nodes to self-organize and self-configure without the involvement of a centralized network manager, router, access point, or a switch.

ABOUT INSTRUCTOR

Prof. 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. His current research interests includes Wireless Ad Hoc and Sensor Networks, Internet of Things (IoT), Computer Networks, Learning Systems, and algorithm design for emerging communication networks.

COURSE PLAN

Week 1 : MANET (Introduction, Self-organizing behaviour, Co-operation)

Week 2 : MANET (MAC, Routing)

Week 3 : MANET (Multicast routing, Mobility model, Transport layer), Opportunistic Mobile Networks

Week 4 : Opportunistic Mobile Networks, UAV networks, Wireless Sensor Networks (Introduction)

Week 5: WSN (Coverage, Topology management), Mobile Sensor Networks

Week 6: WSN (MAC, Congestion control, Routing)

Week 7: WSN (Routing), Underwater WSN

Week 8: Security, Structure of sensor nodes

INTRODUCTION TO SOFT COMPUTING

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All IT companies, in general.

COURSE OUTLINE

Soft computing is an emerging approach to computing which parallel the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on some biological inspired methodologies such as genetics, evolution, ant's behaviors, particles swarming, human nervous systems, etc. Now, soft computing is the only solution when we don't have any mathematical modeling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, hand written character recondition, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.

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 : Introduction to Soft Computing, Introduction to Fuzzy logic,Fuzzy membership functions,Operations on Fuzzy sets

Week 2 : Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences

Week 3 : Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-I, Fuzzy logic controller-II

Week 4 : Solving optimization problems, Concept of GA, GA Operators: Encoding,GA Operators: Selection-I

Week 5 : GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation

Week 6 : Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I

Week 7 : MOEA Approaches: Pareto-II, Introduction to ANN, ANN Architecture

Week 8 : ANN Training-I, ANN Training-II, ANN Training-III, Applications of ANN

DATA MINING

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	TCS, Infosys, CTS, Accenture

COURSE OUTLINE

Data mining is study of algorithms for finding patterns in large data sets. It is an integral part of modern industry, where data from its operations and customers are mined for gaining business insight. It is also important in modern scientific endeavors. Data mining is an interdisciplinary topic involving, databases, machine learning and algorithms. The course will cover the fundamentals of data mining. It will explain the basic algorithms like data preprocessing, association rules, classification, clustering, sequence mining and visualization. It will also explain implementations in open source software. Finally, case studies on industrial problems will be demonstrated.

ABOUT INSTRUCTOR

Prof. Pabitra Mitra is an Associate Professor of Computer Science and Engineering at Indian Institute of Technology Kharagpur. He did his BTech in Electrical Engineering from IIT Kharagpur and PhD from ISI Calcutta. He was a Scientist at Centre for Artificial Intelligence and Robotics, Bangalore and an Assistant Professor at IIT Kanpur. He received the INAE Young engineer Award, IBM Faculty Award and Yahoo Faculty Award. He has authored a book on Data mining and about 50 papers in international journals.

COURSE PLAN

Week 1 : Introduction, Data Preprocessing

Week 2 : Association Rule Mining, Classification Basics

Week 3 : Decision Tree, Bayes Classifier, K nearest neighbor

Week 4 : Support Vector Machine, Kernel Machine

Week 5 : Clustering, Outlier detection

Week 6 : Sequence mining

Week 7 : Evaluation, Visualization.

Week 8 : Case studies

DATABASE MANAGEMENT SYSTEM

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Knowledge of Programming, Data Structure & Algorithms
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS Infosys, Amazon, Flipkart, etc.

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 Department of Computer Science and Engineering, IIT Kharagpur, received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in 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 1 : Relational Databases: Introduction to the Relational Model, Introduction to SQL, Intermediate SQL, Advanced SQL, Formal Relational Query Languages

Week 2 : Relational Databases: Contd.

Week 3 : Database Design: The Entity-Relationship Approach, Relational Database Design, Application Design

Week 4 : Database Design: Contd.

Week 5 : Data Storage and Querying: Storage and File Structure, Indexing and Hashing, Query Processing, Query Optimization

Week 6 : Transaction Management: Transactions, Concurrency Control, recovery Systems

Week 7 : System Architecture: Database System Architectures, Parallel & Distributed Databases Specialty Databases: Object-Based Databases, XML

Week 8 : DBMS Case Studies: PostgreSQL, Application Case Studies: Student Academic Management

CLOUD COMPUTING

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Basics of Computer Architecture and Organization Networking
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	IT industries

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

AI : CONSTRAINT SATISFACTION

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Exposure to AI: Search Methods for Problem Solving and AI: Knowledge Representation & Reasoning helps, but is not necessary..
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Software companies dealing with artificial intelligence applications

COURSE OUTLINE

Human beings solve problems in many different ways. Problem solving in artificial intelligence (AI) is inspired from these diverse approaches. AI problem solvers may be based on search, on memory, or on knowledge representation and reasoning. An approach to problem solving is to pose problems as constraint satisfaction problems (CSP), and employ general methods to solve them. The task of a user then is only to pose a problem as a CSP, and then call an off-the-shelf solver. CSPs are amenable to combining search based methods with reasoning. In this 2 credit course we will look at general approaches to solving finite domain CSPs, and explore how search can be combined with constraint propagation to find solutions.

ABOUT INSTRUCTOR

Prof.Deepak Khemani, Department of Computer Science and Engineering, IIT Madras 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 youngest IIT at Mandi. He has had shorter stays at several Computing departments in Europe. Prof Khemani's long-term goals are to build articulate problem solving systems using AI that can interact with human beings. His research interests include Memory Based Reasoning, Knowledge Representation and Reasoning, Planning and Constraint Satisfaction, Qualitative Reasoning and Natural Language Processing.

COURSE PLAN

Week 1: Constraint satisfaction problems (CSP), examples.

Week 2: Constraint networks, equivalent and projection networks.

Week 3: Constraint propagation, arc consistency, path consistency, i-consistency.

Week 4: Directional consistency and graph ordering, backtrack free search, adaptive consistency.

Week 5: Search methods for solving CSPs, lookahead methods, dynamic variable and value ordering.

Week 6: Lookback methods, Gaschnig's backjumping, graph based backjumping, conflict directed back jumping. Combing lookahead with lookback, learning.

Week 7: Model based systems, model based diagnosis, truth maintenance systems, planning as CSP. Wrapping up.

DESIGN AND ANALYSIS OF ALGORITHMS

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Exposure to introductory courses on programming and data structures.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : 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

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. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals. He is President of both the Indian Association for Research in Computing Science (IARCS) and the ACM India Council. He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

COURSE PLAN

Week 1 : Introduction, Examples and motivation, Examples and motivation, Asymptotic complexity: informal concepts Asymptotic complexity: formal notation, Asymptotic complexity: examples, Assignments MCQ/Fill in blanks (unique answer)

Week 2 : Searching in list: binary search, Sorting: insertion sort, Sorting: selection sort, Sorting: merge sort, Sorting: quicksort Sorting: stability and other issues, Assignments MCQ/Fill in blanks, programming assignment

Week 3 : Graphs: Motivation, Graph exploration: BFS, Graph exploration: DFS, DFS numbering and applications, Directed acyclic graphs, Directed acyclic graphs, Assignments MCQ/Fill in blanks, programming assignment

Week 4 : Shortest paths: unweighted and weighted, Single source shortest paths: Dijkstra, Single source shortest paths: Dijkstra, Minimum cost spanning trees: Prim's algorithm, Minimum cost spanning trees: Kruskal's Algorithm, Union-Find data structure, Assignments MCQ/Fill in blanks, programming assignment

Week 5 : Divide and conquer: counting inversions, Divide and conquer: nearest pair of points, Priority queues, heaps Priority queues, heaps, Dijstra/Prims revisited using heaps, Search Trees: Introduction Assignments MCQ/Fill in blanks, programming assignment

Week 6 : Search Trees: Traversals, insertions, deletions, Search Trees: Balancing, Greedy : Interval scheduling Greedy : Proof strategies, Greedy : Huffman coding, Dynamic Programming: weighted interval scheduling Assignments MCQ/Fill in blanks, programming assignment

Week 7 : Dynamic Programming: memoization, Dynamic Programming: edit distance, Dynamic Programming: longest ascending subsequence, Dynamic Programming: matrix multiplication, Dynamic Programming: shortest paths: Bellman Ford, Dynamic Programming: shortest paths: Floyd Warshall, Assignments MCQ/Fill in blanks, programming assignment

Week 8 : Intractability: NP completeness, Intractability: reductions, Intractability: examples, Intractability: more examples Misc topics; Misc Topics MCQ/Fill in blanks

PROGRAMMING, DATA STRUCTURES & ALGORITHMS USING PYTHON

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	School level mathematics.
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	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

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. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals. He is President of both the Indian Association for Research in Computing Science (IARCS) and the ACM India Council. He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

COURSE PLAN

Week 1 : Informal introduction to programmin, algorithms and data structures viagcd, Downloading and installing Python gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions

Week 2 : 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 3 : Basic algorithmic analysis: input size, asymptotic complexity, O() notation, Arrays vs lists, Merge sort, Quicksort Stable sorting

Week 4 : Dictionaries, More on Python functions: optional arguments, default values, Passing functions as arguments Higher order functions on lists: map, lter, list comprehension

Week 5 : Exception handling, Basic input/output, Handling files, String processing

Week 6 : Backtracking: N Queens, recording all solutions, Scope in Python: local, global, nonlocal names, Nested functions Data structures: stack, queue ,Heaps

Week 7 : Abstract datatypes, Classes and objects in Python, "Linked" lists: find, insert, delete, Binary search trees: find, insert, delete Height-balanced binary search trees

Week 8 : Effcient evaluation of recursive denitions: memoization, Dynamic programming: examples, Other programming languages: C and manual memory management, Other programming paradigms: functional programming.

COMPUTER SCIENCE & ENGINEERING

INTRODUCTION TO HASKELL PROGRAMMING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Would be useful in any industry requiring a good understanding of programming, algorithms and data structures.

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 polymorphim

Week 5 : Higher order functions on lists: map, filter, list comprehension

Week 6 : Computation as rewriting, lazy evaluation and infinite data structures

Week 7 : onditional polymorphism and type classes

Week 8 : User defined datatypes: lists, queues, trees; Input/output and the ghc compiler; Arrays

COMPUTER SCIENCE & ENGINEERING

INTRODUCTION TO HUMAN COMPUTER INTERACTION

TYPE OF COURSE : New
PRE-REQUISITES : Interest in interfaces, curiosity in fixing interface issues
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : 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 doesn't this thing I just bought work? Why is this web site so hard to use? Why is the phone app so confusing? Why do users not like 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-ComputerInteraction, this is the course for you.

ABOUT INSTRUCTOR

Prof. Ponnurangam Kumaraguru Associate Professor, Department of Computer Science, Indraprastha Institute of Information Technology, Delhi 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 Privacy, e-Crime, Online Social Media, and Usable Security, in particular, these days he has been dabbling with complex networked systems (e.g. social web systems like Twitter, Facebook, and telephone logs).

COURSE PLAN

Week 1 : Components of HCI Types of interfaces Design process

Week 2 : Contextual inquiry Importance of users / talking to users Task analysis

Week 3 : Sketching Low & hi fidelity prototyping

Week 4 : Mental models

Week 5 : Usability evaluation Think aloud, observing users Modelling users, expert evaluations

Week 6 : Information visualization

Week 7 : HCI & mobility New faces of HCI

Week 8 : Refresher for all modules seen in the course.

COMPUTER SCIENCE & ENGINEERING

OPTIMIZATION TECHNIQUES FOR DIGITAL VLSI DESIGN

TYPE OF COURSE : New
PRE-REQUISITES : Basic knowledge of electronic design automation (EDA), digital design
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Synopsys, Cadence, Mentor Graphics, Intel, Samsung, etc.

COURSE OUTLINE

Digital VLSI Design flow comprises three basic phases: Design, Verification and Test. This course will give a brief overview of the VLSI design flow. The primary emphasis of the course is to introduce the important optimization techniques applied in the Industry level electronic design automation (EDA) tools in the VLSI design flow. This course is unique in the sense that it will give a comprehensive idea about the widely used optimization techniques and their impact the generated hardware.

ABOUT INSTRUCTOR

Prof. Chandan Karfa, is an Assistant Professor in the Dept. of CSE, IIT Guwahati. He has worked for five years as Senior R&D engineer in EDA Industry. He has also one and half years of teaching experience. His research interests include High-level Synthesis, CAD for VLSI and Formal Verification.

Prof. Santosh Biswas, is an Associate Professor in the Dept. of CSE IIT Guwahati. He has an experience of 8 years in teaching. His research interests are Fault Tolerance, VLSI Testing, Embedded Systems.

COURSE PLAN

Module 1 : Introduction and High-level Synthesis

Module 2 : Logic Synthesis and Physical Synthesis

Module 3 : RTL Optimizations

Module 4 : VLSI Testing

Module 5 : Verification

INFORMATION SECURITY - IV

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Basic Programming skills
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	• TCS • INFOSYS • Wipro • Inautix • CTS • Polaris

COURSE OUTLINE

This Course is part 4 of the series on information security. Part 1-3 have been offered previously and contents are available on nptel.ac.in for viewing. In this course we will start with kali Linux, learn about port scanning and move on to web application scanning and conculude with network forensis.

ABOUT INSTRUCTOR

Prof. V. Kamakoti Department of Computer Science Engineering, Indian Institute of Technology, Madras, specializes in the area of Computer Architecture and Secure Hardware Design. He is an advisor for many security critical organizations including Banking Institutions. He completed his Master of Science (By research) and PhD at the Department of Computer Science and Engineering, IIT Madras in the years 1992 and 1995 respectively.

Prof. M J Shankar Raman completed his BE (Computer Science and Engineering) from Sri Venkateswara College of Engineering, University of Madras. He obtained his M Sc (Engineering) from Indian Institute of Science Bangalore, and Ph. D. from Indian Institute of Technology Madras.

Prof. Vasan holds an undergraduate and masters degree from BITS Pilani and has been working in the IT Industry for close to 25 years now. Vasan has been working with different leading IT companies in many capacities both in India and abroad in the areas of network management, network appliance development and security domains. He has been working close to 7 years with Cisco Systems and have been part of the engineering of different Cisco products.

COURSE PLAN

Week 1 : Short evaluation on scripting, Networking basics (Contents of IS L3) - Introduction to Kali Linux

Week 2 : Layer 2 and Layer 3 Discovery using Kali Linux with demo/practice

Week 3 : Layer 4 discovery using Kali Linux with demo/practice – Port scanning feature in Kali Linux with demo/practice

Week 4 : Finger printing (Specific OS details and vulnerabilities) in Kali Linux with demo/practice

Week 5 : DoS and Web Application Scanning in Kali Linux with Demo/practice - Automating Kali Linux with tools

Week 6 : Network Forensics: An introduction and acquisition of evidence - Analysis and tools of network packets and flows

Week 7 : Unplugged: Wireless Network Forensics Tools and Scripts - Network Forensics: Intrusion and Detection using Snort tool

Week 8 : Network Forensics: Network devices (Switches,Routers, Firewalls) and Proxies

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING C

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This is a course on programming, data structures and algorithms. The learner is assumed to have no prior experience of programming, but is expected to be at the level of a second year undergraduate college student in science or engineering. The course will run over 8 weeks with about 2-3 hours of lectures per week. At the end of each week, the learner is expected to write some programs and submit them for grading. These programming problems are classified as easy, moderate or difficult. The easy problems, typically, are repeats from the lecture. The moderate and difficult ones will require increasing levels of initiative from the learner. In addition, at the end of each week the learner is expected to answer a set of objective-type assessment questions.

ABOUT INSTRUCTOR

Prof. Sudarshan Iyengar, Department of Computer Science & Engineering , IIT Ropar 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 from the past 4 years.

The Video content was originally developed by Prof. Hema Murthy & Prof. Narayanaswamy, Faculty in Deptartment of CSE, IIT Madras along with Dr. Shankar Balachandran who is currently working in Research division of Intel.

COURSE PLAN

Week 1: Introduction to Computers and Programming,Writing your first program, Variables and operators and expressions, Variable declarations, more operators, precedence, Input, Output Statements, Conditionals, Loops

Week 2: Arrays and Multidimensional arrays, Pointers

Week 3: Functions, Running time of a program, Computing time complexity

Week 4: Polynomial evaluation and multiplication, Searching: Linear and Binary, Finding minimum and maximum, Sorting I: Insertion, Merge, Sorting II: Counting, Radix, Finding i-th smallest number

Week 5: Structures and User-defined data types, Brief introduction to C++: Classes and objects, Data Structures: Abstract Data Type

Week 6: Lists, Stacks: Last In First Out, Queues: First In First Out, Trees, Tree traversal, Heaps, Graphs and Representation

Week 7: Greedy algorithms, Dynamic programming, Matrix Chain Multiplication

Week 8: Dijkstra's Algorithm, Strings, Boyer-Moore String Matching Algorithm, File I/O, Modular Programming

DATA SCIENCE FOR ENGINEERS

COMPUTER SCIENCE & ENGINEERING

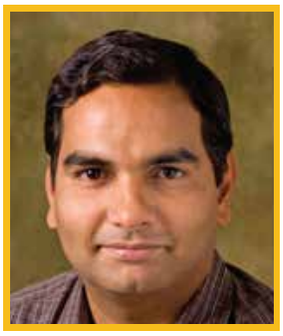
TYPE OF COURSE : New
PRE-REQUISITES : 10 hrs of pre-course material on R will be provided. Participants need to practice this.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Honeywell, ABB, Ford, Gyan Data pvt. Ltd.

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



Prof. Raghunathan Rengasamy, currently Professor at Department of Chemical Engg Indian Institute of Technology, Madras 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 : Statistics (Understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)
Week 5 : 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

COMPUTER ORGANIZATION & ARCHITECTURE : A PEDAGOGICAL ASPECT

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Digital Design.
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	Processor design industry like Intel, AMD, etc.

COURSE OUTLINE

Computer Organization and Architecture (COA) is a core course in the curricula of Computer Sciences as well as Electronics and Electrical Engineering disciplines at the second-year level in most of the Indian universities and technical institutions. This is the first course in COA and the course would provide students with an understanding of the design of fundamental blocks used for building a computer system and interfacing techniques of these blocks to achieve different configurations of an "entire computer system".

ABOUT INSTRUCTOR

Prof. Santosh Biswas is an Associate Professor in the Dept. of CSE IIT Guwahati. He has an experience of 8 years in teaching. His research interests are Fault Tolerance, VLSI Testing, Embedded Systems.

Prof. J K Deka is a Professor in the Dept. of CSE IIT Guwahati. He has an experience of more than 20 years in teaching. His research interests are Formal Modelling and Verification, CAD for VLSI and Embedded Systems (Design, Testing and Verification), Data Mining.

Prof. Arnab Sarkar is an Asst. Professor in the Dept. of CSE IIT Guwahati. He has an experience of 3 years in teaching and about 2 years in industry. His research interests Real-Time and Embedded Systems, Computer Architecture, Algorithms.

COURSE PLAN

Week 1 : Basics: Functional Blocks in a Computer System, Number system and Computer Arithmetic
Week 2 : Addressing Modes, Instruction Set and Instruction Execution Flow
Week 3 : Addressing Modes, Instruction Set and Instruction Execution Flow
Week 4 : Addressing Modes, Instruction Set and Instruction Execution Flow
Week 5 : Hardware and Micro-program based control Unit Design
Week 6 : Hardware and Micro-program based control Unit Design
Week 7 : Hardware and Micro-program based control Unit Design
Week 8 : Memory Architecture
Week 9 : Memory Architecture
Week 10 : Peripherals and Input-Output
Week 11 : Peripherals and Input-Output
Week 12 : Performance Enhancement of Processor
Week 13 : Performance Enhancement of Processor

SOCIAL NETWORKS

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : The course doesn't assume any pre-requisites. We expect one has undergone a first course in basic programming.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Modeling the Networks of Organizations Understanding Customer Interaction etc.,

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

Prof. Sudarshan Iyengar, Department of Computer Science & Engineering , IIT Ropar 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, crowd sourced knowledge building and computational social sciences. His current research proects are "Predicting a Viral meme" (Yayati Gupta), "Understanding Crowd sourced Knowledge building" (Anamika Chhabra - Scientist), "Secure Computation" (Varsha Bhat) and "Network Sampling" (Akrati Saxena). After research, teaching makes the major component of his academic life. He enjoys experimenting with different teaching methodologies.

COURSE PLAN

Week 1: Introduction

Week 2: Handling Real-world Network Datasets

Week 3: Strength of Weak Ties

Week 4: Strong and Weak Relationships (Continued) & Homophily

Week 5: Homophily Continued and +Ve / -Ve Relationships

Week 6: Link Analysis

Week 7: Cascading Behaviour in Networks

Week 8: Link Analysis (Continued)

Week 9: 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)

EMBEDDED SYSTEMS DESIGN

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Computer Organization, Basic of Microprocessors
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	Any industry working in the area of Embedded Systems

COURSE OUTLINE

This course on Embedded systems will highlight to the students the fundamental requirements of embedded systems and the interaction between hardware and software in such systems. Next the course will discuss some basic steps of hardware design, introduce the students to ASIPs, ASICs and FPGAs. Next, the students will be exposed to the very important issue of designing for less power consumption and introduce them to the techniques that are adopted to this end.

ABOUT INSTRUCTOR

Prof. 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.

COURSE PLAN

Week 1: Introduction to Embedded System, ASICs and ASIPs

Week 2: Designing Single Purpose Processors and Optimization

Week 3: Introduction to FPGAs and Synthesis

Week 4: Verilog Hardware Description Language (Verilog HDL)

Week 5: Microcontrollers and Power Aware Embedded System Design

Week 6: Real Time Operating System

Week 7: Real Time Scheduling Algorithms

Week 8: Modelling and Specification

Week 9: Design Synthesis

Week 10: Digital Camera Design and Hardware Software Partitioning

Week 11: Design Optimization

Week 12: Simulation and Verification

VLSI PHYSICAL DESIGN

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic concepts in digital circuit design
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Intel, Cadence, Mentor Graphics, Synopsys, Xilinx

COURSE OUTLINE

The course will introduce the participants to the basic design flow in VLSI physical design automation, the basic data structures and algorithms used for implementing the same. The course will also provide examples and assignments to help the participants to understand the concepts involved, and appreciate the main challenges there in.

ABOUT INSTRUCTOR

Prof. Indranil Sengupta, Department of Computer Science & Engineering, IIT Kharagpur has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Head 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. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

COURSE PLAN

Week 1 : Introduction to physical design automation

Week 2 : Partitioning, Floorplanning and Placement

Week 3 : Grid Routing and Global Routing

Week 4 : Detailed Routing and Clock Design

Week 5 : Clock Routing and Power/Ground

Week 6 : Static Timing Analysis and Timing Closure

Week 7 : Physical Synthesis and Performance Driven Design Flow

Week 8 : Interconnect Modeling and Layout Compaction

Week 9 : Introduction to Testing, Fault Modeling and Simulation

Week 10 : Test Pattern Generation, DFT and BIST

Week 11 : Low Power Design Techniques

Week 12 : Low Power Design Techniques (contd.)

CRYPTOGRAPHY AND NETWORK SECURITY

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : IT companies, DRDO, ISRO, NEVY.

COURSE OUTLINE

The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. This course develops a basic understanding of the algorithms used to protect users online and to understand some of the design choices behind these algorithms. Our aim is to develop a workable knowledge of the mathematics used in cryptology in this course. The course emphasizes to give a basic understanding of previous attacks on cryptosystems with the aim of preventing future attacks.

ABOUT INSTRUCTOR

Prof. Sourav Mukhopadhyay, is an Associate Professor Department of Computer Science & Engineering, IIT Kharagpur, He has completed his B.Sc (Honours in Mathematics) in1997 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 fellows and a part time Lecturer with School of Electronic Engineering, Dublin City University (DCU), Ireland.

COURSE PLAN

Week 1: Introduction to cryptography, Classical Cryptosystem, Cryptanalysis on Substitution Cipher (Frequency Analysis), Play fair Cipher, Block Cipher.

Week 2: Data Encryption Standard (DES), DES (Contd.), Triple DES, Modes of Operation, Stream Cipher, Pseudorandom Sequence.

Week 3: LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory.

Week 4: Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Eular Phi-Function, Eular's theorem, Quadratic Residue, Polynomial Arithmetic.

Week 5: Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem.

Week 6: Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals, Elliptic curve Modulo a Prime.

Week 7: Generalised ElGamal Public Key Cryptosystem, Chinese Remainder Theorem, Rabin Cryptosystem, Legendre and Jacobi Symbol.

Week 8: Message Authentication, Digital Signature, Key Management, Hash Function

Week 9: Universal Hashing, Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS), More on Key Exchange Protocol.

Week 10: Cryptanalysis, Time-Memory Trade-off Attack, Differential Cryptanalysis, More on Differential Cryptanalysis, Linear Cryptanalysis

Week 11: Solving discrete log problem, Algebraic Attack, Implementation Attacks, side channel attack.

Week 12: Internetwork Security, SSL, PGP, Cloud Security

INTRODUCTION TO INTERNET OF THINGS

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic programming knowledge
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

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

Prof. 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 1: Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I

Week 2: Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II

Week 3: Communication Protocols: Part III, Part IV, Part V, Sensor Networks: Part I, Part II

Week 4: Sensor Networks: Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications

Week 5: Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II

Week 6: Introduction to Python programming: Part I, Part II, Introduction to Raspberry Pi: Part I, Part II, Implementation of IoT with Raspberry Pi: Part I

Week 7: Implementation of IoT with Raspberry Pi: Part II, Part III, Introduction to SDN: Part I, Part II, SDN for IoT: Part I

Week 8: SDN for IoT: Part II, Data Handling and Analytics: Part I, Part II, Cloud Computing: Part I, Part II

Week 9: Cloud Computing: Part III, Part IV, Part V, Sensor-Cloud: Part I, Part II

Week 10: Fog Computing: Part I, Part II, Smart Cities and Smart Homes: Part I, Part II, Part III

Week 11: Connected Vehicles: Part I, Part II, Smart Grid: Part 1, Part II, Industrial IoT: Part I

Week 12: Industrial IoT: Part I, Case Study: Agriculture, Healthcare, Activity Monitoring: Part I, Part II

PROBLEM SOLVING THROUGH PROGRAMMING IN C

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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 rot finding of function, differentiation of function and simple integration

ABOUT INSTRUCTOR

Prof. Anupam Basu Department 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. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contribution to the Cause of Empowerment of the Disabled (2014), Universal Design Award 2011, for contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

COURSE PLAN

Week 1 : Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, The compilation process, Syntax and Semantic errors, Variables and Data Types

Week 2 : Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional Branching

Week 3 : Conditional Branching and Iterative Loops

Week 4 : Arranging things : Arrays

Week 5 : 2-D arrays, Character Arrays and Strings

Week 6 : Basic Algorithms including Numerical Algorithms

Week 7 : Functions and Parameter Passing by Value

Week 8 : Passing Arrays to Functions, Call by Reference

Week 9 : Recursion

Week 10 : Structures and Pointers

Week 11 : Self-Referential Structures and Introduction to Lists

Week 12 : Advanced Topics

SYNTHESIS OF DIGITAL SYSTEMS

COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : 1. Digital Design (or Logic Design) 2. Data Structures
COURSE DURATION : 12 weeks
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

COMPUTER SCIENCE & ENGINEERING

ARTIFICIAL INTELLIGENCE : KNOWLEDGE REPRESENTATION & REASONING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Some exposure to formal languages, logic and programming
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Software companies dealing with knowledge and reasoning, including the semantic web and semantic search.

COURSE OUTLINE

An intelligent agent needs to be able to solve problems in its world. The ability to create representations of the domain of interest and reason with these representations is a key to intelligence. In this course we explore a variety of representation formalisms and the associated algorithms for reasoning. We start with a simple language of propositions, and move on to first order logic, and then to representations for reasoning about action, change, situations, and about other agents in incomplete information situations. This course is a companion to the course "Artificial Intelligence: Search Methods for Problem Solving" that was offered recently and the lectures for which are available on nptel.ac.in

ABOUT INSTRUCTOR

Prof. 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 youngest IIT at Mandi. He has had shorter stays at several Computing departments in Europe. Prof Khemani's long-term goals are to build articulate problem solving systems using AI that can interact with human beings. His research interests include Memory Based Reasoning, Knowledge Representation and Reasoning, Planning and Constraint Satisfaction, Qualitative Reasoning and Natural Language Processing.

COURSE PLAN

Week 1 : Introduction, Propositional Logic, Syntax and Semantics
Week 2 : Proof Systems, Natural Deduction, Tableau Method, Resolution Method
Week 3 : First Order Logic (FOL), Syntax and Semantics, Unification, Forward Chaining
Week 4 : The Rete Algorithm, Rete example, Programming Rule Based Systems
Week 5 : Representation in FOL, Categories and Properties, Reification, Event Calculus
Week 6 : Conceptual Dependency (CD) Theory, Understanding Natural Language
Week 7 : Deductive Retrieval, Backward Chaining, Logic Programming with Prolog
Week 8 : Resolution Refutation in FOL, FOL with Equality, Complexity of Theorem Proving
Week 9 : Semantic Nets, Frames, Scripts, Goals and Plans
Week 10 : Description Logic (DL), Structure Matching, Classification
Week 11 : Extensions of DL, The ALC Language, Inheritance in Taxonomies
Week 12 : Default Reasoning, Circumscription, The Event Calculus Revisited
Week 13 : Default Logic, Autoepistemic Logic, Epistemic Logic, Multi Agent Scenarios

INTRODUCTION TO MACHINE LEARNING

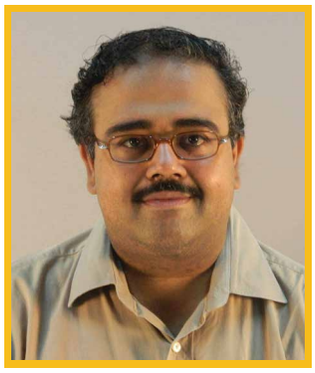
COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Programming & Basis of Statistics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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)

REINFORCEMENT LEARNING

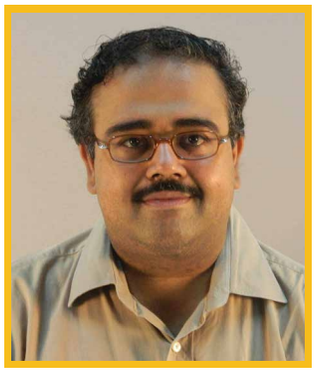
COMPUTER SCIENCE & ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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

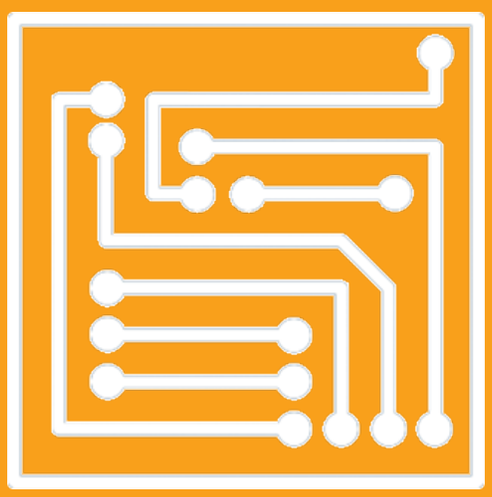
Week 8 : Function Approximation

Week 9 : Least Squares Methods

Week 10 : Fitted Q, DQN & Policy Gradient for Full RL

Week 11 : Hierarchical RL

Week 12 : POMDPs



ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING

4weeks

01. Basics of software-defined radios and practical applications

8weeks

01. Analog circuits
02. Digital switching - I
03. An introduction to coding theory
04. Electronics enclosures thermal issues
05. Probability foundations for electrical engineers

12weeks

01. Antennas
02. Analog IC design
03. Basic electronics
04. Control engineering
05. Electromagnetic theory
06. Power system engineering
07. Biomedical signal processing
08. Principles of signals and systems
09. Industrial automation & control
10. Microprocessors & microcontrollers
11. Deep learning for visual computing
12. Principles of communication systems- I
13. Mathematical methods & techniques in signal processing
14. Integrated circuits, mosfets op-amps and their applications

BASICS OF SOFTWARE-DEFINED RADIOS AND PRACTICAL APPLICATIONS

ELECTRICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	It is an elective course for UG and PG both.
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	Telecommunication Industry (BEL), Defence Industry (DRDO), Aeronautical Industry, and Space Organization (ISRO).

COURSE OUTLINE

Software-defined radio (SDR) is an inherent part of modern communication system, where many processes, which used to be implemented in hardware, are defined in software domain for flexibility and configurability. This course describes various components of software-defined-radios with the understanding of their limitation and application of 'software-defined-solutions' to overcome such limitations. Understanding the interplay of analog and digital signal processing for power as well as spectrum efficient transmission and reception of signal leads to an optimized, yet, practical radio solution. This course will allow students to understand (1) the terminology used in industrial data-sheets and (2) motivation for selecting appropriate commercial solutions for a practical transceiver design.

ABOUT INSTRUCTOR

Prof. Meenakshi Rawat, Department of Electronics & Communication Engineering, Indian Institute of Technology, Roorkee received the BTech degree in electrical engineering from the GovindBallabh Pant University of Agriculture and Technology, Uttarakhand, India, in 2006, and the MSc and PhD degrees in electrical and computer engineering from the University of Calgary, Calgary, AB, Canada, in 2012. From September 2012 to June 2013, she was a Post-Doctoral Research Fellow with the University of Calgary. From July 2013 to June 2014, she was a Post-Doctoral Project Researcher/Scientist with the Ohio State University. She is currently an Assistant Professor with the Indian Institute of Technology (IIT), Roorkee, Uttarakhand, India.

COURSE PLAN

Week1: Basic components of software defined radios, Software defined radio architectures-Part A, Software defined radio architectures- Part B

Week2: Distortion parameters-Sources and metrics of distortion in a transceiver,Nonlinear distortion and nonlinearity specifications, Power amplifiers: Nonlinear Distortion in Transmitted Signals

Week3: Power amplifier Line-up for linearity & power requirement calculations,Linearization Techniques for nonlinear distortion in SDR, Predistortion Techniques for nonlinear distortion in SDR

Week4: Digital Predistortion Techniques for Linear/Nonlinear Distortion

ANALOG CIRCUITS

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course is designed as the introductory course on Analog Circuits for undergraduate students. It covers the basic components and methodologies used for Analog Design. Most of the portion deals with OPAMP based circuits. Later in the course some BJT based circuits are discussed.

ABOUT INSTRUCTOR

Prof. Jayanta Mukherjee is a Professor in the Electrical Engineering Department of IIT Bombay. He did his PhD from The Ohio State University, Columbus Ohio in Electrical and computer Engineering in 2006. His research interests lie in high frequency Passive and Active Circuit Design. He has published a number of papers in top ranked Journals and Conferences and also has a number of patents. He has taught the course "Analog Circuits" a number of times at IIT Bombay. The course material developed for this NPTEL MOOCS course are mainly derived from the teaching materials developed for the course that he has taught.

COURSE PLAN

Week 1 : Introduction, Poles and Zeros, Ideal Opamp, Applications of OPAMP – Inverting and Non Inverting Amplifier

Week 2 : Applications of OPAMP (..Contd) – Summer Amplifier, Difference Amplifier, Integrator, Differentiator

Week 3 : Non Idealities in an OPAMP – Finite Gain, Bandwidth, Slew Rate, Saturation, Offset Voltage, Bias Current

Week 4 : Bode Plots, Frequency Response, Millers Theorem, Feedback, Effect of Feedback

Week 5 : Stability, Nyquist Plot, Phase Margin, Gain margin, Frequency Compensation

Week 6 : Filter Design, Butterworth and Chebyshev Filters Non Linear Applications of Filters – Limiters, Oscillators, Multivibrators

Week 7 : Diodes, Basic BJT Circuits

Week 8 : Basic BJT based circuits

ELECTRICAL ENGINEERING

DIGITAL SWITCHING - I

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of Digital Communications, and Digital Communication Networks.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : 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) 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 rearrangebly 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), Computional analysis.

ELECTRICAL ENGINEERING

AN INTRODUCTION TO CODING THEORY

TYPE OF COURSE : Rerun
PRE-REQUISITES : Linear algebra, probability & digital communications theory
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Telecommunication Companies

COURSE OUTLINE

Error control coding is an indispensible part of any digital communication system. In this introductory course, we will discuss theory of linear block codes and convolutional codes, their encoding and decoding techniques as well as their applications in real world scenarios. Starting from simple repetition codes, we will discuss among other codes: Hamming codes, Reed Muller codes, low density parity check codes, and turbo codes. We will also study how from simple codes by concatenation we can build more powerful error correcting codes.

ABOUT INSTRUCTOR

Prof. Adrish Banerjee, Department of Electrical Engineering Indian Institute of Technology, Kanpur received his Bachelors degree from Indian Institute of Technology, Kharagpur and Masters and Ph.D. degree from University of Notre Dame, Indiana. He is currently an Associate Professor in the Department of Electrical Engineering at Indian Institute of Technology, Kanpur. He is a recipient of Microsoft Research India young faculty award, Institute of Engineers India young engineer award, and IETE Prof. K. Sreenivasan memorial award. His research interests are in the physical layer aspects of wireless communications, particularly green communications, error control coding, and cognitive radio.

COURSE PLAN

Week 1 : Introduction to error control coding; Introduction to linear block codes, generator matrix and parity check matrix; Properties of linear block codes: Syndrome, error detection

Week 2 : Decoding of linear block codes; Distance properties of linear block codes

Week 3 : Some simple linear block codes: Repetition codes, Single parity check codes, Hamming codes, Reed Muller codes; Bounds on size of codes: Hamming bound, Singleton bound, Plotkin bound, Gilbert-Varshamov bound

Week 4 : Introduction to convolutional codes-I: Encoding, state diagram, trellis diagram; Introduction to convolutional codes-II: Classification, realization, distance properties; Decoding of convolutional codes-I: Viterbi algorithm

Week 5 : Decoding of convolutional codes-II: BCJR algorithm; Performance bounds for convolutional codes

Week 6 : Low density parity check codes; Decoding of low density parity check codes: Belief propagation algorithm on BSC and AWGN channels

Week 7 : Turbo codes; Turbo decoding

Week 8 : Distance properties of turbo codes; Convergence of turbo codes ; Automatic repeat request schemes Applications of linear codes

ELECTRONICS ENCLOSURES THERMAL ISSUES

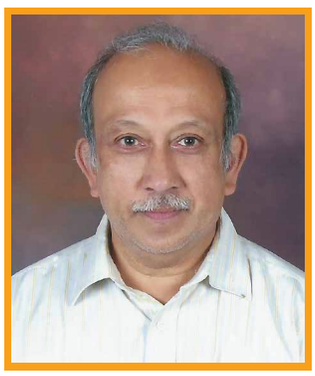
ELECTRICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	12th Standard
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	Electronics and Mechanical involved in enclosure Design

COURSE OUTLINE

Electronics Design is understood as analysis and implementation at various levels from large systems installation to chip design. One of the aspects is failure due to temperature effects is constantly under study. Theory of Heat transfer has been understood and explained way back in 1700. Rigor and precision has resulted in seemingly complicated 'equations'. In the design of enclosures, managing heat is (relatively) well understood. Empirical results can be used to optimise the layout and reduce failure. Practices in use of heat management hardware are available from specialist manufacturers and can be used. This course is an attempt to familiarise the participating registrants with heat related issues in Design of Electronic Product enclosures.

ABOUT INSTRUCTOR



Prof. NV Chalapathi Rao Department of Electronic Systems Engineering, Indian Institute of Science, Bangalore, NV Chalapathi Rao is a B.E. in Mechanical Engineering (1972) from Andhra University, Waltair. Worked in Bharat Electronics Ltd for 10 years designing electronics products for defense. Has a PGDM (MBA) 78-80 from IIM Bangalore. Has been teaching Design of Electronics Products and guiding Product Design projects at the Centre for Electronics Design and Technology (CEDT), Department of Electronics Systems Engineering (DESE) since 1984. He was one of the core faculty of Centre for Product Design and Manufacturing (CPDM) at the time of inception. And taught Product Planning and Management. He continues to advise students at DESE

COURSE PLAN

Introduction to Enclosures and thermal issues
Basics of conductive heat transfer
Radiation at normal ambient
Convection basics
Forced convection
Combined modes
Use of Conduction in enclosures
Radiation as a speciality
Convective cooling in small products
Forced cooling in medium and large systems
Liquid cooled high power modules
Novelty phase change and thermo electrics
Refrigerated cabinets
Heat sinks practical application
Blowers, fans, ventilations of systems
Instrumentation for measurement
Effects on sealed enclosures
Integration of ID with the heat aspects
Case stories in biological instruments
Case study of select participants' work
Application of Thermal CAD and round up

PROBABILITY FOUNDATIONS FOR ELECTRICAL ENGINEERS

ELECTRICAL ENGINEERING

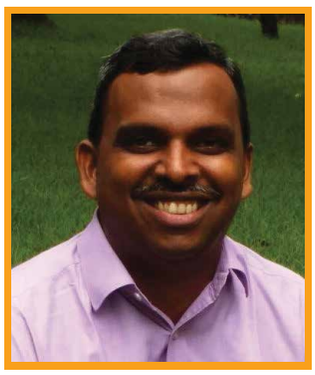
TYPE OF COURSE : New
PRE-REQUISITES : Basic calculus
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course will introduce the basic foundational aspects of probability theory primarily to an electrical engineering audience. In communications, signal processing and networking applications, probability theory and models play a vital role in design and implementation. This course will prepare a student to take courses such as Digital/Wireless Communications, Adaptive Signal Processing and Communication Networks.

ABOUT INSTRUCTOR

Prof. R Aravind, is a faculty member in the Department of Electrical Engineering at the Indian Institute of Technology Madras. Aravind has a PhD in electrical engineering from the University of California, Santa Barbara. His research interests include image and video processing and compression.



Prof. Andrew Thangaraj Department of Electrical Engineering, Indian Institute of Technology, Madras received his B.Tech in Electrical Engineering from the Indian Institute of Technology (IIT), Madras, India in 1998 and a PhD in Electrical Engineering from the Georgia Institute of Technology, Atlanta, USA in 2003. He was a post-doctoral researcher at the GTL-CNRS Telecom lab at Georgia Tech Lorraine, Metz, France from August 2003 to May 2004. From June 2004, he has been with the Department of Electrical Engineering, IIT Madras, where he is currently a professor. He is currently a National MOOCs Coordinator for NPTEL in the SWAYAM project of the MHRD.

COURSE PLAN

Week 1 : Probability space: Experiments, sample space, events

Week 2 : Conditional probability: Baye's rule

Week 3 : Independence: Independent and dependent events, conditional independence

Week 4 : Discrete random variables: PMF, important discrete distributions

Week 5 : Continuous random variables: PDF, CDF, important continuous distributions

Week 6 : Multiple random variables: Joint distribution, independence

Week 7 : Transformation of random variables: CDF method, PDF method

Week 8 : Expectations: mean, variance, correlation, covariance

ANTENNAS

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic knowledge of Electromagnetic Waves.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Telecom industry, defense industry and space organization.

COURSE OUTLINE

This course will cover the fundamentals of Antenna, Dipole Antennas, Monopole Antennas, Loop Antennas, Slot Antennas, Linear and Planar Arrays, Microstrip Antennas (MSA), MSA Arrays, Helical Antennas, Horn Antennas, Yagi-Uda & Log-Periodic Antennas, Reflector Antennas.

ABOUT INSTRUCTOR

Prof. Girish Kumar, Department of Electrical Engineering, Indian Institute of Technology, Bombay received the Ph.D. degree in electrical engineering from Indian Institute of Technology 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.

COURSE PLAN

Week 1 : Antenna Introduction-I, II, III; Antenna Fundamentals-I, II

Week 2 : Antenna Radiation Hazards-I, II; Dipole Antennas-I, II, III

Week 3 : Monopole Antennas-I, II; Loop Antennas; Slot Antennas

Week 4 : Linear Arrays-I, II, III; Planar Arrays

Week 5 : Microstrip Antennas(MSA); Rectangular MSA; MSA Parametric Analysis-I, II; Circular MSA

Week 6 : Broadband MSA-I, II, III, IV, V

Week 7 : Compact MSA-I, II, III; Tunable MSA-I, II

Week 8 : Circularly Polarized MSA-I, II, III; MSA Arrays-I, II,III

Week 9 : Helical Antennas-I, II, III, IV, V

Week 10 : Horn Antennas-I, II, III, IV, V

Week 11 : Yagi-Uda and Log-Periodic Antennas-I, II, III; IE3D Session TA-I, II, III

Week 12 : Reflector Antennas-I, II, III, IV; Lab Session

ANALOG IC DESIGN

ELECTRICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : UG course (or equivalent) on: Basic Electrical Circuits Signals and Systems, Analog Circuits
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course will introduce advanced concepts in analog circuit design specifically relevant to CMOS IC design. It will cover circuit noise and mismatch, their analysis, and their impact on CMOS opamp design. As prerequisites, the student is expected to have undergone a course on (a) basic circuit theory and analysis (b) signals and systems and (c) MOS analog circuits. At the end of this course, the student should be able to design and analyze several types of CMOS opamps at the transistor level.

ABOUT INSTRUCTOR

Prof. S. Aniruddhan is an Assistant Professor in the Integrated Circuits and Systems group of the Department of Electrical Engineering at Indian Institute of Technology Madras. He works broadly in the area of Analog IC design, with specific focus on RFIC design. He obtained a B. Tech. degree in Electrical Engineering from IIT Madras in 2000, and a Ph.D. degree from the University of Washington, Seattle in 2006. Between 2006 and 2011, he worked in the RF-Analog group at Qualcomm Inc., San Diego, designing integrated circuits for Cellular RF applications.

COURSE PLAN

Week 1 : Introduction to Integrated Circuits; Review of some simple MOS amplifiers

Week 2 : Noise in circuits; Noise analysis of common circuits

Week 3 : Mismatch in circuits

Week 4 : Introduction to negative feedback; frequency response and Bode plots

Week 5 : Loop gain and stability; Dominant pole compensation

Week 6 : Block level conceptualization of single- and two-stage opamps

Week 7 : Differential and common-mode analysis; Differential amplifiers

Week 8 : Single-stage opamp

Week 9 : Telescopic opamp

Week 10 : Folded cascode opamp

Week 11 : Two-stage opamp

Week 12 : Fully differential opamps; common-mode feedback

BASIC ELECTRONICS

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : A basic course in electrical engineering (KCL, KVL, network theorems, AC analysis)
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course is about basic electronic circuits, both analog and digital. In the analog part, diode circuits, BJT amplifiers, Op Amp circuits will be covered. In the digital part, combinatorial and sequential circuits will be covered. A unique feature of the course is extensive use of circuit simulation results in order to give a realistic picture of the circuit operation and waveforms. Assignments are designed to help the students to test their understanding of the concepts being covered. A circuit simulation package will be made available (as free download) to enable students to simulate circuits covered in the course and gain further insight in their functioning.

ABOUT INSTRUCTOR

Prof.M.B.Patil, Department of Electrical Engineering, Indian Institute of Technology, Bombay received his B. Tech. from IIT Bombay in 1984, MS from University of Southern California in 1987, and PhD from University of Illinois at Urbana-Champaign in 1992, all in Electrical Engineering. He has worked as a faculty member at IIT Kanpur from 1994 to 1999, and at IIT Bombay from 1999 to date. His research interests are semiconductor devices and circuits simulation. He has been teaching electronics lab and theory courses for several years, and has written a book "Basic electronic devices and circuits" (PHI, 2013). He has also prepared course material in the form of presentations on various topics covered in electronics courses (www.ee.iitb.ac.in/~sequel). For his teaching efforts, he received an "Excellence in Teaching" award from IIT Bombay in 2012.

COURSE PLAN

Week 1 : Network theorems and phasors

Week 2 : RC/RL circuits with a piecewise constant source

Week 3 : Diode circuits

Week 4 : Diode rectifiers, BJT

Week 5 : BJT ampifier

Week 6 : Op-amp circuits

Week 7 : Op-amp circuits (continued), Bode plots

Week 8 : Op-amp circuits (continued)

Week 9 : Op-amp circuits (continued)

Week 10 : Digital circuits (combinatorial)

Week 11 : Digital circuits (sequential)

Week 12 : ADC, DAC, 555 timer

CONTROL ENGINEERING

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Network and Circuits, Basic Engineering Mathematics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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 Pasumarthy 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.

Prof. Viswanath Talasila currently an Associate Professor at the Telecommunication Engineering Department at Ramaiah Institute of Technology (Bengaluru). He has an engineering degree from Bangalore University in 1997. He worked at the Institute of Robotics and Intelligent Systems (DRDO lab, CAIR) from 1997 – 2000 in flight control. He completed his Ph.D. at the University of Twente (Netherlands) in the area of mathematical modeling in 2004. He completed his PostDoctoral research from Imperial College (London) in 2007 in the area of controlled invariant manifolds.

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.

ELECTROMAGNETIC THEORY

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : This is a undergraduate core course required as a foundation to other courses in Microwave, Optical, and Antenna engineering.

COURSE OUTLINE

Electromagnetic theory is a core course in Electrical Engineering curriculum. The course covers static and dynamic electric and magnetic fields and their interaction. Major topics include Electromagnetic Waves, Transmission Lines, Waveguides, and Antenna fundamentals. In addition, quasi-static analysis and numerical methods are also discussed. Successful completion of the course will allow students to take up Microwave Engg, Antennas, and Optics for future studies.

ABOUT INSTRUCTOR

Prof. Pradeep Kumar K, Department of Electrical Engineering, Indian Institute of Technology,Kanpur 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, optical communications, and nonlinear fiber optics.

COURSE PLAN

Week 1 : Coulomb's law and electric fields

Week 2 : Gauss's law, potential and energy, conductors and dielectrics

Week 3 : Laplace and Poisson equations, solution methods, and capacitance

Week 4 : Biot-Savart and Ampere's laws, inductance calculation

Week 5 : Magnetic materials, Faraday's law and quasi-static analysis

Week 6 : Maxwell equations and uniform plane waves

Week 7 : Wave propagation in dielectrics and conductors, skin effect, normal incidence

Week 8 : Oblique incidence, Snell's law, and total internal reflection

Week 9 : Transmission lines, Smith chart, impedance matching

Week 10 : Transients and pulse propagation on transmission line

Week 11 : Waveguides: Metallic and Dielectric

Week 12 : Antenna fundamentals

POWER SYSTEM ENGINEERING

ELECTRICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Power Grid, NTPC, NHEC, DVC and State Electricity Boards.

COURSE OUTLINE

This course is mainly for undergraduate third-year as well as fourth year Electrical Engineering students, which will introduce and explain the fundamental concepts in the field of electrical power system engineering. The basic concepts of underground cables, overhead line insulators, transient overvoltages and insulation coordination will be covered in detail. In addition to that, corona, sag and tension of transmission line will also be covered.

ABOUT INSTRUCTOR

Prof. Debapriya Das, Department of Electrical Engineering, Indian Institute of Technology, Kharagpur obtained his B.E. degree from Calcutta University (B.E. College (Presently known as IIEST), Shibpur, Howrah, WB), M.Tech. from I.I.T. Kharagpur and Ph.D. from I.I.T., Delhi. He has nearly thirty years of experience in teaching and research.

COURSE PLAN

Week 1 : Overhead Line Insulators

Week 2 : Underground Cables

Week 3 : Transient Overvoltages and Insulation Coordination

Week 4 : Corona

Week 5 : Sag and Tension

Week 6 : Distribution System Load Flow and Voltage Stability

Week 7 : Approximate Method of Distribution System Analysis

Week 8 : Application of Capacitors for Radial Distribution Systems

Week 9 : Load Frequency Control

Week 10 : Load Frequency Control

Week 11 : Unit commitment

Week 12 : Unit Commitment

ELECTRICAL ENGINEERING

BIOMEDICAL SIGNAL PROCESSING

TYPE OF COURSE : New
PRE-REQUISITES : Signals and Systems
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Philips Research, GE Global Research, Siemens Research TCS, Wipro, Xerox Research Centre

COURSE OUTLINE

This course is prepared for the engineering students in their final year of undergraduate studies or in their graduate studies. Electrical Engineering students with a good background in Signals and Systems are prepared to take this course. Students in other engineering disciplines, or in computer science, mathematics, geo physics or physics should also be able to follow this course. While a course in Digital Signal Processing would be useful, it is not necessary for a capable student. The course has followed problem solving approach as engineers are known as problem solvers. The entire course is presented in the form of series of problems and solutions.

ABOUT INSTRUCTOR

Prof. Sudipta Mukhopadhyay, Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology, Kharagpur is a graduate from JU (1988), MTech (1991) and PhD (1996) from IIT Kanpur. He worked in Philips Medical Systems & Ge Global Research for more than a decade before joining IIT Kharagpur about a decade back. He has written more than 100 articles in refereed journals and international conferences. Guided more than 60 MTech and 7 PhD scholars.

COURSE PLAN

Week 1 : Preliminaries; Biomedical signal origin & dynamics (ECG)

Week 2 : Biomedical signal origin & dynamics (EEG, EMG etc.)

Week 3 : Filtering for Removal of artifacts

Week 4 : Filtering for Removal of artifacts contd.

Week 5 : Filtering for Removal of artifacts contd.

Week 6 : Filtering for Removal of artifacts contd.

Week 7 : Event Detection

Week 8 : Event Detection contd.

Week 9 : Waveform Analysis

Week 10 : Waveform Analysis contd.

Week 11 : Frequency-domain Analysis

Week 12 : Frequency-domain Analysis

ELECTRICAL ENGINEERING

PRINCIPLES OF SIGNALS AND SYSTEMS

TYPE OF COURSE : New
PRE-REQUISITES : Basic knowledge of Integration, Differentiation Complex Numbers
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Most companies in Electronics, Communication and Signal Processing. Examples are Qualcomm, Broadcom Intel, Sasken etc.

COURSE OUTLINE

This course introduces the fundamental principles of signals and system analysis. These concepts form the building blocks of modern digital signal processing, communication and control systems. Hence, a sound understanding of these principles is necessary for all students of Electronics and Communication engineering (ECE), Electrical and Electronics Engineering (EEE), and Instrumentation Engineering (IE). The course will cover various basic tools of signal and system analysis such as signal classification, LTI systems, Properties of LTI Systems, Frequency Response, Laplace Transform, Z-Transform, Fourier Transform, Fourier Series, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Cascade/ Parallel structures and their various practical applications. Various concepts such as convolution, impulse/ frequency response, causality, stability of systems will be especially emphasized. Other additional topics such as state space techniques and solutions to state space equations will also be covered. This course is suitable for all UG/PG students and practicing engineers/ managers who are looking to build a solid grasp of the fundamental concepts of signals and systems as well as students/ professionals preparing for their college/ university/ competitive exams.

ABOUT INSTRUCTOR

Prof. Aditya K. Jagannatham Department of Electrical Engineering Indian Institute of Technology,Kanpur, 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 : Introduction to Signals, Signal Classification, Continuous/ Discrete Time Signals
Week 2 : Definition and Classification of Systems, Linear Time Invariant (LTI) Systems
Week 3 : Properties of LTI Systems, Impulse Response, Convolution, Causality, Stability
Week 4 : Impulse Response of Discrete Time Systems, Discrete Time Convolution, Difference Equations and Analysis
Week 5 : Laplace Transform, Properties of Laplace Transform, Inverse Laplace Transform
Week 6 : Introduction to z-Transform, Properties of z-Transform, Region of Convergence, Inverse z-Transform
Week 7 : Introduction to Fourier Analysis, Fourier Series for Periodic Signals, Properties of Fourier Series
Week 8 : Introduction to Fourier Transform, Properties of Fourier Transform, Frequency Response of Continuous Time Systems, Examples of Frequency Response
Week 9 : Fourier Analysis of Discrete Signals, Discrete Time Fourier Transform (DTFT), Properties of DTFT, Examples of DTFT
Week 10 : Frequency Response of Discrete Time Systems, Discrete Fourier Transform (DFT), Properties of DFT, Examples of DFT
Week 11 : IIR/ FIR Filters, Direct Form Realization, Cascade and Parallel Form Realization, Problem Solving
Week 12 : Concept of State, State Space Analysis, State Space Representation of Continuous Time Systems, Solution of State Equations for Continuous Systems

INDUSTRIAL AUTOMATION AND CONTROL

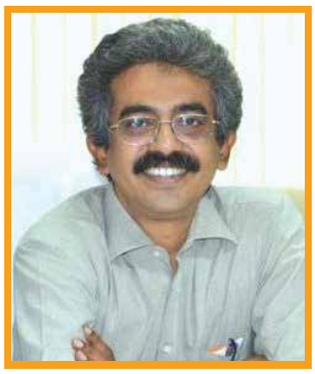
ELECTRICAL ENGINEERING

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Electrical Networks, Control Systems
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	All Process Control (Oil and Gas, Chemical) Manufacturing (Machine tools, Textile) etc.

COURSE OUTLINE

This course provides an overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course, in 52 lectures, discusses a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC Machines. A student of IIT Kharagpur once commented - " because of the course I can identify and relate to much of the equipment that I see in a factory".

ABOUT INSTRUCTOR



Prof. Siddhartha Mukhopadhyay, Department of Electrical Engineering IIT Kharagpur has done his B. Tech, M. Tech and Ph. D., all from IIT Kharagpur in 1985, 1987 and 1991 respectively. In 1990 he joined the Electrical Engineering Department of IIT Kharagpur. And is currently a Professor there. He has co-authored about 200 research papers, two books and two video courses. He has about 20 years experience of working with organisations like National Semiconductors, Texas Instruments, General Motors, Indian Railways, SAIL, DRDO, GE R&D and several others. Apart from his research interests he is interested in pedagogy and innovation.

COURSE PLAN

Module 1 : Introduction; Introduction(Cont.); Architecture of Industrial Automation Systems; Architecture of Industrial Automation Systems(Cont.)

Module 2 : Measurement Systems Characteristics; Measurement Systems Characteristics(Cont.); Data Acquisition Systems; Data Acquisition Systems(Cont.)

Module 3 : Introduction to Automatic Control; Introduction to Automatic Control(Cont.); P-I-D Control; P-I-D Control(Cont.) PID Control Tuning; PID Control Tuning(Cont.); Feedforward Control Ratio Control; Feedforward Control Ratio Control(Cont.) Time Delay Systems and Inverse Response Systems; Time Delay Systems and Inverse Response Systems(Cont.) Special Control Structures; Special Control Structures(Cont.); Concluding Lesson on Process Control (Self-study) Introduction to Sequence Control, PLC , RLL; Introduction to Sequence Control, PLC , RLL(Cont.); Sequence Control. Scan Cycle, Simple RLL Programs; Sequence Control. Scan Cycle, Simple RLL Programs(Cont.); Sequence Control. More RLL Elements, RLL Syntax; Sequence Control. More RLL Elements, RLL Syntax(Cont.); A Structured Design Approach to Sequence Control; A Structured Design Approach to Sequence Control(Cont.); PLC Hardware Environment; PLC Hardware Environment(Cont.)

Module 4 : Flow Control Valves; Flow Control Valves(Cont.); Hydraulic Control Systems - I; Hydraulic Control Systems - I(Cont.) Hydraulic Control Systems - II; Hydraulic Control Systems - II(Cont.); Industrial Hydraulic Circuit; Industrial Hydraulic Circuit(Cont.); Pneumatic Control Systems - I; Pneumatic Control Systems - I(Cont.); Pneumatic Systems - II; Pneumatic Systems - II(Cont.); Energy Savings with Variable Speed Drives; Energy Savings with Variable Speed Drives(Cont.); Introduction To CNC Machines; Introduction To CNC Machines(Cont.)

Module 5 : The Fieldbus Network - I; The Fieldbus Network - I(Cont.); Higher Level Automation Systems; Higher Level Automation Systems(Cont.); Course Review and Conclusion (Self-study)

ELECTRICAL ENGINEERING

MICROPROCESSORS AND MICROCONTROLLERS

TYPE OF COURSE : New
PRE-REQUISITES : Digital Design, Digital Logic
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Companies involved in development of microprocessor and microcontroller based products

COURSE OUTLINE

Microprocessors are used extensively in the design of any computing facility. It contains units to carry out arithmetic and logic calculations, fast storage in terms of registers and associated control logic to get instructions from memory and execute them. A number of devices can be interfaced with them to develop a complete system application.

ABOUT INSTRUCTOR

Prof. Santanu Chattopadhyay is currently a Professor in the Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology,Kharagpur received his PhD from Indian Institute of Technology (IIT) Kharagpur in 1996. His research interests include 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 1 : Introduction: General processor architecture, Microprocessors, Microcontrollers

Week 2 : 8085 – Part I

Week 3 : 8085 – Part II

Week 4 : 8085 – Part III

Week 5 : 8085 – Part IV

Week 6 : 8051 – Part I

Week 7 : 8051 – Part II

Week 8 : PIC, AVR

Week 9 : ARM – Part I

Week 10 : ARM – Part II

Week 11 : Interfacing examples – Part I

Week 12 : Interfacing examples – Part II

ELECTRICAL ENGINEERING

DEEP LEARNING FOR VISUAL COMPUTING

TYPE OF COURSE : New
PRE-REQUISITES : Digital Image Processing, Machine Learning
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Industry related to Deep Learning and Machine Vision such as Intel, Microsoft, Google, Nvidia, Philips, GE Siemens, Samsung, IBM, Apple, TCS, Infosys, Wipro Robert Bosch, Baidu, Wymo, Tesla, etc.

COURSE OUTLINE

Deep learning is a genre of machine learning algorithms that attempt to solve tasks by learning abstraction in data following a stratified description paradigm using non-linear transformation architectures. When put in simple terms, say you want to make the machine recognize Mr. X standing in front of Mt. E on an image; this task is a stratified or hierarchical recognition task.

ABOUT INSTRUCTOR

Prof. Debdoot Sheet is an Assistant Professor of Electrical Engineering at the Indian Institute of Technology Kharagpur, founder of SkinCurate Research. He received the MS and PhD degrees in computational medical imaging and machine learning from the Indian Institute of Technology Kharagpur in 2010 and 2014 respectively. He was a DAAD visiting PhD scholar to TU Munich during 2011-12. His research interests include deep learning and domain adaptation, computational medical imaging, image and multidimensional signal processing, surgical analytics and informatics, visualization and augmented reality technology design. He has widely published in journals including Medical Image Analysis (MedIA), and conferences like the IEEE International Symposium on Biomedical Imaging (ISBI). He is a member of IEEE, SPIE, ACM, IUPRAI and BMESI and serves as an Editor of IEEE Pulse since 2014.

COURSE PLAN

Week 1 : Introduction to Visual Computing and Neural Networks

Week 2 : Multilayer Perceptron to Deep Neural Networks with Autoencoders

Week 3 : Autoencoders for Representation Learning and MLP Initialization

Week 4 : Stacked, Sparse, Denoising Autoencoders and Ladder Training

Week 5 : Cost functions, Learning Rate Dynamics and Optimization

Week 6 : Introduction to Convolutional Neural Networks (CNN) and LeNet

Week 7 : Convolutional Autoencoders and Deep CNN (AlexNet, VGGNet)

Week 8 : Very Deep CNN for Classification (GoogLeNet, ResNet, DenseNet)

Week 9 : Computational Complexity and Transfer Learning of a Network

Week 10 : Object Localization (RCNN) and Semantic Segmentation

Week 11 : Generative Models with Adversarial Learning

Week 12 : Recurrent Neural Networks (RNN) for Video Classification

PRINCIPLES OF COMMUNICATION SYSTEMS - I

ELECTRICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic knowledge of Probability, Calculus
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Most companies in wireless communications area should find this useful. Examples are Qualcomm, Broadcom, Intel etc.

COURSE OUTLINE

This course covers fundamental concepts of communication systems, which are essential for the understanding of advanced courses in digital/ wireless communication systems. Beginning with various basic tools such as Fourier Series/ Transform, the course will also cover several important modulation techniques such as Amplitude Modulation, Frequency Modulation, Phase Modulation etc.

ABOUT INSTRUCTOR

Prof. Aditya K. Jagannatham, Department of Electrical Engineering Indian Institute of Technology, Kanpur, 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 for communication, Fourier Series/Transform, Properties, Autocorrelation, Energy Spectral Density, Parsevals Relation
Week 2 : Amplitude Modulation (AM), Spectrum of AM, Envelope Detection, Power Efficiency, Modulation Index
Week 3 : Double Sideband Suppressed Carrier (DSB-SC) Modulation, Quadrature Carrier Multiplexing (QCM), Demodulation, Costas Receiver
Week 4 : Single Sideband Modulation (SSB), Hilbert Transform, Complex Pre-envelope/ Envelope, Demodulation of SSB, Vestigial Sideband Modulation (VSB)
Week 5 : Angle Modulation, Frequency Modulation (FM), Phase Modulation (PM), Modulation Index, Instantaneous Frequency
Week 6 : Spectrum of FM Signals, Carsons Rule for FM Bandwidth, Narrowband FM Generation, Wideband FM Generation via Indirect Method, FM Demodulation
Week 7 : Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal, Pulse Amplitude Modulation
Week 8 : Quantization, Uniform Quantizers – Midrise and Midtread, Quantization noise, Lloyd Max Quantization Algorithm, Non uniform Quantizers, Delta Modulation, Differential Pulse Code Modulation (DPCM)
Week 9 : Basics of Probability, Conditional Probability, MAP Principle
Week 10 : Random Variables, Probability Density Functions, Applications in Wireless Channels
Week 11 : Basics of Random Processes, Wireless Fading Channel Modeling
Week 12 : Gaussian Random Process, Noise, Bit-Error and Impact on Wireless Systems

ELECTRICAL ENGINEERING

MATHEMATICAL METHODS AND TECHNIQUES IN SIGNAL PROCESSING

TYPE OF COURSE : New
PRE-REQUISITES : UG in Digital Signal Processing, familiarity with probability and linear algebra
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Any company using DSP techniques in their work, such as, TI, Analog Devices, Broadcom and many more.

COURSE OUTLINE

This course will start with the review of basic signals, systems and signal space: Review of 1-D signals and systems, review of random signals, multi-dimensional signals, of vector spaces, inner product spaces, orthogonal projections and related concepts. and then Sampling theorems (a peek into Shannon and compressive sampling), Basics of multi-rate signal processing: sampling, decimation and interpolation, sampling rate conversion (integer and rational sampling rates), oversampled processing (A/D and D/A conversion), and introduction to filter banks.

ABOUT INSTRUCTOR

Prof. Shayan Srinivasa Garani, Department of Electronic Systems Engineering, Indian Institute of Science, Bangalore received his Ph.D. in Electrical and Computer Engineering from Georgia Institute of Technology – Atlanta, M.S. from the University of Florida – Gainesville and B.E. from Mysore University. Dr. Srinivasa has held senior engineering positions within Broadcom Corporation, ST Microelectronics and Western Digital. Prior to joining IISc, Dr. Srinivasa was leading various research activities, managing and directing research and external university research programs within Western Digital.

COURSE PLAN

Week 1 : Review of vector spaces, inner product spaces, orthogonal projections, state variable representation

Week 2 : Review of probability and random processes

Week 3 : Signal geometry and applications

Week 4 : Sampling theorems (Shannon sampling vs. compressive sampling overview), decimation and expansion (time and frequency domain effects)

Week 5 : Sampling rate conversion and efficient architectures, design of high decimation and interpolation filters. Multistage designs

Week 6 : Introduction to 2 channel QMF filter bank, M-channel filter banks, overcoming aliasing, amplitude and phase distortions.

Week 7 : Subband coding and Filter Designs

Week 8 : Introduction to multiresolution analysis and wavelets, wavelet properties

Week 9 : Wavelet decomposition and reconstruction, applications to denoising.

Week 10 : Derivation of the KL Transform, properties and applications

Week 11 : Topics on matrix calculus and constrained optimization relevant to KL Transform derivations.

Week 12 : Signal Modeling: Least squares technique, Pade approximation and more..

ELECTRICAL ENGINEERING

INTEGRATED CIRCUITS, MOSFETS, OP-AMPS AND THEIR APPLICATIONS

TYPE OF COURSE : New
PRE-REQUISITES : B.Tech./B.E./M.Sc. and M.Tech./M.E.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course is a design-oriented course aimed at understanding fabrication, parameters, and specifications of integrated circuits, MOSFETs, Op-Amps as well as their applications in the Analog domain. Below are some of the course outcomes. To understand and analyze the Op-Amps., The ability to understand the IC Technology and equipment used in fabrication. To understand feedback techniques and types of Noise. Ability to design amplifiers using Op-Amps. Ability to analyze and design filters using Op-Amps, To develop the skill to build and troubleshoot Analog circuits

ABOUT INSTRUCTOR

Prof. Hardik Jeetendra Pandya is a 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. He is recipient of prestigious Early Career Research Award from Science and Engineering Research Board, Government of India as well as a start-up grant of 228 Lacs from IISc.

COURSE PLAN

Week 1 : Introduction to Integrated Circuit Technology

Week 2 : Fabrication processes for Integrated Circuits

Week 3 : Understanding Op-Amps

Week 4 : CMRR of an Op-Amp and Offset voltages and currents

Week 5 : MOSFETs Fabrication and Applications

Week 6 : Frequency Response and Feedback techniques for Integrated Circuits

Week 7 : Comparators, Instrumentation Amplifiers, Filters

Week 8 : Oscillators

Week 9 : MOSFETs Current Mirrors

Week 10 : Noise, Op-Amp Circuits Analog-to-Digital Converter (ADC)

Week 11 : Digital-to-Analog Converter (DAC) using Op-Amps

Week 12 : Understanding the Datasheet of Op-Amps

HUMANITIES & SOCIAL SCIENCES

HUMANITIES & SOCIAL SCIENCES

4weeks

01. Psychiatry-An Overview
02. How The Brain Creates Mind
03. Postcolonial Literature
04. Introduction To Indian Art-An Appreciation
05. Sociology of Science
06. Perspectives on Neurolinguistic
07. Great Experiments In Psychology
08. Patent Drafting for beginners
09. Business English Communication
10. Brief Introduction To Psychology

8weeks

01. Introduction to Advanced Cognitive Processes
02. Enhancing Soft Skills & Personality
03. Folk And Minor Art In India
04. Speaking Effectively
05. Emotional Intelligence
06. Strategic Performance Management
07. Postmodernism in Literature
08. Language And Mind
09. Educational leadership
10. Appreciating Carnatic Music
11. Literary theory and Literary Criticism

12weeks

01. An Introduction to Microeconomics
02. Sociological Perspectives on Modernity
03. Introduction to Cognitive Psychology
04. Patent Law For Engineers And Scientists
05. Better Spoken English

HUMANITIES & SOCIAL SCIENCES

PSYCHIATRY-AN OVERVIEW

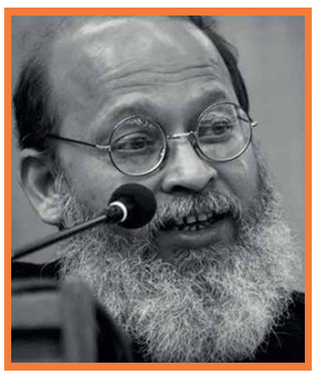
TYPE OF COURSE : Rerun
PRE-REQUISITES : No Specific Courses Required. Basic Knowledge about Brain should suffice.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Health, Pharmaceutical

COURSE OUTLINE

This course is intended for medical students both UG and PG (from any speciality) as an introduction to Psychiatry and other mental health issues. It will be useful for Psychology and Neurosciences students too as it provides an overview of Psychiatric illnesses and their treatment as well as the biological /psychological basis of behavior.

ABOUT INSTRUCTOR

Prof. Alok Bajpai, Design Programme, Indian Institute of Technology Kanpur 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 1 : Brain and Behaviour –approaches , Neuroanatomy ,Neurophysiology,Imaging,electrophysiology, Psychology

Week 2 : Diagnostic process in Psychiatry ,Mental Status Examination1 ,Mental status examination 2 ,Classificatory systems,Investigation ,Psychological testing

Week 3 : Psychiatric Disorders and their treatment-1 ,Organic syndromes ,Schizophrenia ,Mood Disorders ,Anxiety disorders ,Obsessive Compulsive disorders

Week 4 : Psychiatric Disorders and their treatment -2 , Childhood Disorders-introduction ,Autism ,Learning disability, ADHD ,Other disorders

HUMANITIES & SOCIAL SCIENCES

HOW THE BRAIN CREATES MIND

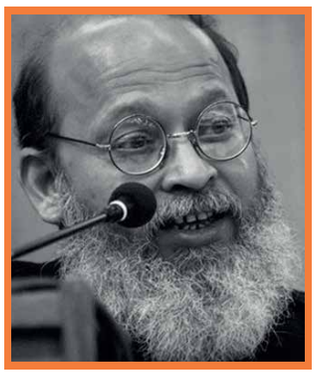
TYPE OF COURSE : Rerun
PRE-REQUISITES : Should watch the course links mentioned below
http://nptel.ac.in/courses/109104029/
Biological basis of Behaviour-Prof.Braj Bhushan
http://nptel.ac.in/courses/109104082/12
A Beautiful Mind-Dr.Alok Bajpai
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Health; Psychology; Brain computer interface

COURSE OUTLINE

This course intends to introduce the human brain and its processes especially with regards to electrochemical activity, the issues of mind and consciousness. It also indicates towards further possibilities of research. Anyone with an interest in Human brain can join. Just a basic understanding of Brain would suffice. It should be useful for students of Neurosciences, Psychology , Medical and people working at brain computer interface.

ABOUT INSTRUCTOR

Prof. Alok Bajpai, Design Programme, Indian Institute of Technology Kanpur 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 1 : Brain to Mind-- and how do we know it---(essentially single neuron to multiple) Brain and gross specialization --- areas , right-left , association ,connectivity and our tools to learn including EEG

Week 2 : Being Conscious -- Dynamics --- how do we learn about it from EEG

Week 3 : Cognition,Memory,Emotion -- Normal and Pathology

Week 4 : Sleep Brain and Future-- with interactive session

POSTCOLONIAL LITERATURE

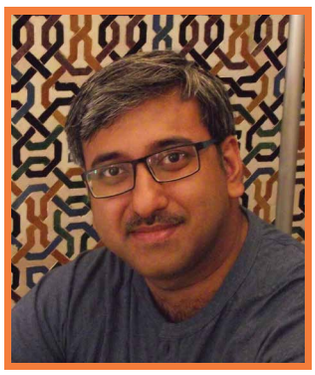
HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Universities and academic institutions teaching courses on postcolonialism and South Asian studies.

COURSE OUTLINE

This course on Postcolonial literature will explore colonialism and anti-colonial resistance through the cultural legacies and literary imprints that they leave. It will also be an introduction to the specialised field of postcolonial studies which started emerging during the 1980s and ever since then has come to occupy a significant position within the various humanities departments across the world. It is hoped that this course will enable students to competently navigate the complex maze of theoretical terms and concepts that characterise postcolonial studies and savour the wonderful variety and richness of the literature that is today classified under the rubric of postcolonialism.

ABOUT INSTRUCTOR



Prof. Sayan Chattopadhyay, is an Assistant Professor of English literature at the Department of Humanities and Social Sciences at IIT Kanpur. He has a doctorate degree from the University of Cambridge. His primary areas of research include Postcolonial Studies and Indian English Writings, and his research articles have appeared in various scholarly journals including Journal of Postcolonial Writing (Routledge), Ariel: A Review of International English (University of Calgary), The Journal of Commonwealth Literature (Sage) and Prose Studies: History, Theory, Criticism (Routledge).

COURSE PLAN

Week 1 : Introduction: What is postcolonialism?
Commonwealth Literature
Colonial Discourse Analysis: Michel Foucault
Colonial Discourse Analysis: Edward Said
Joseph Conrad's Heart of Darkness

Week 2 : Colonialism: The African Perspective
Chinua Achebe's Things Fall Apart (I)
Chinua Achebe's Things Fall Apart (II)
Decolonisation and the Discourse of Nationalism: The Context of India
Sonnets of Henry Derozio

Week 3 : Raja Rao's Kanthapura (I)
Raja Rao's Kanthapura (II)
Critics of Nationalism: Rabindranath Tagore and Frantz Fanon
Homi Bhabha and the concept of cultural hybridity
Caribbean Poetry: Derek Walcott

Week 4 : Diasporic literature: Selections from Jhumpa Lahiri's Interpreter of Maladies
Gayatri Spivak: Answering the question "Can the Subaltern Speak?"
Mahasweta Devi Pterodactyl I
Mahasweta Devi Pterodactyl II
Conclusion: Postcolonial Futures

HUMANITIES & SOCIAL SCIENCES

INTRODUCTION TO INDIAN ART-AN APPRECIATION

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Universities and Academic Institutions that teach and research on Visual arts & Art History and Museums & Art Galleries that deal with visual arts and antique collection.

COURSE OUTLINE

The Indian sub-continent has a tradition of visual arts dating back more than 10000 years. The works of art produced over the periods and across the huge expanse of the subcontinent are diverse in their style, subject and medium used. Each art work from different periods be it an architecture, sculpture, painting or decorative and functional object - embody and echo the objectives and ethos of the cultural period that produced it. This course intends to introduce an appreciation method to study, understand and enjoy Indian art as much comprehensibly as possible. The course is selective, specific and focused on the highlights and salient features of Indian art, both traditional and modern.

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 1 : Introducing Indian Art

Week 2 : Religious and Cultural Diversities

Week 3 : Stylistic Variations

Week 4 :Tradition to Modern

SOCIOLOGY OF SCIENCE

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

This course aims to stimulate inspire and provoke awareness of science and technology impact society on and vice versa. The course will also discuss the various theoretical underpinnings of science and technology in society The course will focus also on the impact of science and technology on international relations social institutions social groups and on everyday life One of the learning outcomes upon completion of the course would be that students will have a better understanding of the complex relationship between science and technology and between science technology and society.

ABOUT INSTRUCTOR

Prof. Anindya Jayanta Mishra, Department of Humanities and Social Sciences, Indian Institute of Technology, Roorkee is a Gold Medal awardee in MA Sociology from Hyderabad Central University. He has obtained a Ph.D. in Sociology from IIT Kanpur in 2005. His research interests include Social Gerontology, Sociology of Health, Sociology of Work, and Science, Technology and Society. He has a teaching experience of 11 years at Indian Institute of Technology Roorkee where he has been teaching the Under graduate and Post Graduate students since 2006. An Associate Professor of Sociology in the Department of Humanities & Social Sciences, Dr Mishra has to his credit about 20 papers in reputed national and international journals besides having contributed significantly to various anthologies/conferences.

COURSE PLAN

Week 1 : Introduction to Sociology, History of Science, Role of Social Sciences in Technology Institutes

Week 2 : Sociology of Science: Social Shaping of Science, Ethos of Science, Matthew Effect in Science

Week 3 : Structure & Methodology of Science: Structure of Scientific Revolution, Science as Falsification, Scientist as Indexical Reasoner

Week 4 : Science and Technology in India: Science & Technology in Colonial India, Development of Indian Science, Peer Review in Indian Science

HUMANITIES & SOCIAL SCIENCES

PERSPECTIVES ON NEUROLINGUISTIC

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : 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 use language of mind consistently to achieve a specific and desired outcome. This course aims to train a person to make an introspection of his or her own self. The course will also study the structure of subjective experience. Neuro Linguistic Programming focuses and polishes the human excellence and communication. This program works with modelling studying an expert in the field and then breaking down the process of what makes students successful into thoughts beliefs values and actions.

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 MA in English Gold Medalist from Bihar University Bihar and 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 Neurolinguistic for the first year B.Tech students and is running Linguistics as elective for the 3rd and the 4th year B.Tech students.

COURSE PLAN

Week 1 : Introduction to Neurolinguitic Programming with history and uses of NLP

Week 2 : Introduction to four pillars of Neurolinguistic with sensory Acuity

Week 3 : Presupposition of NLP, Goals and outcomes

Week 4 : Negotiation and Persuasion with Emotionality and Stage/Anchoring

HUMANITIES & SOCIAL SCIENCES

GREAT EXPERIMENTS IN PSYCHOLOGY

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Any company has to manage its services. Hence, any company will recognize/value this online course

COURSE OUTLINE

Psychology as a subject interests many but what is popularly known are the common views that humans hold about their race. Over the century, the subject's endevour to establish itself as a science through various experiments remains unknown to many.The present course attempts to share the most important experiments in the history of Psychology that has helped shape its identity. It aims to aid students' understanding of how to design experiments with human subjects and assist the student to understand Psychology with a scientific eye.

ABOUT INSTRUCTOR

Prof. Rajlakshmi Guha Department of Humanities And Social Science Engineering IIT Kharagpur is an Assistant Professor she has done her PhD in Psychology. She has research interests in the areas of Cognitive Psychology, Social Psychology, Counselling Psychology, Perception, Attention, Memory processes, Physiological basis of emotion, and student's mental health etc.

COURSE PLAN

Week 1 : History and genesis of Psychology as a Science

Week 2 : Classic studies in Cognitive and Social Psychology

Week 3 : Famous studies in Clinical and Health Psychology

Week 4 : Experiments in Individual differences and cultural diversity

PATENT DRAFTING FOR BEGINNERS

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	None
COURSE DURATION	**:**	4 weeks
INDUSTRY SUPPORT	**:**	Law Firms, LPOs, knowledge-based industries etc

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

HUMANITIES & SOCIAL SCIENCES

BUSINESS ENGLISH COMMUNICATION

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

The course Business English provides methods for developing English language and communication skills for today's workplace. It caters to anyone who is interested in improving their language skills for participating in the global business economy. The course is accessible to those with an interest in improving their working knowledge of business English. It is divided into four modules : Reading, Writing, Vocabulary and Grammar.

ABOUT INSTRUCTOR

Prof. Aysha Iqbal Viswamohan Department Humanities and social science Indian Institute of Technology, Madras. Her research interests include film studies, popular culturals and drama.

COURSE PLAN

Week 1 : Reading -This module will cover a range of topics, from reading simple comprehension passages to reading memos, advertisements, biographies of famous people as well as company profiles. Reading techniques will also be taught, such as scanning and skimming. Through the module, the student will be taught to read a passage and understand what is relevant and what is not.

Week 2 : Vocabulary - This module will focus on vocabulary and the student will be taught a range of both formal and words and their spellings that will prove to be practically useful while venturing out into the business world. The student will get an idea of the range of vocabulary that can be potentially, according to each context, such as formal presentations and daily conversations.

Week 3 : Writing - This module will focus on a range of topics, such as how to write an email in polite, business English as well as informal personal letters, understanding forms, writing structured letters to newspapers, writing resumes, job references, reports and notes. After the module, the student will hence get a comprehensive idea of about writing for a wide variety of contexts.

Week 4 : Grammar - The module will focus exclusively on forms of grammar. This ties up directly to all the other modules as well. since having a good grasp of grammar is key to reading, writing and vocabulary. The student will be taught to understand and locate tenses, forms of verbs, passive voices and active voices, question tags, prepositions and the like.

HUMANITIES & SOCIAL SCIENCES

BRIEF INTRODUCTION TO PSYCHOLOGY

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course will be helpful in understanding oneself, one's behaviour, and what lie beneath such behaviour. It will help you understand how we understand, feel, and act. Through this brief introduction to psychology we will cruise through some of the major psychological concepts and principles, primarily focusing on the perceptual processes, learning, memory and emotions.

ABOUT INSTRUCTOR

Prof. Braj Bhushan Department of Humanities and Social Sciences Indian Institute of Technology, Kanpur His research interest lies in Cognitive Neuropsychology, Cognitive Factors in Design, Trauma Psychology. He has been awarded with many laurels some being "Our Common Future Fellowship (2010), Volkswagen Stiftung, Germany", "Abstract Award (2008), International Association for Suicide Prevention, 3rd Asia Pacific Regional Conference of IASP, Hong Kong", "In Search of Excellence' Award (2004), IAAP and NAOP-I", "Young Scientist Award (2002), Indian Science Congress Association", "B.H.U. Merit and Prize Award (1991), Banaras Hindu University".

COURSE PLAN

Week 1 : Perception

Week 2 : Learning

Week 3 : Memory

Week 4 : Emotion

HUMANITIES & SOCIAL SCIENCES

INTRODUCTION TO ADVANCED COGNITIVE PROCESSES

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All industries engaging with human resources, user – interface design & consumer oriented goods may benefit from this course.

COURSE OUTLINE

This course serves as a general introduction to the field of cognitive psychology. Cognitive psychology is referred to as the scientific study of advanced mental processes, such as organization of knowledge, reasoning, decision-making, language, problem solving, emotion etc. Following up on the course on basic cognitive processes the current course will build up on how the basic mental processes like memory, attention & perception give rise to higher-level cognitive processes. I will also talk about the methods used in contemporary Cognitive Psychology to investigate how these higher mental processes are used to achieve the desired outcomes. Some of the lectures will be about making students abreast of recent research in each of these topics

ABOUT INSTRUCTOR

Prof. Ark Verma, Department of Humanities and Social Sciences, Indian Institute of Technology, Kanpur has done his Bachelor's Degree in Psychology & English Literature from the University of Allahabad in 2007. After that he did his Master's Degree in Cognitive Science at the Centre of Behavioral & Cognitive Sciences, University of Allahabad in 2009. He joined the PhD program in the Department of Experimental Psychology at Ghent University, Belgium in January 2010 & was awarded PhD in 2014. He joined IIT Kanpur as an Assistant Professor of Psychology in May 2015. (His research lies in the field of Cognitive Psychology (Lateralisation, Symmetry Detection, Attention) & Psycholinguistics (Visual Word Recognition & Bilingualism)

COURSE PLAN

Week 1 : Language

Week 2 : Knowledge & Mental Imagery

Week 3 : Reasoning & Decision Making

Week 4 : Problem Solving & Creativity

Week 5 : Individual Differences

Week 6 : Cognitive Development

Week 7 : Expertise, Cognition & Emotion

Week 8 : Cognitive Disorders

ENHANCING SOFT SKILLS & PERSONALITY

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Developing Soft Skills and Personality
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	All industry/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

COURSE OUTLINE

The course aims to cause an enhanced 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. (The focus of this course is on interpersonal and management 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. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad.)

COURSE PLAN

Week 1 : Highlights of Developing Soft Skills and Personality Course-1-24; Highlights of Developing Soft Skills and Personality Course-25-48; Definitions and Types of Mindset; Learning Mindsets; Secrets of Developing Growth Mindsets

Week 2 : Importance of Time and Understanding Perceptions of Time; Using Time Efficiently; Understanding Procrastination; Overcoming Procrastination; Don't Say "Yes" to Make Others Happy!

Week 3 : Types of People; How to Say "No"; Controlling Anger; Gaining Power from Positive Thinking-1; Gaining Power from Positive Thinking-2

Week 4 : What Makes Others Dislike You?; What Makes Others Like You?-1; What Makes Others Like You?-2 Being Attractive-1, 2

Week 5 : Common Errors-1,2,3,4,5

Week 6 : Humour in Communication; Humour in the Workplace; Function of Humour in the Workplace; Money and Personality; Managing Money

Week 7 : Health and Personality; Managing Health-1: Importance of Exercise; Managing Health-2: Diet and Sleep Love and Personality; Managing Love

Week 8 : Ethics and Etiquette; Business Etiquette; Managing Mind and Memory; Improving Memory; Care for Environment; Highlights of the Course

FOLK AND MINOR ART IN INDIA

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	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

SPEAKING EFFECTIVELY

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	An intermediate course in English Language
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	Any College / University with Humanities Programme

COURSE OUTLINE

This course aims to introduce learners to the dynamics of effective spoken communication by establishing speaking as an autonomous medium with a distinctive vocabulary, syntax, structure, style and register. It will enable learners to participate in one to one interactions, in small groups and before a group. Learners are expected to master the fundamentals of speaking such as vocabulary, body language, pronunciation and basic conversation skills before they move on to more advanced activities such as appearing in interviews, making formal presentations and participating in meetings.

ABOUT INSTRUCTOR

Prof. Anjali Gera Roy is a Professor in the Department of Humanities and Social Sciences IIT Kharagpur, where she has designed and taught courses in language, literature and communication for more than 25 years. She has conducted and taught in a number of executive development programs in IIM Bangalore and IIT Kharagpur and run several tailor-made programs for the industry. She has been a Visiting Faculty in IIM Bangalore and Guest Faculty in Communication in IIM Rohtak and IIM Kashipur.

COURSE PLAN

Week 1: Introduction; The Art of Speaking; Encoding Meaning Using Verbal and Nonverbal Symbols; Cross Cultural Communication; Verbal Communication; Encoding Meaning Using Verbal Symbols; How Words Work and How to Use Words

Week 2: Nonverbal Communication; Encoding Meaning Using Nonverbal Symbols; How to Improve Body Language; Eye Communication, Facial Expression, Dress and Appearance; Posture and Movement, Gesture, Paralanguage; Role Plays and Activities

Week 3: Phonetics; Standard Language and Queen's English; Phonemes of English: Vowels; Phonemes of English: Diphthongs and Consonants; Stress and Rhythm; Intonation

Week 4: Voice and Delivery; Voice and Personality; How to Improve Voice; How to Improve Delivery; Pace,Pause,Pitch Volume, Modulation, Resonance

Week 5: Basic Conversational Skills; Greetings and making introductions; Asking for information and giving instructions Making requests; Agreeing and disagreeing; Making recommendations

Week 6: Appearing in Interviews and taking Interviews; Interviewing Skills; Appearing in an Interview; Conducting an Interview; Analysis of a bad interview; Analysis of a good interview

Week 7: Making and Assessing Presentations; How to Make Successful Presentations; How to Make Successful Presentations Analysis of a Bad Presentation; Analysis of a Good Presentation

Week 8: Group Discussions and Meetings; Participating in a Meeting; Chairing a Meeting; Analysis of an ill conducted meeting; Analysis of a well conducted meeting

EMOTIONAL INTELLIGENCE

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	**:**	Rerun
PRE-REQUISITES	**:**	None
COURSE DURATION	**:**	8 weeks
INDUSTRY SUPPORT	**:**	Human resource management division, training & development division of both manufacturing and service industries, MBA and HRM students

COURSE OUTLINE

"Intelligence quotient (IQ) gets you hired but emotional quotient (EQ) gets you promoted". This popular quote by Times magazine during late nineties has made the concept of emotional intelligence more popular among people by highlighting its multiple implications and applications. The uses and utility of emotional intelligence at home, school and workplace have benefited thousands in many disciplines. This course is designed to sensitize the participants about the concept, theory and applications of emotional intelligence. over the hardware (EQ).

ABOUT INSTRUCTOR

Prof. Rabindra Kumar Pradhan is currently working as Associate Professor in the Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur. He is currently working in diverse areas of behavioral sciences and human resource management. He is actively involved in teaching, training & research in the fields of positive psychology, industrial and organizational psychology, human resource development and management, and organizational behavior. He has 18years of experience in teaching, research and training. He has published 2 books on emotional intelligence, 1 book on human resource management and 1 book on human development through training. He has also published more than 50 journal articles and 10 book chapters.

COURSE PLAN

Week 1 **:** Introduction to emotion, intelligence & wisdom

Week 2 **:** Concept, theory, measurement and applications of intelligence

Week 3 **:** Emotional intelligence: concept, theory and measurements

Week 4 **:** Correlates of emotional intelligence

Week 5 **:** Emotional intelligence, culture, schooling and happiness

Week 6 **:** For enhancing emotional intelligence EQ mapping

Week 7 **:** Managing stress, suicide prevention, through emotional intelligence, spirituality and meditation

Week 8 **:** Application of emotional intelligence at family, school and workplace

HUMANITIES & SOCIAL SCIENCES

STRATEGIC PERFORMANCE MANAGEMENT

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : IT Companies, R & D Companies, Pharma Companies Manufacturing and Services sector

COURSE OUTLINE

Performance management is important because it plays a pivotal role in any organization's human resource framework. There are clear benefits from managing individual and team performance to achieve organizational objectives. A well-designed performance management process stimulates managers to develop high-quality strategic plans, set ambitious targets, and track performance closely-all activities which help to achieve strategic objectives and consequently sustained value creation.

ABOUT INSTRUCTOR

Prof. K. B. L. Srivastava is Professor, Department of Humanities and Social Sciences and Joint Professor in Vinod Gupta School Management, IIT Kharagpur 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 26 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 1 : Introduction to Performance Management and Performance Management Process, Role of PM in employee development

Week 2 : Performance Management and Strategic Planning: Planning for performance effectivenes

Week 3 : Approaches to Performance Measurement: Measuring behavior and results, Issues in performance management

Week 4 : Implementing performance management systems: Self-appraisal, Team appraisal and 360 feedback system

Week 5 : Performance management skills, Increasing self-awareness

Week 6 : Performance review, analysis and discussion, use of performance management data for HR decision making

Week 7 : Potential Appraisal, Linking performance with reward systems and legal issues

Week 8 : Performance Management Practices: Select case studies of Indian Organizations, Future of performance management systems

POSTMODERNISM IN LITERATURE

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Any college / university that has Humanities / Arts programs

COURSE OUTLINE

This is an eight-week course pitched at the Postgraduate level to provide an overview of a theoretical understanding of the fundamentals of Postmodernism in Literature. Through a discussion of seminal texts, key ideas and critical events in the 20th century, the course maps the dominant socio-cultural and literary practices usually labelled as Postmodernism. Ranging from popular culture to particular theories, from literary events to ideological debates, this course attempts to cover a wide variety of topics and frameworks, to enable a critical understanding of Postmodernism in Literature. The course includes the discussion of selected literary texts and engages with various literary critical approaches from different paradigms including Feminism and Postcolonialism.

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 1 : Introducing Postmodernism -Definitions, Concepts, General Online background

Week 2 : Reading the seminal texts and events which define Postmodernism-Online Lyotard,Barthes

Week 3 : Locating the Postmodern in the contemporary

Week 4 : Postmodernism in literature and historical survey

Week 5 : Postmodernism as a literary critical approach

Week 6 : Detailed study of selected texts - Prose

Week 7 : Detailed study of selected texts, Poetry and drama

Week 8 : Detailed study of selected texts - miscellaneous

LANGUAGE AND MIND

HUMANITIES & SOCIAL SCIENCES

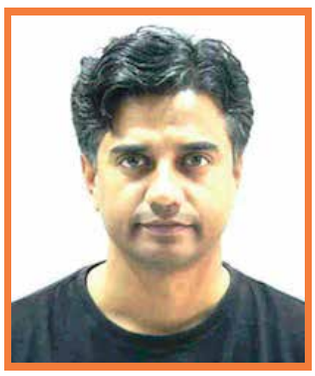
TYPE OF COURSE	**:**	Rerun
PRE-REQUISITES	**:**	None
COURSE DURATION	**:**	8 weeks
INDUSTRY SUPPORT	**:**	None

COURSE OUTLINE

Language learning can be put under three broad perspectives. Some believe language is pairing of lexicon and syntax i.e. of words and the set of rules that defines how we can combine those words most fundamental of these rules are innate i.e. they are already there in the human mind before it is exposed to society. This means there is perhaps an innate Language Faculty. Still others believe that General Cognitive Abilities that account for other kinds of learning can also account for language.

ABOUT INSTRUCTOR

Prof. Rajesh Kumar, Associate Professor Department of Humanities and Social Sciences Indian Institute of Technology,Madras



Academic Background:
PhD (Linguistics), University of Illinois at Urbana-Champaign
MPhil (Linguistics), University of Delhi,
MA (Linguistics), University of Delhi
Research interests: Language in Education, Sociolinguistics, Linguistic Theory, Language and Cognition,
Honours and Awards: Fellow of the Marlene and Morton Meyerson Centennial Chair (2002-03) in the Department of Asian Studies and the College of Liberal Arts at the University of Texas at Austin, U.S.A.
Henry Kahane award for Outstanding Teaching Assistant 2001, Department of Linguistics, University of Illinois at Urbana-Champaign, IL, U.S.A.

COURSE PLAN

Week 1: On Language; What is Language?; What is scientific about language?
How is language constitutive of being human?; Distinction between human and non-human language
Origin of language; What is the relationship between language and mind?; How do children acquire language?
Nature of learning language; Generative foundation of language acquisition; Biological foundation of Language
Language acquisition device; Universal grammar

Week 2: Language in Mind; Acquisition and/or learning; I-language and Innateness; Patterns – Universal Grammar
Human Brain; Language deficit/ loss

Week 3: Patterns in sounds and words; Sounds; Vowels/Consonants; Places and manners of articulation; Features of sounds

Week 4: Words and sentences; Words; Constraints of patterns in words; Cluster as constraints; Syllables

Week 5: Grammar; Parts of sentences; Subjects/ Predicates; Lexical categories; Functional categories; Nature of verbs

Week 6: Advanced Grammar; Complement/ adjunct; Restrictions; Semantic relations; Case; Movement

Week 7: Levels of representation and principles of grammar; Movement/displacement; Motivation for the movement
Complementizer phrase; Case assignment; Passive morphology and NP movement; D structure; Binding theory
Indices and antecedents; Co-indexing; Constraints

Week 8: Language and cognition; Compound verb; Negation; Language and Cognition ; Goal of cognitive sciences
Computational linguistics- goals, breakthroughs and challenges; Language and mind

EDUCATIONAL LEADERSHIP

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Graduation
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	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.

ABOUT INSTRUCTOR

Prof. Atasi Mohanty, Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur 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 1 : Educational Management & Leadership: Issues & challenges

Week 2 : Professional Development & the Reflective Practitioner

Week 3 : Professional Ethics & Values in Teaching

Week 4 : Key Challenges for Educational Leaders: Grooming Capable & Authentic Educational Leaders

Week 5 : Emotional Intelligence & Educational Leadership

Week 6 : Leadership for Managing Diversity & Inclusion in Education

Week 7 : Educational Leadership in a changing World : 21st Century Challenges

Week 8 : Innovative Pedagogy ,Technology & Turnaround Leadership : The Stakeholders' Perspectives

APPRECIATING CARNATIC MUSIC

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

Carnatic music is a vibrant musical tradition that has evolved, and is largely practiced, in Southern India and wherever else there is a significant diaspora of South Indians. A highly nuanced and tonally rich melodic music, its rhythmic aspect too is considerably complex. As much as it is rooted in tradition there is immense demand on the improvisational skills of the musicians. The coming together of these two aspects in a concert can give the listener a musical high.

ABOUT INSTRUCTOR

Prof. Lakshmi Sreeram, Visiting Professor, IIT Madras Trained in Carnatic music since her childhood, Lakshmi has been a performer for over 25 years. She also performs Khayal, a north Indian tradition of classical music. She has a Ph.D in Philosophy from the University of Bombay focusing on the idea of dhvani in Anandavardhana's Dhvanyaloka, a 9th century Sanskrit text in the tradition of Alankarasastra (literary theory). She has been teaching introductory courses on Carnatic and Hindustani music at the prestigious Indian Institute of Technology, Madras. She is also a freelance journalist. For more details and music clips, please visit www.lakshmisreeram.com.Kharagpur with financial supports from industries.

COURSE PLAN

Music in India
Variety of Music in India - Traditions of art or classical music in India
Carnatic Music – the southern music.

Musical material
The 12 pitches or swara sthana-s
The scale - natural or just tempered scale as opposed to the equal or even tempered scale.

Raga - the basic melodic facet of Indian music
What makes for a raga – swara (note/tone), gamaka (embellishment), pidi (phrase), graha, nyasa, jeeva swaras.
Variety of raga-s and their classification. The 72 melakarta schema

Tala - the rhythmic facet
Concepts of the avartana, samam, and eduppu
Suladi sapta tala schema

Composition
Composers - the Carnatic trinity and their contribution; before them and after them
Kinds of composition
Some great compositions
Carnatic music and notation

Improvisation: What is the nature of improvisation in Carnatic music; various kinds of improvisation - alapana, neraval, swara prastara and tanam

Presentation of a Carnatic concert - the meshing of the compositional and improvisational aspects.

Accompaniment - its unique nature in Carnatic music.

Percussive and melodic instruments

Listening to a Carnatic concert - aesthetic and technical aspects.

LITERARY THEORY AND LITERARY CRITICISM

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Any college / university that has Humanities / Arts programme

COURSE OUTLINE

The course presents an overview of major trends in literary criticism and literary theory. It traces the key topics in these domains beginning from the classical times of Aristotle, Plato and Longinus till more recent theoretical trends, such as film studies, gender studies and Eco criticism.

ABOUT INSTRUCTOR

Prof. Aysha Iqbal Viswamohan is Professor at the Department of Humanities & Social Sciences, IIT Madras. Her research interests include Film Studies, Popular Culture and Drama. She has taught and introduced several courses in these areas and has also developed online courses for NPTEL. She has edited 'Postliberalization Indian Novels in English: Global Reception & Politics of Award'. London: ANTHEM, 2013.

COURSE PLAN

Week 1 : Introduction & Course Overview

Week 2: Classical Theory

Week 3: Romanticism

Week 4: Marxism & Formalism

Week 5: Psychoanalysis and Psychoanalytic Criticism

Week 6: Post Structuralism

Week 7: Reader Response criticism

Week 8: Postmodernism

HUMANITIES & SOCIAL SCIENCES

AN INTRODUCTION TO MICROECONOMICS

TYPE OF COURSE : New
PRE-REQUISITES : Class 12 level maths
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : All Banking Enterprises

COURSE OUTLINE

Microeconomics is the study of the allocation of scarce resources among individuals. Economic theories are based on the assumption that individuals as well as firms have well defined objectives; utility maximization for individuals and profit maximization for firms and they act systematically according to the incentives and constraints of their economic environment. (It is this framework that allows the economist to gain a fundamental understanding of the human puzzle in an economic setting. This course in the fundamentals of economics covers consumer theory, producer theory as well as the market structures through which individuals and firms interact.)

ABOUT INSTRUCTOR

Prof. Vimal Kumar, Department of Economic Sciences Indian Institute of Technology, Kanpur. After receiving a Ph.D. in Economics from University of California Irvine in 2008, Vimal Kumar worked in the research division of a multinational firm called Watson Wyatt Worldwide for a year. In June 2009, he joined Indian Institute of technology Kanpur. Initially, he worked as an Assistant Professor of Economics and was promoted to Associate Professor in 2015.

COURSE PLAN

Week 1 : What is Economics, Demand, Supply, Equilibrium, Change in Supply and Demand, Elasticity
Week 2 : Comparative Statics, Consumer Theory, Preferences, Utility Maximization, Substitution and Income Effect, Fiffin Goods
Week 3 : Compensated Demand, Producer Theory, Type of Firms, Production functions and Isoquants, Factor Substitutions, Return to Scale and Economies of Scale
Week 4 : Cost Curves, Cost Functions, Cost Minimization, Profit Maximization, Market Structures, perfect and Imperfect Markets
Week 5 : Perfectly competitive firm, Monopoly, Market Power, Price discrimination, Taxation, Introduction to Game Theory
Week 6 : Cost Curves
Week 7 : Market Environment 1,Perfectly Competitive Market,Short Run vs. Long Run
Week 8 : Equilibrium Analysis,Social Surplus,Dead weight Loss
Week 9 : Market Environment 2- Monopoly,Profit Maximization
Week 10 : Price Discrimination,First Degree,Second Degree,Third Degree
Week 11 : Introduction to Game Theory,Nash Equilibrium
Week 12 : Market Environment 3- Oligopoly,Cournot Game,Bertrand Game

HUMANITIES & SOCIAL SCIENCES

SOCIOLOGICAL PERSPECTIVES ON MODERNITY

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The objective of the course is to enable students to understand modernity as a socio-cultural product in specific socio-historical contexts. The course exposes students to theoretical perspectives to look at modernity and its constituents as a practice deeply embedded in culture and society. It familiarises students with encountering problems in their everyday life from more rationalist perspectives. It attempts to critically engage with and interrogate the multiple views on modernity.

ABOUT INSTRUCTOR

Prof. Sambit Mallick, Department of Humanities and Social Sciences Indian Institute of Technology Guwahati is Associate Professor of Sociology at the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati. He specializes in the sociology of science and technology, and also includes historical sociology and philosophy of the social sciences among his research interests.

COURSE PLAN

Week 1 : Introduction: Modernity as a project of Enlightenment

Week 2 : Modernist paradigm in sociology: modern science, industrialisation and development

Week 3-5 : Sociological modernism: Marx, Weber and Simmel

Week 6-7 : Structuralist interpretation: Levi-Strauss and Althusser

Week 8-9 : Western Marxism: Lukacs, Gramsci and Touraine

Week 10 : Synthesising modernity: Wallerstein, Giddens and Habermas

Week 11 : Deconstructing modernity, modernity in non-modern contexts, the idea of alternative or multiple modernities

Week 12 : Reflexivity: dialectic of engaging with and interrogating modernity

HUMANITIES & SOCIAL SCIENCES

INTRODUCTION TO COGNITIVE PSYCHOLOGY

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

One of the most puzzling fact for humans over the centuries has been the understanding of human behavior. Understanding and predicting human behavior will helps humans in exerting more control over situations. The bases of human behavior are the cognitive processes underlying them. The present course is an attempt to discuss and understand the basic cognitive processes that guide human behavior. The knowledge from the course will be useful in tackling everyday problems and attaining optimal solutions.

ABOUT INSTRUCTOR

Prof. Naveen Kashyap is an Associate Professor of Psychology at the Department of Humanities and Social Sciences 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, human memory, advance cognitive process and research methodology to UG and PG students of IITG Guwahati for the past 10 years.

COURSE PLAN

Topic: Introduction to Cognitive Psychology

Week 1: History and study of human cognition
Week 2: Theories and Research in human cognition

Topic: Basic Cognitive Processes

Week 3: Object Perception and Recognition
Week 4: Attentional Processes and cognition
Week 5: Encoding and retrieving memory traces

Topic: Organizational Knowledge

Week 6: Memory of general knowledge
Week 7: Concept Formation
Week 8: Visual and Spatial Memory

Topic: The Use of Knowledge

Week 9: Human language skills
Week 10: Thought process and Problem Solving
Week 11: Reasoning
Week 12: Decision Making

PATENT LAW FOR ENGINEERS AND SCIENTISTS

HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Studying for or completed engineering or a science degree
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	Would be beneficial for candidates preparing for the Patent Agent Examination

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.

BETTER SPOKEN ENGLISH

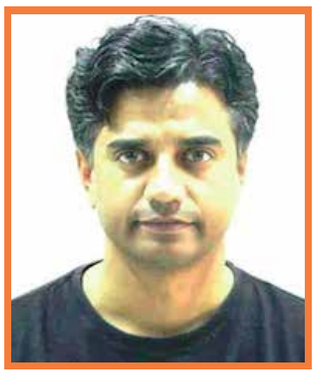
HUMANITIES & SOCIAL SCIENCES

TYPE OF COURSE	**:**	Rerun
PRE-REQUISITES	**:**	None
COURSE DURATION	**:**	12 weeks
INDUSTRY SUPPORT	**:**	None

COURSE OUTLINE

This course aims at introducing students in spoken english, the elements involved in it, presentation skills, etc.

ABOUT INSTRUCTOR



Prof. Rajesh Kumar, Associate Professor Department of Humanities and Social Sciences Indian Institute of Technology,Madras
Academic Background:
PhD (Linguistics), University of Illinois at Urbana-Champaign
MPhil (Linguistics), University of Delhi,
MA (Linguistics), University of Delhi
Research interests: Language in Education, Sociolinguistics, Linguistic Theory, Language and Cognition,
Honours and Awards: Fellow of the Marlene and Morton Meyerson Centennial Chair (2002-03) in the Department of Asian Studies and the College of Liberal Arts at the University of Texas at Austin, U.S.A.
Henry Kahane award for Outstanding Teaching Assistant 2001, Department of Linguistics, University of Illinois at Urbana-Champaign, IL, U.S.A.

The original course contents have been developed by **Prof. Shreesh Chaudhary, who was a faculty member at IIT Madras**. This course is one of among the most popular is the NPTEL courses on English Language.

COURSE PLAN

Why a course in Spoken English?
Aspects of Theatre in Formal Presentation : Grooming, Body Language, Eye Contact, Voice Modulation
Linguistic Aspects of Mishearing
A "Good" Tempo of Speech in English
Research and Organization of Presentation I : Sources of Information; Tables, Charts, Graphs…
Making Power Point Slides and Other Presentation Aid

Grammar of Phrasal Pause in English
Rhythm in Spoken English :
Phrasal Pause in Spoken English:

Listening to Units of Time, Weight, Distance, Etc.:
Word Stress in English : Unique Features
Stress in Simple English Words our derived words
Listening to a Technical Conversation : Bid for Power
Some "Difficult" Sounds in English - I, II

MANAGEMENT

MANAGEMENT

4weeks

01. Management of New Products and Services
02. Research Writing
03. Services Marketing – A Practical Approach

8weeks

01. Quality Design And Control
02. Total Quality Management - II
03. Practitioners Course In Descriptive,Predictive And Prescriptive Analytics
04. Systems Engineering: Theory & Practice
05. Managing Services
06. Project Management
07. Consumer Behavior
08. Principles Of Human Resource Management
09. Foundation Course In Managerial Economics
10. Supply Chain Analytics

12weeks

01. Design And Analysis Of Experiments
02. Business Analytics For Management Decision
03. Soft Skills For Business Negotiations And Marketing Strategies
04. Business analytics and data mining Modeling using R
05. Financial Statement Analysis and Reporting
06. Six Sigma

MANAGEMENT

MANAGEMENT OF NEW PRODUCTS AND SERVICES

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Preferably Marketing Management I
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	Consumer Durables, FMCG, Automotive, Chemical, Pharmaceutical, Engineering and Service Industries

COURSE OUTLINE

This is a post graduate level course on New Product/Service Development. The objective of the course is to familiarize the participants with methods for identifying opportunities and how to convert the opportunities into commercially viable products and services. Participants will be provided with case illustrations of theoretical concepts . After attending the course participants will be familiar with various steps of new product development and will be able to prepare marketing plans for successful commercialization of their ideas. (He has founded two successful start-ups and mentored many. His earlier courses on Marketing Management I and II, Strategic marketing and Managing Services on NPTEL are well subscribed. The book on Services marketing co-authored by Prof Chatterjee and published by Pearson India is also well known.)

ABOUT INSTRUCTOR

Prof. Jayanta Chatterjee is an Adjunct Senior Professor of Marketing, Design 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 eighteen years of Management teaching experience in India and abroad and 30 years of hands on management experience in different countries. He has risen through Sales, Marketing, Project Management, Technology and Business development functions in top multinationals like Siemens, Allen Bradley, and Rockwell International to CEO and Executive Director positions.

COURSE PLAN

Week 1 : New Product and New Service Management - Theoretical Foundations

Week 2 : From ideation to pre- launch of new products

Week 3 : Post Launch activities, NPD process based on organization

Week 4 : NPD- Global marketing and Architecture of Marketing Plan

RESEARCH WRITING

MANAGEMENT

TYPE OF COURSE : New
PRE-REQUISITES : None. Just an interest in writing based on research.
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : All educational institutions

COURSE OUTLINE

Research is of no use till it is shared with people who can use it. Writing about one's research and publishing it validates the research. An added advantage of publication is feedback from peers and experts, which in turn helps with the evolution and perfection of new areas of study.

ABOUT INSTRUCTOR

Prof. Aradhna Malik, is a faculty in the Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur, since 2008. She earned her Masters in Child Development from Punjab University, Chandigarh, India and PhD from University of Denver, USA. Aradhna taught the research writing component of the course titled 'English for Technical Writing' to PhD students from all departments across IIT Kharagpur for over three years. Aradhna currently 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

COURSE PLAN

Week 1 : What, why and how of technical and research writing

Week 2 : Literature review

Week 3 : Writing about methods, results, and discussion of results

Week 4 : Referencing, academic integrity, and writing for different types of readers (Research proposals, Dissertations, Journal articles, Magazine articles)

MANAGEMENT

SERVICES MARKETING – A PRACTICAL APPROACH

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Any company has to manage its services. Hence, any company will recognize/value this online course

COURSE OUTLINE

This course will help students to learn the fundamentals of services marketing from a practical point of view. The course focusses on the needs of the customers, who are to be kept satisfied and delighted for a business to prosper. The course will help students understand services marketing from various perspectives and will also be useful if participants wish to establish a new service business of manage an existing one.

ABOUT INSTRUCTOR

Prof. Biplab Datta, is an Associate Professor (Marketing) at Vinod Gupta School of Management, Indian Institute of Technology Kharagpur, India. He holds a Ph.D. degree from Indian Institute of Technology Delhi, India. His research interests include Marketing Management, Service Quality Management and Customer Relationship Management. He was awarded a Silver Medal in Architecture by IIT Kharagpur in 1992 and earned ISO 9000 Lead Auditor Certificate from NBA, U.K. He has published a book entitled "Services Marketing: A Practical Approach". He has published several papers in national and international journals.

COURSE PLAN

Week 1 : Introduction, Why Study Services Marketing Management?, The Service System, Characteristics of Services, Understanding the Macro-Environment

Week 2 : Understanding the Micro-Environment, Services Marketing Process, Services Marketing Research, Exploring Marketing Opportunities, New Service Development, Segmenting the Market, Targeting and Positioning, Understanding Consumer Behaviour, The Service Product, Service Quality, Designing the Service Process

Week 3 : Developing Service Personnel, Educating Customers, Managing Service Delivery Channels, Managing Channel Conflict, Managing Demand and Capacity, Designing the Physical Evidence, Managing Integrated Marketing Communications, Pricing the Service, Managing Customers, Managing Service Recovery, Providing Service Guarantees, Consumer Protection

Week 4 : Case Studies in Services Marketing-1, Case Studies in Services Marketing-2, Case Studies in Services Marketing-3, Case Studies in Services Marketing-4, Case Studies in Services Marketing-5

QUALITY DESIGN AND CONTROL

MANAGEMENT

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Tata Steel, Tata Motors, L&T Linde and similar such manufacturing and service organizations including IT companies

COURSE OUTLINE

The objective of the course is to introduce basic concepts and statistical methods employed for assurance of quality in products, processes and systems in an industrial environment (manufacturing and service organizations), such as Management and Control of Quality and Quality System, Statistical Process Control, Process Capability Analysis, Acceptance Sampling, Process Capability Analysis, Design for Reliability, Robust Design and Taguchi Method for Quality Improvement.

ABOUT INSTRUCTOR

Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur, He served as the Head of the Department during September, 2006 to August, 2009. A mechanical engineering graduate (IIEST, Shibpur) with MTech degree and PhD in industrial engineering (IIT Kharagpur), Professor Ray has about more than thirty-six years of diversified experience - eight years in industry and more than twenty-eight years of teaching and research experience at IIT Kharagpur. He has served as a visiting professor at several institutions abroad and is trained in Japan on Production Management/JIT-based Manufacturing.

COURSE PLAN

Week 1 : History and Evolution of Quality Control and Management

Week 2 : Management of Quality-I

Week 3 : Management of Quality-II

Week 4 : Statistical Process Control-I

Week 5 : Statistical Process Control-II

Week 6 : Process Capability Analysis

Week 7 : Acceptance Sampling-I

Week 8 : Acceptance Sampling-II

Week 9 : Design for Reliability-I

Week 10 : Design for Reliability-II

Week 11 : Quality by Experimental Design

Week 12 : Robust Design and Taguchi Method

TOTAL QUALITY MANAGEMENT - II

MANAGEMENT

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Probability & Statistics
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	All service, manufacturing, industry, government department, any type of private industry

COURSE OUTLINE

This is the second part of the two part course (TQM-I, TQM-II) and will cover topics ranging from Quality Engineering, Quality Function Development, Introduction to Design of Experiments, Process Optimization and Robust Product Design, Steps to Six Sigma, Management of Quality, its ultimate philosophy, etc.

ABOUT INSTRUCTOR

Prof. Raghu Nandan Sengupta completed his bachelors in 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. 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, 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.)

COURSE PLAN

Week 1 : Quality Engineering, Quality Function Deployment

Week 2 : Quality Function Deployment, Introduction to Design of Experiments

Week 3 : Introduction to Design of Experiments

Week 4 : Introduction to Design of Experiments

Week 5 : Introduction to Design of Experiments, Process Optimization and Robust Product Design

Week 6 : Process Optimization and Robust Product Design

Week 7 : Process Optimization and Robust Product Design, Steps to Six Sigma

Week 8 : Steps to Six Sigma, Management of Quality, its ultimate philosophy

PRACTITIONERS' COURSE IN DESCRIPTIVE, PREDICTIVE AND PRESCRIPTIVE ANALYTICS

MANAGEMENT

TYPE OF COURSE : New
PRE-REQUISITES : The student should have completed fivesemesters of UG Engineering or Science program.
COURSE DURATION : 8 weeks
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

Introduction to analytics

Differentiating descriptive, predictive, and prescriptive analytics, data mining vs data analytics
Industrial problem solving process; Decision needs and analytics, stakeholders and analytics, SWOT analysis
Model and modeling process, modeling pitfalls, good modelers, decision models and business expectations, Different types of models – overview of context diagrams, mathematical models, network models, control systems models, workflow models, capability models; 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; 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
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; 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

MANAGEMENT

SYSTEMS ENGINEERING: THEORY & PRACTICE

TYPE OF COURSE : Rerun
PRE-REQUISITES : The student should have either completed an engineering degree or is enrolled in the program and have completed at least six semesters of the curriculum
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : HAL, BHEL, BEL, L&T, Automotive companies, Aerospace and defense companies, DRDO, Boeing, Lockheed, Airbus, Brahmos, ISRO, VSSC, etc.

COURSE OUTLINE

Systems engineering is a discipline that utilizes an inter-disciplinary problem-solving approach across the entire technical effort irrespective of whether the systems or the systems of systems are for military, industrial, commercial or civil applications. This course will provide an overview of both theory and practice of the systems engineering discipline along with systems engineering design approach.

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.

COURSE PLAN

Week 1 : Systems engineering – what is, origin, and examples; Systems engg as a profession
Power of systems engg and examples ; Systems engg viewpoint, perspectives, domains ; Systems engg fields, approaches, activities, and products

Week 2 : Complex system structure-building blocks, hierarchy, interfaces; Complex system structure-environment, interactions, complexity; System development process – life cycle,evolutionary characteristics; Systems engg method; Systems testing throughout development

Week 3 : Managing systems development, risks, work breakdown structure (WBS), systems engg management plan (SEMP) Systems risk management, organizing for systems engg; Need analysis – originating, operations, functional, and feasibility Need validation, systems ops requirement; System requirements development, performance requirements

Week 4 : Implementing concept exploration, validating requirements; Concept definition – selection and validation, functional analysis and allocation ; Systems architecture, system modeling languages, Model-Based Systems Engg (MBSE) Decision making, modeling for decisions; Simulation, Trade-off analysis

Week 5 : Engg development stage – program risk reduction, prototype development for risk mitigation
Development testing, risk reduction; Revision of functional analysis and design; Overview of probability data analysis; Hypothesis testing

Week 6 : Engineering design – implementing system building blocks, component design; Design validation, change management; Concepts of reliability, redundancy; Concepts of maintainability, availability, producibility; User interface design and GUI

Week 7 : Integration, testing and evaluating total system; Test planning and preparation, system integration
Developmental and operational test and evaluation; Engineering for production, transition from development to production Production operations - 1

Week 8 : Production operations - 2; Installation, maintenance and upgrading; Installation testing; In-service support Upgrades and modernization

MANAGING SERVICES

MANAGEMENT

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Tourism, Hospitality, Healthcare, Retail, Media, Entertainment and E-Service organisations

COURSE OUTLINE

Service is the key economic engine for most developed countries and also for emerging economies like India. This course focuses on the interdisciplinary nature of Service Management seamlessly spanning Marketing, Operations, Technology and People Management. New Service Business Models will be explored that seek to balance People, Planet concerns with Profit objectives.

ABOUT INSTRUCTOR

Prof. Jayanta Chatterjee, is a Professor in the Industrial Management Engineering Department as well as at the interdisciplinary Design Program, Indian Institute of Technology, Kanpur and a Visiting Professor at Design Factory, Aalto University, Finland and School of Management, Asian Institute of Technology, Thailand. He is a graduate in Electrical Engineering from Jadavpur University and a PhD in Strategy and Technology management from IIT Delhi. Professor Chatterjee seamlessly moves between corporate and academic assignments as an erudite hands- on practitioner and a rigorous teacher-researcher. He has 15 years of experience in management teaching and research, and 28 years of top management experience in Sales, Marketing, Brand and Customer Equity management across different countries. Currently his research teaching, advisory services focus on Product Service Systems, Business Model Innovation and Creative Renewal.

COURSE PLAN

Week 1 : What is Service?/Evolving Service Markets/The Service Customers/Product Service Systems/The Service Act Seamless Service

Week 2 : Service Management Elements/Core Vs. Supplementary Services/Intangibility of Services/Response to IHIP Challenges/Process & Promotion/Process Issues in Service

Week 3 : Challenges of Services-1/Service Uniqueness-2/Consumer in the Services Flow-1/Service Consumer Behaviour-2/Customer Co Creation of Services-1/Customer Co Creation of Services-2

Week 4 : Positioning the Service Offering/Important Vs. Determinant attributes/Positioning & Brand Creation/Positioning Maps/Designing & Managing Service as a Process/Balancing Demand & Capacity

Week 5 : Service Logistics & Service Channels/E-Services/Service Failure/Service & the New Media/Service Recovery/Integrating People & Process for Service Leadership

Week 6 : Pricing Fundamentals/Pricing Fundamentals/Service Pricing/Service Pricing/Revenue Management/Revenue Management

Week 7 : Managing Service Productivity/Developing the Relation Focused Service Excellence/Customer as Co-creator

Week 8 : Service Entrepreneurs/Service Professionals/Service Business Models/Service Globalization/Creating Customer focused Service Leadership

PROJECT MANAGEMENT

MANAGEMENT

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic Probability & Statistics Basic Operations Research
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : 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, faculty at Industrial & Management Department at IIT Kanpur 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

Project Management,Concepts and Definitions
Project Management Cycle
Risk associated with Projects Decision
Tree Modeling
Cost Evaluation Techniques in Project Management
GANNT Chart and Precedence Diagrams
PER, CPM
Project Life Cycles
Concepts of Scheduling
GERT
Q-GERT
Critical Chain and Theory of Constraints
Activity Network Diagram
Resource requirement, Resource constraints, Crashing of Jobs
Project Control Techniques
Earned Value Project

CONSUMER BEHAVIOR

MANAGEMENT

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Marketing Department of the companies dealing in B2C and B2B markets

COURSE OUTLINE

Drawing heavily from the fields of psychology, anthropology and economics; the course Consumer Behaviour puts forth the decision-making processes of buyers, both individually and in groups. It studies the decision-making parameters at both individual as well as group levels as endeavors to understand the consumer preferences and choice heuristics. The course will also bring forth the parameters, process and conflicts while considering family as decision-making unit. The course will sensitize the participants about how the aforesaid concepts will help them in designing appropriate marketing mix and the overall marketing strategy.

ABOUT INSTRUCTOR

Prof. Srabanti Mukherjee is an Assistant Professor in Marketing at Vinod Gupta School of Management, Indian Institute of Technology Kharagpur, India. She holds a PhD degree from Indian Institute of Engineering Science and Technology Shibpur, India. Prior to joining this Institute she has taught in several premiere institutes including Indian Institute of Management Indore, Indian Institute of Social Welfare and Business Management, IIEST Shibpur and Visva Bharti University.

COURSE PLAN

Week 1: Introduction to Consumer Behaviour, The Changing Patterns of Consumer Behaviour, Use of Market , Segmentation in Consumer Behaviour, Dimensions of Consumerism, Process of Motivation

Week 2: Theories of Motivation-1, Theories of Motivation-2, Consumer Involvement, Case study on Motivation and Involvement, Consumer perception and imagery

Week 3: Case Study on Consumer Perception formation, Theories of Personality, Self-Concept, Learning theories, Case Study on Consumer Learning Process

Week 4: Attitude Formation-1, Attitude Formation-2, Changing Attitude, Attitude Formation, Case Study on Consumer, Consumers' Value

Week 5: AIO classification of Lifestyle, VALSTM Typology, Application of Lifestyle in Marketing, Culture and subculture, Group as a determinant of buyer behaviour

Week 6: Celebrities as Reference group, Concept of family and family life-cycle, Family Buying Decisions, Case Study on Family Buying Decisions, Diffusion of Innovation

Week 7: Opinion Leadership Types of Consumer Buying Behaviour, Black-Box Model, Modelling Buyer Behaviour-1, Modelling Buyer Behaviour-2

Week 8: Modelling Buyer Behaviour-3, Modelling Industrial buyer Behaviour-1,Modelling Industrial buyer Behaviour-2, Dimensions of Consumer Research, Course Wrap up

MANAGEMENT

PRINCIPLES OF HUMAN RESOURCE MANAGEMENT

TYPE OF COURSE : Rerun
PRE-REQUISITES : Any student who has passed class XII
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Management of human resources is the most important function in any organization. It is essential to achieve a balance between caring for one's employees, helping them work to their maximum potential and achieving the goals of an organization through the work the employees put in. This course is specifically designed to sensitize students who are preparing to enter the workforce to issues related to workforce management.

ABOUT INSTRUCTOR

Prof. Aradhna Malik earned her Masters in Child Development from Panjab 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.** Aradhna 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 1 : Introduction to HRM Staffing / Recruitment : Job Analysis and Design, Human resource Planning / Recruitment, Employee Testing and Selection,Interviewing Candidates

Week 2: Performance Management and Appraisal Process : Performance Appraisal Process / Types of Performance Appraisal / Performance Evaluation / Performance Feedback Training and development : Training Process / Need for Training / Training Methods / General and Specific Training/ Training evaluation

Week 3 : Managing Careers : Basics of Career Management / Career Planning / Succession Planning/ Career Development / Promotions and Transfers / Employee Commitment, Implications : Implications of the above in real life

Week 4 : Compensation Management: Components of Wage Structure / Wage and Salary Administration / Compensation Structure / Compensation Benchmarking / Internal and External Parity / Competency based pay

Week 5 : Pay for Performance and Incentives : Competency / Performance based pay / Variable pay / Team or Group base pay /Incentives / Managerial Incentives / Fringe Benefits

Week 6 : Benefits and Services : Retirement / Insurance / Flexible benefits

Week 7 : Employee Relations: Ethics, Justice and Fair treatment in HR / Collective Bargaining /Employee Safety and Health / Managing Global Human Resources / International HRM

Week 8 : Strategic Human Resource Management and HR Scorecard :Linking people, strategy and performance
a. HR – Strategic Partner
b. Creating an HR scorecard
c. Measuring HR alignment
Conclusion

MANAGEMENT

FOUNDATION COURSE IN MANAGERIAL ECONOMICS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic Algebra and Calculus
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Public Policy organizations, Banks, Managerial levels in all Industries.

COURSE OUTLINE

This course is developed to teach modern microeconomic theory to understand the behavior of household, firms and their interaction under different market structure. The purpose of this course is to provide students with a basic understanding of economic theory that can be used in managerial decision making problems within various organizational settings such as a firm or a government agency. Objective is to develop a good understanding of economic concepts and tools that have direct managerial applications.

ABOUT INSTRUCTOR

Prof. Barnali Nag teaches economics and business environment in Vinod Gupta School of Management, IIT Kharagpur. She is a PhD from IGIDR (Indira Gandhi Institute of Development Research), Mumbai and did her post-doctoral research from Wharton Business School, University of Pennsylvania. She has worked as Business Research Fellow at the Indian School of Business, Hyderabad and RIS, New Delhi, Ministry of External Affairs, GoI, an advanced Institute for actionable research. Before joining VGSoM, IIT Kharagpur, she was a faculty in Indian Institute of Management Kashipur. Dr. Nag has published in various refereed international journals of repute.

COURSE PLAN

Week 1 : Introduction, Demand and Supply

Week 2 : Elasticity of demand and supply.

Week 3 : Government intervention and efficiency

Week 4 : Producer theory and cost curves.

Week 5 : Market structures and perfect competition.

Week 6 : Monopoly and histology images.

Week 7 : Monopolistic competition

Week 8 : Oligopoly

SUPPLY CHAIN ANALYTICS

MANAGEMENT

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	Basic knowledge of Operations management will be desirable.
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	IBM, Mu-Sigma, Genpact, Accenture, Capgemini, Wipro, Deloitte.

COURSE OUTLINE

In present time of intense global competition, customers are demanding more and more variety, with better quality and service at lowest cost. This means that in order to be successful, firms need to develop supply chain strategies and logistical capabilities that serve the needs of their customers whilst maximizing overall profitability. All supply chains, in order to function properly, must focus on the huge opportunity that exists in their analytics.

ABOUT INSTRUCTOR

Prof. Rajat Agrawal is an Associate Professor at Department of Management Studies, Indian Institute of Technology Roorkee, He is 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.

COURSE PLAN

Week 1: Context of today's supply chains (SC) analytics
Understanding and defining the supply chain analytics (SCA)
Revisions of Basic Lessons of Supply Chain Management
Why is Analytics Important in a supply chain?
Relating Operations Management with Supply chain concepts with SC Analytics
The importance of supply chain analytics in the flows involving material, money, information and ownership

Week 2: Supply chain analytics
Key issues in supply chain analytics
What involves in supply chain analytics
Concept of Descriptive Analytics in a Supply Chain
Discussion on a Few Supply Chains Analytics applications in India (students participation is expected)
Decision Domains in in supply chain analytics

Week 3: Foundation of Business Anlaytics (BA)
E2: Introduction to Modeling, Approaches for Optimization and Simulation, Modeling software, Supply Chain (SC) Decisions that requires mathematical or interpretative modelingUnderstanding of Data and its role in Analytics
Analytics of a Transportation problem in a Supply Chain
Managerial implication of results of analytics

Week 4: A case study of supply chain analytics

Week 5: Foundation of PRESCRIPTIVE ANALYTICS IN NETWORK PLANNING IN A SUPPLY CHAIN
Network Planning in a Supply Chain
Importance of Network Planning
Design of Logistics Network using Heuristics/optimization (Exercise 3.4 Levi (2008))
Concept of 3PL/4PL in a Supply Chain
Case Study: GATI

Week 6: Foundation of Modeling Coordination Decisions in SUPPLY CHAIN MANAGEMENT

Week 7: Foundation of PERFORMACE MANAGEMENT IN SUPPLY CHAIN MANAGEMENT

Week 8: IT ENABLEMENT OF SUPPLY CHAINS
Role of ICT in Supply chains

MANAGEMENT

DESIGN AND ANALYSIS OF EXPERIMENTS

TYPE OF COURSE : New
PRE-REQUISITES : Probability and statistics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Manufacturing companies like GM, Tata Motors, Tata Steel Process industries such as ONGC, General Electric R&D organizations

COURSE OUTLINE

The objective of this course is to impart students a holistic view of the fundamentals of experimental designs, analysis tools and techniques, interpretation and applications. Upon completion of this course, the students will know (i) the fundamentals of experiments and its uses, (ii) basic statistics including ANOVA and regression, (iii) experimental designs such as RCBD, BIBD, Latin Square, factorial and fractional factorial designs, (iv) application of statistical models in analysing experimental data, (v) RSM to optimize response of interest from an experiment, and (vi) use of software such as Minitab.

ABOUT INSTRUCTOR

Prof. J. 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.

COURSE PLAN

Week 1 : Introduction to design and analysis of experiments with basic concepts and applications

Week 2 : Basic statistics

Week 3 : Analysis of Variance (ANOVA)

Week 4 : Regression

Week 5 : Experimental designs: Randomized complete block design (RCBD)

Week 6 : Experimental designs: Variants of RCBD such as Latin Square, central composite design, etc.

Week 7 : Experimental designs: Full factorial experiments

Week 8 : Experimental designs: 2k factorial experiments

Week 9 : Experimental designs: Fractional factorial experiments

Week 10 : Experimental designs: 2k-p factorial experiments

Week 11 : Response surface methodology (RSM)

Week 12 : Introduction to software MINITAB

MANAGEMENT

BUSINESS ANALYTICS FOR MANAGEMENT DECISION

TYPE OF COURSE : New
PRE-REQUISITES : Basic Statistics, Basic Mathematics, Basic Management
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Students can get exposure on data analysis, modeling and spreadsheet use with this course which will be exclusively quantitative and an application to business/ management related problems. It is connected with problem sets and real life cases to know the relevance of a particular problem and the decision making thereof.

ABOUT INSTRUCTOR

Prof. Rudra P Pradhan is Associate Professor at Vinod Gupta School of Management, IIT Kharagpur. His specialization is Econometric Modeling and Financial Econometrics. His teaching and research assignments are mostly on econometric modeling and mathematical modeling.

COURSE PLAN

Week 1 : Introduction to Business Analytics

Week 2 : Exploring Data and Analytics on Spreadsheets

Week 3 : Descriptive Analytics

Week 4 : Inferential Analytics 1

Week 5 : Inferential Analytics 2

Week 6 : Predictive Analytics 1

Week 7 : Predictive Analytics 2

Week 8 : Predictive Analytics 3

Week 9 : Prescriptive Analytics 1

Week 10 : Prescriptive Analytics 2

Week 11 : Prescriptive Analytics 3

Week 12 : Decision Analytics

MANAGEMENT

SOFT SKILLS FOR BUSINESS NEGOTIATIONS AND MARKETING STRATEGIES

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : This course would also be very useful for the aspirants for Government as well as Private employment.

COURSE OUTLINE

The primary focus of this course is to highlight various categories and applications of soft skills through various cases extracted from the real field and other research case studies. The fundamental concepts and distinctions between Soft Skills and Hard Skills are discussed.

ABOUT INSTRUCTOR

Prof. Uttam Kumar Banerjee, is currently a Senior Professor in the Department of Architecture & Regional Planning, as well as Joint-Faculty in the RCG School of Infrastructure Design and Management at the Indian Institute of Technology Kharagpur, where he has served as the Head in both the departments from 2004 to 2007 and 2011 to 2014 respectively. He has graduated with Bachelor of Architecture (B.Arch), post-graduated with Master of City Planning (MCP) and Ph.D. in Transportation system evaluation from Indian Institute of Technology Kharagpur.

COURSE PLAN

Week 1 : Soft Skills and Hard Skills

Week 2 : Non-verbal communications

Week 3 : Negotiations

Week 4 : Professional Negotiations

Week 5 : Business Negotiation

Week 6 : Product Marketing Negotiation

Week 7 : Negotiation for Services

Week 8 : Marketing Strategy

Week 9 : Power Marketing

Week 10 : Power Marketing Strategies

Week 11 : Power Marketing Presentations

Week 12 : Time Management in Marketing

MANAGEMENT

BUSINESS ANALYTICS AND DATA MINING MODELING USING R

TYPE OF COURSE : New
PRE-REQUISITES : Basic Statistics Knowledge
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Big Data companies, Analytics & Consultancy companies. Companies with Analytics Division

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 : General Overview of Data Mining and its Components Introduction and Data Mining Process Introduction to R Basic Statistical Techniques

Week 2 : Data Preparation and Exploration Visualization Techniques

Week 3 : Data Preparation and Exploration Visualization Techniques Dimension Reduction Techniques Principal Component Analysis

Week 4 : Performance Metrics and Assessment Performance Metrics for Prediction and Classification

Week 5 : Supervised Learning Methods Multiple Linear Regression

Week 6 : Supervised Learning Methods Multiple Linear Regression

Week 7 : Supervised Learning Methods Nave Bayes

Week 8 : Supervised Learning Methods Classification & Regression Trees

Week 9 : Supervised Learning Methods Classification & Regression Trees

Week 10 : Supervised Learning Methods Logistic Regression

Week 11 : Supervised Learning Methods Logistic Regression Artificial Neural Networks

Week 12 : Supervised Learning Methods and Wrap Up Artificial Neural Networks Discriminant Analysis Conclusion

MANAGEMENT

FINANCIAL STATEMENT ANALYSIS AND REPORTING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : All industries/companies

COURSE OUTLINE

Financial Analysis and reporting is an integral part of overall financial analysis carried out by various business organizations in India and all around the world. It depicts the financial health of any company and helps the companies to augment their financial resources and management of generated funds efficiently.

ABOUT INSTRUCTOR

Prof. Anil K. Sharma, Department of Management Studies Indian Institute of Technology, Roorkee, is a gold medalist in M.Com and has a Ph.D. in Financial Management from Punjab University, Chandigarh. He is working at IIT Roorkee for the past 15 years and has more than 20 years teaching experience in total. His area of interest is finance and accounting.

COURSE PLAN

Week 1 : Introduction, Indian Economy, Industry & Industrial scenario in India, Forms of business organizations, Sole Proprietorship, Partnership firms and private companies, Public and Govt. Companies.
Week 2 : Content of annual reports, Quality of financial reporting, Reporting regulation in India, Reporting regulations for Partnership firms, Reporting regulations of Companies.
Week 3 : Nature & objectives of Financial Statements, Uses & Limitations of Financial Statements, Stakeholders of financial statements, Income Statement, Income Statement.
Week 4 : Income Statement, Income Statement, Balance Sheet, Balance Sheet, Balance Sheet.
Week 5: Balance Sheet, Cash Flow Statement, Sources of financial information, Tools and techniques of financial statement analysis, Tools and techniques of financial statement analysis.
Week 6 : Tools and techniques of financial statement analysis, Ratio Analysis, Ratio Analysis, Ratio Analysis, Ratio Analysis.
Week 7 : Ratio Analysis, Ratio Analysis, Cash flow statement, Cash flow statement, Cash flow statement.
Week 8 : Cash flow statement, Comparative Statement, Common Size Statement, Du-Pont Analysis, Concepts on sickness, distress.
Week 9 : Report preparation of financial statement analysis, Types of business combinations, Consolidated financial statements, Consolidated financial statements, Consolidated financial statements.
Week 10 : Inter-company transactions and profit confirmations, Inter-company transactions and profit confirmations, Minority interest, consolidated net income and consolidated retained earnings, Minority interest, consolidated net income and consolidated retained earnings, Minority interest, consolidated net income and consolidated retained earnings.
Week 11 : Balance Sheet Under Income Tax Act, Balance Sheet Under Income Tax Act, Balance Sheet Under Companies Act, Balance Sheet Under Companies Act, Balance Sheet Under Companies Act.
Week 12 : Window dressing, Window dressing, Recent scandals in financial reporting, Recent scandals in financial reporting, Recent scandals in financial reporting.

MANAGEMENT

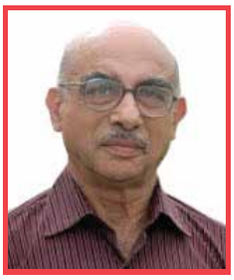
SIX SIGMA

TYPE OF COURSE : Rerun
PRE-REQUISITES : Engineering and Math courses in undergraduate (B Tech) program
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Manufacturing and Service Industry.

COURSE OUTLINE

The course on Six Sigma will focus on detailed strategic and operational issues of process improvement and variation reduction called Six Sigma, a measure of quality that strives for near perfection. It is a disciplined, data-driven approach for eliminating defects (driving towards six standard deviations between the mean and the nearest specification limit) in any process-from manufacturing to transactional and from product to service.

ABOUT INSTRUCTOR



Prof. T. P. Bagchi Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur holds a B Tech in Mechanical Engineering from IIT Kanpur, India and MASc and Ph.D in Industrial Engineering from the University of Toronto, Canada. He also holds a DSc in Quality Engineering from IIT Kharagpur, India.

Prof. Jitesh J Thakkar, Industrial and Systems Engineering Indian Institute of Technology, Kharagpur, He received Ph.D in Supply Chain Management from IIT Delhi, Masters in Technology in Industrial Engineering from IIT Delhi and Bachelors in Mechanical Engineering with Gold Medal from the oldest Government Engineering College Birla Vishvakarma Mahavidyalaya, Sardar Patel University, Gujarat.

COURSE PLAN

Week 1: Quality concepts and definition; Key concepts in quality management; Fundamentals of Total Quality Management (TQM); Cost of quality and Six Sigma

Week 2: Fundamentals of statistics; Probability theory and concepts; Probability rules and events; Sampling distribution and test of hypothesis

Week 3: Quality philosophies and standards; Tools for TQM and continuous improvement; Quality Function Deployment (QFD) and Design failure mode effects analysis (DFMEA); Quality awards, benchmarking and service quality

Week 4: Service quality and process control ; Project management: Complexities and examples
Project management: Key decisions, Work breakdown structure, schedule development and cost estimation
Project planning and scheduling: Network, critical path method, PERT, crashing

Week 5: Measurement accuracy and process variations; Acceptance sampling; Operating characteristic curve

Week 6: Design of sampling plan; Basics of Statistical Process Control; Statistical Process Control for services

Week 7: Control charts for variables and attributes; Process capability: Fundamentals and measures; Quality Function Deployment (QFD) and Kano Model

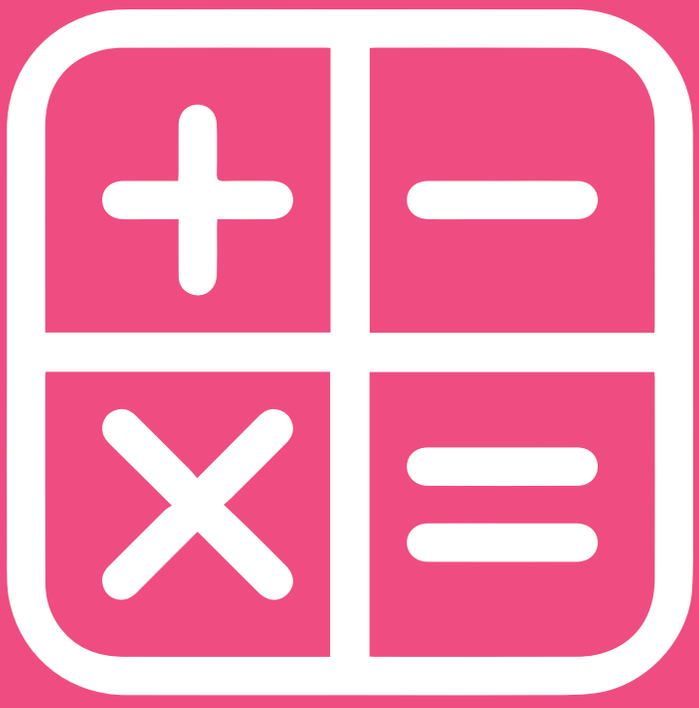
Week 8: Design of experiment (DOE); Experimental analysis in product realization; Experimental setups and strategies

Week 9: Factorial experiment, ANOVA and Response surface; Benchmarking: Customer-service and Product-service performance; Benchmarks and performance measurement: Critical success factors and case study

Week 10: Supply Chain Management, TQM and quality chain; Taguchi Product Design Approach; Taguchi's Robust Design

Week 11: DMAIC, Zero defect and Six Sigma; Six Sigma: Case study and Tools; Design for Manufacturing (DFM), Design for Assemble (DFA) and Reliability Analysis

Week 12: Failure Mode and Effect Analysis (FMEA); Six Sigma: Strategic planning and Implementation
Six Sigma and Operational Excellence: Summary



MATHEMATICS

MATHEMATICS

4weeks

01. Numerical Methods: Finite difference approach

8weeks

01. Calculus for Economics,Commerce and Management
02. Multivariable calculus

12weeks

01. Numerical Linear Algebra
02. Chaotic Dynamical Systems
03. Stochastic Processes

MATHEMATICS

NUMERICAL METHODS: FINITE DIFFERENCE APPROACH

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Numerical Methods Basic Knowledge
COURSE DURATION	:	4 weeks
INDUSTRY SUPPORT	:	TCS, Intel, General Electric, General Motors, ABB, Nuclear Industries, etc

COURSE OUTLINE

This course is an advanced course offered to UG/PG students of Engineering/Science background. It contains solution methods for different class of partial differential equations. The convergence and stability analysis of the solution methods is also included . It plays an important role for solving various engineering and sciences problems. Therefore, it has tremendous applications in diverse fields in engineering sciences.

ABOUT INSTRUCTOR

Prof. Ameeya Kumar 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. He has authored and co-authored more than 32 peer-reviewed journal papers, which includes publications in Springer,ASME, American Chemical Society and Elsevier journals. He is also active in writing book chapter with reputed international publication house.

COURSE PLAN

Week 1: Introduction to Numerical methods, Initial and Boundary value problems, Numerical solution of ODE, Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge-Kutta method.

Week 2: Introduction of PDE, Classification of PDE: parabolic, elliptic and hyperbolic. Boundary and initial conditions, Taylor series expansion, analysis of truncation error, Finite difference method: FD, BD & CD, Higher order approximation, Order of Approximation, Polynomial fitting, One-sided approximation.

Week 3: Parabolic equation in 2D, Explicit & Crank-Nicolson method, Alternating direction Implicit method (ADI), Elliptic equations, Solution of Poisson equation with Example, Successive over Relaxation (SOR) method, Solution of Elliptic equation by using ADI method, Example.

Week 4: Hyperbolic equations, solution using Explicit method, Stability analysis of Explicit and Implicit scheme, Example, Characteristics of PDE, Solution of Hyperbolic equation by using methods of Characteristics, Hyperbolic equation of first order, Lax-Wendroff's method, Wendroff's method, stability analysis of method, Example.

MATHEMATICS

CALCULUS FOR ECONOMICS, COMMERCE AND MANAGEMENT

TYPE OF COURSE : New
PRE-REQUISITES : Basic School Level Mathematics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course is based on the course"mathematics for Economics, Commerce and Management", which was run at IIT Bombay for 8 years. Mathematical tools give a precise way of formulating and analyzing a problem and to make logical conclusions. Knowledge of mathematical concepts and tools have have become necessary for students aspiring for higher studies and career in any branch of Economics, Commerce and Management.

ABOUT INSTRUCTOR

Prof. Inder Kumar Rana, Department of Mathematics, Indian Institute of Technology, Bombay is an Emeritus Fellow at Department of Mathematics, IIT Bombay. He has an experience of 36 years of teaching mathematics courses to Undergraduate (B. Tech) and Master's M.Sc. students at IIT Bombay. He has authored 4 books,namely, Introduction to measure and Integration American Mathematical Society, Graduate Studies in Mathematics Volume 45, 2000,
From Numbers to Analysis: World Scientific Press, 1998,
Calculus @IITB: Concepts and Examples, Math4all, India, 2007
From Geometry to Algebra: A course in Linear Algebra: Math4all, India, 2007.

COURSE PLAN

Week 1 : Revision of basic concepts from Mathematical finance

Week 2 : Basic set theory and concept of functions

Week 3 : Limits and Continuity of a function of one variable and its applications

Week 4 : Derivative and tools to compute

Week 5 : Application of derivatives in increasing/decreasing

Week 6 : Application of derivatives in optimization

Week 7 : Functions of several variables

Week 8 : Applications

MULTIVARIABLE CALCULUS

MATHEMATICS

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	Standard 12th
COURSE DURATION	**:**	8 weeks
INDUSTRY SUPPORT	**:**	None

COURSE OUTLINE

This course is a basic course offered to UG and PG students of Engineering/Science background. It contains matrices computations involving rank, eigen values, eigen vectors, singularity transformations, (diagonalisation, Joradan canonical etc). It also convers vectors spaces, basis and dimension, linear transformation and their properties. Besides discussing the matrix theory, it also includes its applications in solving diverse science and engineering problems.

ABOUT INSTRUCTOR

Prof. 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 theses and has published more than 40 papers in various international journals of repute.

Prof. 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 **:** Limits, continuity and partial derivatives of multivariable functions

Week 2 **:** Differentiability and chain rule

Week 3 **:** Change of variables, Euler's theorem, tangent planes, normal lines and extreme values

Week 4 **:** Taylor's theorem, error approximation, polar curves and multiple integrals

Week 5 **:** Change of order and change of variables in multiple integral

Week 6 **:** Beta and gamma functions

Week 7 **:** Normal vector and potential field

Week 8 **:** Vector identities and line integral

NUMERICAL LINEAR ALGEBRA

MATHEMATICS

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

This course is a basic course offered to UG/PG students of Engineering/Science background. It contains basics of matrix algebra, computer arithmetic, conditioning and condition number, stability of numerical algorithms, vector and matrix norms, convergent matrices, stability of non-linear systems, sensitivity analysis, singular value decomposition (SVD), algebraic and geometric properties of SVD, least square solutions, Householder matrices and applications, QR method, Power method and applications, Jacobi method for finding the eigenvalues of a given matrix.

ABOUT INSTRUCTOR

Prof. P. N. Agrawal is a Professor in the Department of Mathematics, IIT Roorkee. His area 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. Uaday Singh in the same Department.

Prof. D. N. Pandey is an Associate Professor in the Department of Mathematics, IIT Roorkee. Before joining IIT Roorkee he worked as a faculty member in BITS-Pilani Goa campus and LNMIIT Jaipur. His area of expertise includes semigroup theory, functional differential equations of fractional and integral orders.

COURSE PLAN

Week 1: Matrix operations and type of matrices, Determinant of a Matrix, Rank of a matrix,Vector Space-I,Vector Space-II

Week 2: Linear dependence and independence, Bases and Dimensions – I, Bases and Dimension - II, Linear Transformation - I, Linear Transformation - II

Week 3: Orthogonal subspaces, Row space, column space and null Space, Eigenvalues and Eigenvectors-I, Eigenvalues and Eigenvectors-II, Diagonalizable Matrices

Week 4: Orthogonal Sets, Gram Schmidt orthogonalization and orthonormal bases, Introduction to Matlab, Sign integer representationComputer representation of numbers

Week 5: Floating point representation, Round-off error, Error propagation in computer arithmetic, Addition and multiplication of floating point numbers, Conditioning and condition numbers-I

Week 6: Conditioning and condition numbers-II, Stability of numerical algorithms-I, Stability of numerical algorithms-II, Vector norms - I, Vector norms - II

Week 7: Matrix Norms - I, Matrix Norms-II, Convergent Matrices - I, Convergent Matrices - II, Stability of non-linear system

Week 8: Condition number of a matrix: Elementary properties, Sensitivity analysis-I, Sensitivity analysis-II, Residual theorem, Nearness to singularity

Week 9: Estimation of the condition number, Singular value decomposition of a matrix – I, Singular value decomposition of a matrix - II, Orthogonal Projections, Algebraic and geometric properties of matrices using SVD

Week 10: SVD and their applications, Perturbation theorem for singular values, Outer product expansion of a matrix, Least square solutions-I, Least square solutions-II

Week 11: Psudeo - inverse and least square solution, Householder matrices and their applications, Householder QR factorization –I, Householder QR factorization –II, Basic theorems on eigenvalues and QR method

Week 12: Power method, Rate of convergence of Power method, Applications of Power method with shift, Jacobi method-I, Jacobi method-II

CHAOTIC DYNAMICAL SYSTEMS

MATHEMATICS

TYPE OF COURSE	:	New
PRE-REQUISITES	:	A good course in Real Analysis, Metric Spaces.
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

The aim of this course is to provide insight into elementary topics and current studies in the theory of chaotic dynamical systems. The focus will be on providing the students with basics in the area and introduce them to the fundamentals in this field. This course discusses the various definitions of Mathematical Chaos in elementary analytical way.

ABOUT INSTRUCTOR

Prof.Anima Nagar is a faculty at the Mathematics Dept. of IIT Delhi. Her primary area of research is in Topological Dynamics.

COURSE PLAN

Week 1 : Analysis of the dynamics

Week 2 : Dynamics of one-dimensional maps of both the interval and the circle

Week 3 : Recurrence and minimality

Week 4 : Elementary bifurcations

Week 5 : Sarkovski's theorem

Week 6 : Li Yorke chaos and Scrambled sets

Week 7 : ATransitivity and Devaney Chaos

Week 8 : Stronger forms of Transitivity

Week 9 : Symbolic Dynamics

Week 10 : Topological Entropy

Week 11 : Higher Dimensional Dynamics

Week 12 : Toral Automorphisms and Henon Map

STOCHASTIC PROCESSES

MATHEMATICS

TYPE OF COURSE : Rerun
PRE-REQUISITES : A basic course on Probability
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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.

Prof. N. Selvaraju, Department of Mathematics, Indian Institute of Technology Guwahati 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, Kolmogrov 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 filteration; 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

MECHANICAL ENGINEERING

MECHANICAL ENGINEERING

4weeks

01. Computer Numeric Control Of Machine Tools And Processes
02. Principles Of Vibration Control
03. Metal Cutting And Machine Tools
04.Product Design and Development
05.Two phase flow and heat transfer

8weeks

01. Design Practice
02. Product Design and Manufacturing
03. Basics Of Finite Element Analysis - I
04. Transport Phenomena In Materials
05. Gear And Gear Unit Design : Theory And Practice
06. Traditional And Non-Traditional Optimization Tools
07. Mechanism And Robot Kinematics
08. Advances in welding and joining technologies
09. Engineering Mechanics:Statics And Dynamics
10. Fluid Machines
11. Automatic Control
12. Failure analysis and Prevention
13. Mechanical Measurement System
14. Joining Technologies for metals
15. Steam and Gas Power Systems
16. Engineering Economic Analysis
17. Surface Engineering of Nanomaterials
18. Introduction to Mechanical Vibration
19. Modelling and Simulation of Dynamic Systems
20. Introduction to Machining and Machining Fluids

12weeks

01. Introduction To Composites
02. Manufacturing Process Technology I & II
03. Advanced Fluid Mechanics
04. Introduction To Mechanical Micro Machining
05. Machinery Fault Diagnosis And Signal Processing
06. Fundamentals of Nuclear Power Generation
07. Atomization and Sprays (Spray Theory)
08. Compliant Mechanisms : Principles and Design
09. Convective Heat Transfer
10. Operations Management
11. Theory of Production Processes
12. Experimental Stress Analysis

MECHANICAL ENGINEERING

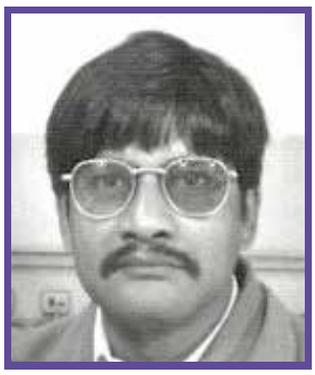
COMPUTER NUMERIC CONTROL OF MACHINE TOOLS AND PROCESSES

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic Knowledge of Machine tools, Workshop practice Desirable but not necessary : binary logic, logic gates, curved surface geometry
COURSE DURATION : 4 weeks
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

PRINCIPLES OF VIBRATION CONTROL

MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basics of Mechanical Vibrations
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Oil, Space, Manufacturing industries

COURSE OUTLINE

Vibration is undesirable in most engineering systems. The ill effects of vibration include fatigue failure, severe damages due to resonance, malfunctioning of sensitive instruments/systems, loss of accuracy of workpiece due to vibration of machine tools, etc. This course will give a brief overview about the various strategies to control such vibrations in systems and principle behind them.

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 Design Programme, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design and Child-Reconfigurable Robot Interaction.

COURSE PLAN

Week 1 : Introduction to Vibration control

Week 2 : Dynamic Properties and Selection of Materials

Week 3 : Dynamic Vibration Absorbers

Week 4 : Principles of Active Vibration Control

METAL CUTTING AND MACHINE TOOLS

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	None
COURSE DURATION	**:**	4 weeks
INDUSTRY SUPPORT	**:**	All metal cutting industries

COURSE OUTLINE

This course would encompass a comprehensive study of metal cutting and machine tools. Within a limited time of 4 weeks this course would elaborate on the theory of metal cutting supplemented with numerical problems. Tool geometry, chip formation, cutting force calculations and measurement, tool wear and other aspects will be given due attention. This would be followed by a descriptive study of the machine tools like lathe, milling, grinding, drilling and shaping machines, followed by numerical problems.

ABOUT INSTRUCTOR

Prof. Asimava Roy 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. **He 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: Introduction : 1 lecture
Geometry of single point turning tools A : 1 lecture
Geometry of single point turning tools B : 1 lecture
Different types of cutting tools : 1 lecture
MCQ discussion : 1 lecture

Week 2: Mechanism of chip formation : 1 lecture
Calculation of Cutting forces : 1 lecture
Measurement of cutting forces : 1 lecture
Tool wear and tool life : 1 lecture
MCQ discussion : 1 lecture

Week 3: General purpose machine tools : Lathe :1 lecture
Milling machine and grinding machine :1 lecture
Drilling and shaping machines :1 lecture
Alignment tests : Radial drilling machine :1 lecture
MCQ discussions : 1 lecture

Week 4: Gear cutting machines :1 lecture
Fixed automation:1 lecture
CNC machines :1 lecture
Non-traditional machine tools, rapid prototyping machines : 1 lecture
MCQ discusions :1 lecture

PRODUCT DESIGN AND DEVELOPMENT

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	Rerun
PRE-REQUISITES	**:**	No-prerequisite
COURSE DURATION	**:**	4 weeks
INDUSTRY SUPPORT	**:**	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 and Development is conceptualized and planned in such a way that it helps both job creators as well as job seekers.

ABOUT INSTRUCTOR

Prof. 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 three video and one web course under the National Programme on Technology Enhanced Learning (NPTEL). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN

Week 1 : Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process,Product analysis.

Week 2 : Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function.Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

Week 3 : Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA,Ergonomics in product design,.

Week 4 : DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS

MECHANICAL ENGINEERING

TWO PHASE FLOW AND HEAT TRANSFER

TYPE OF COURSE : Rerun
PRE-REQUISITES : Fluid Mechanics and Heat Transfer
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : General Electric, General Motors, Indian Oil, HPCL, BPCL

COURSE OUTLINE

Two phase flow with or without phase change is commonly encountered in a variety of engineering processes. The power generation, nuclear reactor technology, food production, chemical process, aerospace and automotive industries are all driving forces in this complex field. Due to its universality in applications, a thorough understanding of two phase flow is of utmost important.

ABOUT INSTRUCTOR

Prof. Arup Kumar Das is Assistant Professor in Department of Mechanical and Industrial Engineering at IIT Roorkee and actively involved in teaching and research in the direction of two phase flow for last ten years. His research interests are in the fundamental understanding of interfacial transport in macro and micro-scale confinements with applications in energy, environment, and bio-systems. He has authored and co-authored more than 35 peer-reviewed journal papers, which includes publications in Springer, Royal Society of Chemistry, American Chemical Society and Elsevier journals. He is also active in writing book chapter with reputed international publication house.

COURSE PLAN

Week 1 : Introduction, Flow Regimes, Homogeneous Flow, Drift Flux, Separated Flow

Week 2 : Bubbly, Slug, Annular and Stratified Flow, Measurement of Void Fraction

Week 3 : Signal Analysis, Two Fluid-Population Balance Technique, Volume of Fluid Method, Lattice Boltzmann Model, Smoothed Particle Hydrodynamics

Week 4 : Molecular Dynamics, Boiling, Condensation, Solid-Liquid Flow, Gas-Solid-Flow

DESIGN PRACTICE

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	No prerequisite
COURSE DURATION	**:**	8 weeks
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

PRODUCT DESIGN AND MANUFACTURING

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	The student should have completed two semesters of UG Engineering or Science program.
COURSE DURATION	**:**	8 weeks
INDUSTRY SUPPORT	**:**	HAL, NAL, SAIL, ISRO

COURSE OUTLINE

In the last few decades, the product development process has undergone a noticeable change, which is due to the global competition, international markets, and increasing customer needs. Managing the product development process, right from idea generation to final product manufacturing has to be systematic and effective to meet the customer needs, while incorporating the time-to-market constraint as well. This course presents an overview of the product design and development process, along with the manufacturing aspects. (The concepts Design for Manufacturing and Assembly, analytical tools for development, costing and manufacturing would help the students and practitioners learn to conceptualize, design, and manufacture competitively-priced quality products. Prototyping and simulation using soft tools are also incorporated make the students learn the modern tools in manufacturing.)

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."

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 traveled 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 product design and manufacturing,Product design: definition, and evolution.,Product design morphology,Product design morphology: Preliminary ,and detailed design.

Week 2 : Product design: flowcharting,Creativity techniques,Translating customer needs,Product Development process

Week 3 : Value Engineering: a product design approach,Elements of Value Engineering,Value Engineering tools,Case study in Value Engineering

Week 4 : Product manufacturing: Process selection,Design for Manufacturing (DFM),Design for Manufacturing and Assembly (DFMA),Design for Environment: Life Cycle Impact Assessment

Week 5 : Product costing: Elements of product cost,Product costing: Life Cycle Costing,Material selection: Metals and alloys,Material selection: Plastics, Ceramics, Rubber.

Week 6 : Integrated Product and Process Design and Development,Quality monitoring: Control charts for processes,Quality monitoring: Control charts for attributes and defects, Quality Assurance

Week 7 : Patenting: Creativity versus Innovation,Patenting: need and process,Prototyping: methods of..,Prototyping: laboratory demonstration

Week 8 : Product manufacturing aspects: Layout design,Product manufacturing aspects: Soft tools,Product manufacturing aspects: Process simulation,Managing competitiveness: Benchmarking, Outsourcing, and mass customization

MECHANICAL ENGINEERING

BASICS OF FINITE ELEMENT ANALYSIS - I

TYPE OF COURSE : Rerun

PRE-REQUISITES : Must be enrolled into a B. Tech. program or equivalent and should have completed second year of his 4-year program

COURSE DURATION : 8 weeks

INDUSTRY SUPPORT : 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 learn FEA from an application standpoint. Currently, many users of FEA have limited understanding of theoretical foundation of this powerful method. The consequence is that quite often they use commercial codes inaccurately, and do not realize that their results may be flawed. The course is intended to address this limitation by making the student aware of the underlying mathematics in easy to understand format. (The course is open to all engineering students who have at the minimum successfully completed two years of their B. Tech (or equivalent) degrees. The course is also open to all professionals in industry who wish to learn fundamentals of FEA in a semi-formal but structured setting, and plan to use this knowledge in their workplace.)

ABOUT INSTRUCTOR

Prof. Nachiketa Tiwari is an Associate Professor of Mechanical Engineering at IIT Kanpur. He has a PhD in engineering mechanics from Virginia Tech. His doctoral thesis involved nonlinear analysis of composite structures through FE, analytical and experimental methods. Dr. Tiwari also has deep understanding of fundamentals of FEA as he has used several tools in industry for over a dozen years for producing world class products. His current areas of research interest are composite structures, noise, vibrations, and product design. He has established Dhwani, an Acoustics Lab at IITK, which is one of the best in the country.

COURSE PLAN

Week 1 : Intro & concepts

Week 2 : Mathematical concepts

Week 3 : 1-D BVP problems of 2nd order

Week 4 : Applications: heat transfer/solid mechanics

Week 5 : Beams

Week 6 : Errors & convergence

Week 7 : Time dependent problems

Week 8 : Eigen value problems and closure

TRANSPORT PHENOMENA IN MATERIALS

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	Mathematics courses at 1st year UG level.
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	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

Prof. Gandham Phanikumar, Department of MME Indian Institute of Technology, Madras, 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 1 : Mathematical foundations of transport phenomena, introduction to subscript notation & tensors

Week 2 : Control volume formulation and concept of balance

Week 3 : Navier-Stokes equations, exact solutions for simple geometries

Week 4 : Friction factors, empirical relations in fluid flow

Week 5 : Application of fluid flow solutions to materials processing

Week 6 : Governing equations for heat transfer, problem statements

Week 7 : Exact solutions for heat transfer problems

Week 8 : Empirical correlations, heat transfer coupled with fluid flow

MECHANICAL ENGINEERING

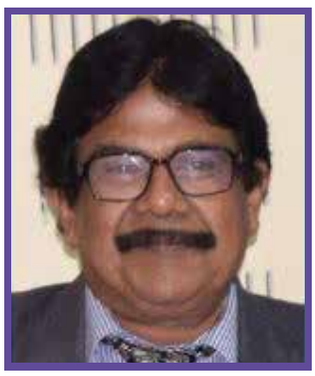
GEAR AND GEAR UNIT DESIGN : THEORY AND PRACTICE

TYPE OF COURSE : New
PRE-REQUISITES : Prior knowledge of general mechanics, theory of machines and solid mechanics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Most of the Civil Engineering companies

COURSE OUTLINE

Over and above the outline of gear design that are taught in undergraduate and postgraduate levels through the basic course of design of Machine Elements or specialized course Mechanical Drives, detail aspects of practical design in industries will be focused. The course would help to fill the gap the knowledge at graduation and step into producing the detail design and drawing of gear units in Industries. The course is developed based on long time research, teaching and working in industries in this area.

ABOUT INSTRUCTOR



Prof. Rathindranath Maiti is at present Professor in Mechanical Engineering Department, IIT, Kharagpur. His teaching and research interests are Machine design, Gear Engineering, Mechanical and Fluid Drives. He has worked in Design and R&D in Hindustan Aeronautics Ltd. and Macneil and Magor Ltd. in India and Eaton Hydraulics in Japan, for about ten years together. Recipient of DAAD and INSA Fellowships he has worked in the areas of Fluid power/Mechanical Power Transmissions in TU-Dresden, Germany; Cardiff School of Engineering, UK ; Krakow University of Technology and Wroclaw University of Technology, Poland. Publications, over 40 in peer reviewed international journals and conferences; and few patents are in his credit.

COURSE PLAN

Week 1 : Introduction to Gear and Gear unit Design

Week 2 : Design of Spur (Straight and Helical), Bevel and Worm gears.

Week 3 : Design of a gear box- part-1

Week 4 : Design of a gear box- part-2

Week 5 : Design of a gear box- part-3

Week 6 : Design of a gear box- part-4

Week 7 : Introduction to Involute Gear Tooth Correction

Week 8 : Internal Gearing, Epicyclic and other special Gearing

MECHANICAL ENGINEERING

TRADITIONAL AND NON-TRADITIONAL OPTIMIZATION TOOLS

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : RDCIS, Ranchi CMERI, Durgapur, and others

COURSE OUTLINE

At the beginning of this course, a brief introduction will be given to optimization. The principle of optimization will be explained in detail. The working principles of some traditional tools of optimization, namely exhaustive search method, random walk method, steepest descent method will be discussed with suitable numerical examples.

ABOUT INSTRUCTOR

Prof. Dilip Kumar Pratihar is a Professor in the Department of Mechanical Engineering, Indian Institute of Technology, Kharagpur. He 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 and received University Gold Medal, A.M. Das Memorial Medal, Institution of Engineers' (I) Medal, and others. He completed post-doctoral studies in Japan and then, in Germany under the Alexander von Humboldt Fellowship Programme. His research areas include robotics, soft computing and manufacturing science.

COURSE PLAN

Week 1 : Principle of Optimization

Week 2 : Traditional methods of Optimization

Week 3 : Working principle of Genetic Algorithms (GAs)

Week 4 : Working principle of Genetic Algorithms (GAs)

Week 5 : Binary-coded Genetic Algorithm

Week 6 : Real-coded Genetic Algorithm, Faster GAs, Scheduling GA

Week 7 : Simulated Annealing, Particle Swarm Optimization

Week 8 : Multi-objective Optimization

MECHANISM AND ROBOT KINEMATICS

MECHANICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Engineering Mechanics, Undergraduate Mathematics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Automobile and Aerospace industries
Automation and robotic device manufacturers
Bio-Medical device manufacturers

COURSE OUTLINE

This course will be a foundation course in analysis of mechanisms and robots. After a brief introduction to the subject matter and terms, the audience will be introduced to kinematic analysis of planar constrained mechanisms, and closed and open chain robot manipulators.

ABOUT INSTRUCTOR

Prof. Anirvan Dasgupta is a faculty in Mechanical Engineering at IIT Kharagpur since 1999. His interests are in the mechanics of discrete and continuous systems. Specifically, his current areas of research includes mechanics of inflatable structures, vibration induced transport, railway vehicle dynamics, and wave propagation in linear and non-linear media. He has extensively taught courses at undergraduate and postgraduate levels like Mechanics, Kinematics of Machines, Dynamics, Dynamics of Machines, Vibration Analysis, Wave Propagation in Continuous Media, and Railway Vehicle Dynamics.

COURSE PLAN

Week 1 : Introduction to Mechanisms and Robotics, Mobility Analysis-I

Week 2 : Mobility Analysis-II, Displacement Analysis: constrained mechanisms and robots-I

Week 3 : Displacement Analysis: constrained mechanisms and robots-II

Week 4 : Displacement Analysis: constrained mechanisms and robots- III, Velocity Analysis: constrained mechanisms and robots-I

Week 5 : Velocity Analysis: constrained mechanisms and robots-II

Week 6 : Velocity Analysis: constrained mechanisms and robots-III

Week 7 : Velocity Analysis: singularity and path generation,Acceleration Analysis, Force Analysis-I

Week 8 : Force Analysis-II, Coordinate Transformations and kinematics of serial robots

ADVANCES IN WELDING AND JOINING TECHNOLOGIES

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	No pre-requisites
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	None

COURSE OUTLINE

The progress of several welding and joining processes is ever increasing with the development of new materials and their application in modern technologies. The microjoining and nanojoining is even more challenging area with the development of miniature components. This course is primarily designed from fundamental understanding to the most recent advances in welding and joining technologies.

ABOUT INSTRUCTOR

Prof. Swarup Bag, Department of Mechanical Engineering, IIT Guwahati
The broad area of instructor's teaching and research interest is materials and manufacturing processes through computational models and experiments. The instructor completed his Ph.D on "Development of bi-directional heat transfer and fluid flow model for reliable design of GTA and laser welding processes" from Indian Institute of Technology Bombay. Later he has worked at the Center for Material Forming (CEMEF), MINES Paris Tech, France in Metallurgy, Structure and Rheology (MSR) group. Soon after post-doctoral research experience, he joined in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati as a faculty member.

COURSE PLAN

Week 1-2 : Fundamentals of welding and joining

Week 2-3 : Laser and electron beam welding

Week 3-4 : Solid state welding processes

Week 4-5 : Computational welding mechanics

Week 5-6 : Micro-joining and nano-joining

Week 6-7 : Welding metallurgy

Week 7-8 : Welding and joining of non-metals

Week 7-8 : Metal transfer in welding and metal printing

ENGINEERING MECHANICS: STATICS AND DYNAMICS

MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Static and dynamical mechanical systems are the heart of all engineering today. The static systems range from bridges, load bearing members of roofs to fasteners and bolts. Dynamical systems are also ubiquitous in the form of machines which convert electrical energy to mechanical energy. Understanding the equations governing these static and dynamical systems is at the heart of this course.

ABOUT INSTRUCTOR

Prof. Mahesh Panchagnula,Department of Applied Mechanics, Indian Institute of Technology, Madras completed his B.S. - Mechanical Engineering, Indian Institute of Technology, 1992 M.S. - Mechanical Engineering, Purdue University, 1994 Ph.D.- Mechanical Engineering,Purdue University, 1998.

The Videos have also been created by Prof. M.S Sivakumar of IIT Madras.

COURSE PLAN

Week 1 : Basics of rigid bodies

Week 2 : Introduction to trusses and joints

Week 3 : Discussion on beams

Week 4 : Overview of friction and work & energy

Week 5 : Plane kinematics

Week 6 : Plane kinetics

Week 7 : Work-Energy and Impulse-Momentum methods

Week 8 : Overview of Vibrations

FLUID MACHINES

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	Rerun
PRE-REQUISITES	**:**	Basic knowledge of Fluid Mechanics
COURSE DURATION	**:**	8 weeks
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

AUTOMATIC CONTROL

MECHANICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Completed first year of BE/BTech.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Automatic Control is the theory used in various applications, for example, manufacturing of a product, refrigeration and air conditioners, aircraft, missile, satellite launching, etc. The study of a dedicated course is required to understand the fundamental and advance concepts of automatic controls for engineers and designers.

ABOUT INSTRUCTOR

Prof. Anil Kumar works as an Assistant Professor faculty in the Department of Mechanical and Industrial Engineering at IIT Roorkee for more than four years. He teaches subjects like, Automatic Control, Machine Design, Vibrations and Noise, etc. to UG students. His research area belongs to modal identification of structures, testing of piping joints, vibration mitigation.

COURSE PLAN

Week 1 : Automatic Control System.

Week 2 : Mathematical Modelling.

Week 3 : Transient Response Analysis.

Week 4 : Stability and Steady State Error.

Week 5 : Root Locus Technique.

Week 6 : Design via Root Locus and Compensation Techniques.

Week 7 : State Space Method.

Week 8 : Application of MATLAB in Automatic Control.

FAILURE ANALYSIS AND PREVENTION

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	Heavy engineering and pressure vessel industry, power plants

COURSE OUTLINE

The course content is designed for systematic understanding on various aspects related with failure such as fundamental sources of failure of mechanical components, industrial engineering tools relevant to failure and failure analysis, general procedure of failure analysis through sample collection, preparation and preservation, testing, macro and microscopic observation of fracture, mode of fracture, metallographic procedure and image analysis, use of fracture mechanics and fracture toughness principles in failure analysis and analysis findings and report/recommendation writing. Presentation will include case studies to communicate concepts and procedures effectively. Case studies will be taken up from failure analysis of weld joints in different sectors.

ABOUT INSTRUCTOR

Prof. D. K. Dwivedi, Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee obtained BE (mechanical engineering) , in 1993 from GEC Rewa, ME (welding engineering) 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. He has published more than 95 research papers in SCI/SCIE indexed journals and undertaken 16 sponsored research and 48 industrial consultancy projects. Instructor has authored one book entitled "Production and Properties of Cast Al-Si Alloys with New Age International, New Delhi (2013).

COURSE PLAN

Week1: Introduction: Need and scope of failure analysis and prevention
Introduction: Engineering disasters and understanding failures
Fundamental sources of failures: Deficient design I, II
Fundamentalsources of failures: Deficient design III and upgrading of a part

Week2: Fundamental sources of failures: Imperfections in base metals
Fundamental sources of failures: Improper Manufacturing I, II, III, IV and improper service conditions

Week3: Fundamental sources of failures: Poor assembly, service andmaintenance
Industrial engineering tools for failure analysis:Pareto diagram
Industrial engineering tools for failure analysis:Fishbone diagram and FMEA; FMEA; Fault tree analysis

Week4: Industrial engineering tools for failure analysis: Reliability-I ; II
General procedure of failure analysis: Steps, Background information collection, Preliminary examination

Week5: General procedure of failure analysis: NDT for failure analysis
General procedure of failure analysis: Destructive testing, DT, selection, preservation, cleaning & sectioning of samples
General procedure of failure analysis: Macroscopy of fracture surfaces-I General procedure of failure analysis: Macroscopy of fracture surfaces-II

Week6: General procedure of failure analysis: Macroscopy of fracture surfaces-III; IV
General procedure of failure analysis: Microscopy of fracture surfaces; Metallography of failed components
General procedureof failure analysis: Determination of type of fracture I

Week7: General procedure of failure analysis: Determination of type of fracture II
General procedure of failure analysis: Determination of type of fracture III and chemical analysis
General procedure of failure analysis: Application of fracture mechanics I, II; Simulated test and analysisof evidences/results

Week8: General procedure of failure analysis: Questions for analysis; General procedure of failure analysis: Reporting failure analysis and failure analysis of welded joint; General procedure of failure analysis: Failure analysis of weld joint; Examples of failure analysis; Embrittlement of steels

MECHANICAL MEASUREMENT SYSTEM

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	All Mechanical Engineering industries involving instrumentation.

COURSE OUTLINE

This course provides a simple understanding of the mechanical measurement systems and statistical analysis of experimental data. The course contains the generalized configuration and functional elements of measuring systems, static and dynamic characteristics of measuring instruments. The course also include the instrumentation for displacement, strain, velocity, force, toque, power, pressure, sound, flow and temperature measurement.

ABOUT INSTRUCTOR

Prof. Ravi Kumar is a Professor in the Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee. He has been teaching thermal engineering courses in the Department in addition to the course on Instrumentation and Experimental Methods. He is a member of ASME, ASHRAE and IIFIIR.

COURSE PLAN

Week 1: Basic concepts of measurement, Functional elements of instruments, Classification of measuring instruments, Methods of correction for interfering and modifying inputs & Static characteristics of measuring instruments (1)

Week 2: Static characteristics of measuring instruments (2)

Week 3: Uncertainty analysis

Week 4: First order system- ramp response

Week 5: Second order system- ramp response

Week 6: Transducers (2)

Week 7: Strain gauges

Week 8: Sound measurement

JOINING TECHNOLOGIES FOR METALS

MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

It is proposed to include following joining technologies of commercial importance under different groups of processes. Fundamentals of Metal Joining Technologies: mechanisms for obtaining metallic continuity: fusion, deformation, diffusion, chemical interactions. Fusion based processes: principle of fusion welding processes, oxy-fuel has welding, common arc welding processes, laser beam welding, spot welding processes, newer variants of fusion welding processes.Solid-liquid joining processes: brazing and soldering, braze welding, cold metal transfer welding,Solid state joining processes: diffusion bonding, ultrasonic welding and explosive welding.

ABOUT INSTRUCTOR

Prof. D. K. Dwivedi Department of Mechanical & Industrial Engineering , Indian Institute of Technology Roorkee obtained BE (mechanical engineering) , in 1993 from GEC Rewa, ME (welding engineering) 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. He has published more than 95 research papers in SCI/SCIE indexed journals and undertaken 16 sponsored research and 48 industrial consultancy projects. Instructor has authored one book entitled "Production and Properties of Cast Al-Si Alloys with New Age International, New Delhi (2013).

COURSE PLAN

Week 1: Introduction: Manufacturing and Joining Fundamental Mechanisms of joining, heat and pressure in joining Classification of joining processes,Heat generation and power density concept in welding Protection of the weld metal approaches, effect of gases on weld properties

Week 2: Principle of fusion welding processes, oxy-fuel gas welding Fundamentals of welding: type of weld, types of joint, welding position, arc heat generation Physics of welding arc: arc initiation, maintenance, shielded metal arc welding Electrode melting rate, effect of electrode polarity and welding parameters Gas tungsten arc welding: electrode, shielding gases, Introduction of gas metal arc welding

Week 3: Variants of Gas tungsten arc welding: GTAW, Hot wire GTAW, Flux assisted GTAW Variants of Gas metal arc welding: Pulse GMAW, CMT welding
Submerged arc welding Electro-slag and Electro-gas welding processes Laser beam welding

Week 4: Brazing Soldering and Braze welding, Fundamentals of resistance welding Resistance welding processes: spot, seam welding Flash butt welding

Week 5: Adhesive joining, Welding bonding, Solid state joining technologies: Fundamentals Ultrasonic joining, Diffusion bonding

Week 6: Explosive welding, Magnetic pulse welding, Weld thermal cycle, Heat affected zone and weld thermal cycle: I, Heat affected zone and weld thermal cycle: II

Week 7: Solidification of weld metal, Fundamentals of weldability of metals, Weldability of carbon & alloy steels: Fe-C, CCT, Weldability of stainless steels: schaeffler diagram, Metallurgical transformation in weld and heat affected zone of steels

Week 8: Weldability of aluminium alloys: porosity, HAZ softening, PMZ issues, Solidification cracking and their control, Residual stresses in weld joints: effect on joint performance, and control of residual stress, Cracking of welded joints: solidification and liquation cracks, Cracking of welded joint: cold cracking

MECHANICAL ENGINEERING

STEAM AND GAS POWER SYSTEMS

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : BHEL, NTPC and other private power industries.

COURSE OUTLINE

This Course provides a simple understanding of the steam and gas power systems. The course contains the analysis of vapour power cycle i.e. Rankine cycle, steam generators and their accessories, Performance of Boilers and combustion of fuel, high pressure boilers, flow through steam and gas nozzles, different type of steam turbines for power generation and condensers. The gas turbine cycle, working of gas turbines, centrifugal compressors, axial compressors and combustion chamber of gas turbines.

ABOUT INSTRUCTOR

Prof. Ravi Kumar is a Professor in the Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee. He has been teaching thermal engineering courses to UG and PG students of the Department. He is a member of ASME, ASHRAE and IIFIIR. He has supervised number of masters and doctoral students in this area.

COURSE PLAN

Week 1 : Review of Thermodynamics, Rankine Cycle, Performance of Rankine Cycle, Binary Vapour Cycle and Co-generation, Problem Solving.

Week 2 : Steam Generators, Fire Tube Boilers, Water Tube Boilers, Boiler Mountings and Accessories, High Pressure Boilers- LaMont and Benson Boilers.

Week 3 : High Pressure Boilers- Loeffer and Velox Boilers, Draught, Performance of Boilers, Combustion of Fuel,Problem Solving.

Week 4 : Boiler Trial, Nozzles and Diffusers-Momentum and Continuity Equations, Nozzles and Diffusers-Efficiency and Critical Pressure, Nozzles and Diffusers-General Relationship and supersaturated Flow, Problem Solving.

Week 5 : Steam Turbines, Compounding of Steam Turbines, Impulse Steam Turbines, Impulse Steam Turbine Performance,Problem Solving.

Week 6 : Impulse-Reaction Steam Turbines, Impulse-Reaction Turbine Performance, Energy Losses in Steam Turbines,Condensers, Problem Solving.

Week 7 : Gas Turbine Cycles, Gas Turbine Cycles- Performance Evaluation, Gas Turbine Cycles- Modifications, Problem Solving,Centrifugal Compressors.

Week 8 : Centrifugal Compressor Characteristics, Axial Flow Compressors, Axial Flow Compressor Characteristics, Jet Propulsion,Problem Solving.

ENGINEERING ECONOMIC ANALYSIS

MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic Knowledge of economics & mathematics
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course focuses on economic and cost analysis of engineering projects, giving insights on modern techniques and methods used on economic feasibility studies relating to design and implementation of engineering projects. The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

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 course on "Engineering Economy" to 2nd year undergraduate students of the Department for the last six years (a semester every year).

COURSE PLAN

Week 1: Introduction to Engineering Economy, Time value of money, Cash flow diagrams, Interest and Interest rate, Discrete compounding and payment

Week 2: Interest formulae for discrete compounding and discrete payments- Gradient series factors, Nominal & Effective interest

Week 3: Economic equivalence, Methods of comparison of alternatives

Week 4: Replacement analysis, Economic life of the asset

Week 5: Depreciation and Depletion

Week 6: Elements of cost, Break even analysis, Economic order quantity,

Week 7: Cost estimation, Decision under risk and uncertainty

Week 8: Effect of taxation on economic studies, Income tax analysis

MECHANICAL ENGINEERING

SURFACE ENGINEERING OF NANOMATERIALS

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	Nanoshel; Adnano Technologies; Mittal Enterprises; Ultrananotech; Reinste Nano Ventures; etc.

COURSE OUTLINE

Surface engineering (SE) is a sub-discipline of Materials Science and Materials Engineering which deals with the surface of a solid and its modifications. The primary goal of SE of nanomaterials is to modify the properties of surface to improve its electrical and thermal properties, and to improve the compatibility of nanomaterials with some matrix when they are used as reinforcing fillers in composites for high performance applications.

ABOUT INSTRUCTOR

Prof. 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 1 : Tribology & its classification, Friction tribology, Wear & corrosion, Lubrication, Effect of tribology on surface of nanomaterials.

Week 2 : Conventional surface engineering, Types of surface modifications, Physical modifications, Chemical modifications, Applications of surface engineering towards nanomaterials.

Week 3 : Deposition and surface modification methods, Physical vapor deposition, Chemical vapor deposition, Advanced surface modification practices, Advantages of deposition for surface modification.

Week 4 : Synthesis, processing and characterization of nano-structured coatings, Functional coatings,Advanced coating practices, Characterization of nano-coatings, Applications of nano-coatings,

Week 5 : Need of advanced methods for surface and coating testings, Size dependency in nanostructures of nanocoatings, Size effect in electrochemical properties of nanostructured coatings, Size effect in mechanical properties of nanostructured coatings, Size effect in physical and other properties of nanostructured coatings.

Week 6 : Thin films for surface engineering of nanomaterials, Sputtering techniques, Evaporation processes, Thin film deposition through gas phase techniques, Liquid phase techniques.

Week 7 : Microencapsulation: Processes, Microencapsulation: Kinetics of release, Plating of nanocomposite coatings, Advantages of microencapsulation over other conventional methods.

Week 8 : Current trends in surface modification of nanomaterials, Modified Nanomaterials: In-use for consumer products, Main problems in synthesis of modified nanomaterials.

INTRODUCTION TO MECHANICAL VIBRATION

MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : Completed first year of BE/BTech.
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

Vibration is a common phenomenon occurring in a mechanical system. For example, vibration of a rotor due to unbalanced mass, vibration of a vehicle engine at varying speed. The study of a dedicated course is required to understand the fundamental and advance concepts of mechanical vibrations for engineers and designers. This course is of basic level. It introduces fundamentals of vibration, free and forced, undamped and damped vibration, vibration of single Degree of Freedom (DoF) system, 2-DoF and multi-DoF systems, theory of vibration absorbers and vibration instruments.

ABOUT INSTRUCTOR

Prof. Anil Kumar works as an Assistant Professor faculty in the Department of Mechanical and Industrial Engineering at IIT Roorkee for more than four years. He teaches subjects like, Automatic Control, Machine Design, Vibrations and Noise, etc. to UG students. His research area belongs to semi-active rail suspension, modal identification of structures, testing of piping joints, pedestrian-structure interaction modelling.

COURSE PLAN

Week 1 : Fundamental of Vibrations.

Week 2 : Free Vibration of Single Degree of Freedom Systems.

Week 3 : Forced Vibration of Single Degree of Freedom Systems

Week 4 : Forced Vibration of Single Degree of Freedom Systems.

Week 5 : Vibration Measuring Instruments.

Week 6 : Vibration of Two Degree of Freedom Systems.

Week 7 : Vibration Absorbers and Critical Speed of Shafts.

Week 8 : Vibration of Multi Degree of Freedom Systems.

MODELLING AND SIMULATION OF DYNAMIC SYSTEMS

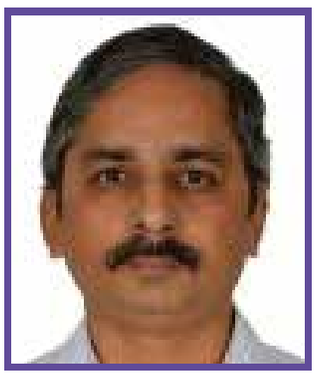
MECHANICAL ENGINEERING

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Railways, DRDO

COURSE OUTLINE

The term modeling refers to the development of a mathematical representation of a physical system while the term simulation refers to the procedure of solving the equations that resulted from model development. The quality or usefulness in a model is measured by its ability to capture the governing physical features of the problem. Here, the expertise of the modeler is useful. The model is amenable to manipulation which would be impossible, too expensive, or too impractical to perform on the system which it portrays. This feature makes it a very useful tool to study system behavior.

ABOUT INSTRUCTOR



Prof. Pushparaj Mani Pathak is currently Associate Professor at IIT Roorkee. He was graduated from N.I.T., Calicut in 1988 in Mechanical Engineering. He completed his M. Tech in Solid Mechanics and Design from IIT Kanpur in 1998. Later he was awarded the PhD degree from IIT Kharagpur in 2005. His areas of research are Robotics, Dynamics, Control, and Bond Graph Modelling. He has served in different industries from 1989 to 1994. He is in teaching profession since 1994. He is serving in Mechanical and Industrial Engineering Department, IIT Roorkee since 2006. He has co-authored one book on Intelligent Mechatronic Systems: Modeling, Control and Diagnosis published by Springer, London and has published more than 40 papers in International Journals in the field of Robotics and Control. He has supervised 34 M. Tech theses and 7 PhD theses in different areas.

COURSE PLAN

Week 1 : Introduction to Modelling and Simulation

Week 2 : Bond Graph Modelling of Dynamic Systems

Week 3 : Basic System Models

Week 4 : System Models of Combined Systems

Week 5 : Dynamic Response and System Transfer Function

Week 6 : Block diagram/Signal flow diagram/State Space formulation and Frequency response.

Week 7 : Simulation and Simulation application

Week 8 : Parameter Estimation, System Identification and Optimization

INTRODUCTION TO MACHINING AND MACHINING FLUIDS

MECHANICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : No pre-requisites
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Oil India Ltd., ONGC, TATA motors, ISRO, BARC, DRDL, NTPC, CMTI, CMERI, CGCRI, Grind Master, NRL

COURSE OUTLINE

Machining is one of the basic and very important courses for the mechanical undergraduate students. This process comes under the subtractive manufacturing processes where in material is removed. This course gives the basic understanding of the various machining processes and its physics.

ABOUT INSTRUCTOR

Prof. Mamilla Ravi Sankar is **currently an Assistant Professor in the Department of Mechanical Engineering, IIT Guwahati.** He did his B.Tech from Sri Venkateswara University, Tirupati, and M.Tech as well as PhD from IIT Kanpur. His research group is focus on Sustainable Manufacturing, Eco-friendly Cutting fluids, Coatings, Advanced Manufacturing, Tribology and Rheology. MRS Lab also involves in development of lab scale Innovations to Commercial Manufacturing Products. He has published over 30 research articles in internationally reputed journals, 2 Patents, 2 Edited Books and 6 Book chapters.

COURSE PLAN

Week 1: Introduction and Importance of Machining: Introduction to manufacturing, Top-down and bottom-up approaches, Machining and Various Machining Processes. Principles of Metal Cutting: Shear zone, Chip formation, chip thickness measurements, machining mechanics of ductile and brittle materials.

Week 2: Cutting tool: Tool Geometry, Tool signature. Cutting forces and Cutting velocities : Cutting forces, Merchant Circle, Empirical Models, Chip thickness ratio, Cutting velocities, Strain rates, Mathematical formulations.

Week 3: Tribology, Surface roughness in Machining: Chip-tool tribology, tool-workpiece tribology, Sticking and sliding zone, types of lubrication, Surface roughness, Materials removal rate, Machinability. Thermal Aspects of Machining: Cutting temperature, Measurement of temperature, heat generation, heat distribution, metallurgical and microstructural study.

Week 4: Tool Wear and Tool life: Carter wear, flank wear, nose wear, other tool wears, tool life criteria. Tool Materials and Coatings: Coating materials, PVD, CVD, RF, Laser coatings, Tool texturing.

Week 5: Cutting Fluids: Classification, Functions, Types of lubrication, Cutting fluid additives, Emissions, Health Hazards, Rheology and Biodegradability. Cutting fluid application: Standoff distance, angle of impingement, contact angle, area of cooling, Solid lubricants. Eco-friendly cutting fluids: Development of eco-friendly cutting fluids, bio degradation of these fluids, COD, BOD, HRT, Advantages of sustainable cutting fluids over mineral oil based cutting fluids.

Week 6: Multipoint Machining Processes: Milling, Drilling, Broaching, Tapping, Sawing, Gear Cutting.

Week 7: Abrasive machining processes: Grinding wheel specification, classification, Thermal aspects, Lapping, Honing, Super finishing, Drag finishing, vibratory finishing, Applications. Cutting fluids for abrasive machining processes: Cutting fluids in grinding, honing, super-finishing.

Week 8: Machining of Advanced Materials: Machining of Biomaterials, Aero Space materials, Smart Materials.
Advances in Metal Cutting: Hard Machining, High Speed Machining, Diamond Turning, Double tool Machining, Machining with rotary tools, Thin wall machining, Laser Assisted Machining. Cutting fluids machining advanced materials: Cutting fluids for machining advanced materials, high speed machining, hard machining.

MECHANICAL ENGINEERING

EXPERIMENTAL STRESS ANALYSIS

TYPE OF COURSE : Rerun
PRE-REQUISITES : Basic course on Strength of Materials. Course on Theory of Elasticity desirable
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : HAL, 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 experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain gauges and also a brief introduction to the emerging techniques like digital image correlation. In addition it also provides the fundamental aspects of six different experimental techniques such as Moiré, Brittle Coatings, Holography, Speckle Methods, Thermoelastic Stress Analysis and Caustics.

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 1 : Overview of Experimental Stress Analysis

Week 2 : Physical Principle of Experimental Techniques, Introduction to Various experimental Techniques

Week 3 : Fringe Patterns – Richness of Qualitative Information, Multi Scale Analysis

Week 4 : Selection of Experimental Techniques, Introduction to Crystal Optics

Week 5 : Light Ellipse, Retardation Plates and Plane Polariscope

Week 6 : Jones Calculus, Plane and Circular Polariscope analysis

Week 7 : Compensation Techniques, Calibration of Photoelastic Materials

Week 8 : Fringe ordering and Three-Dimensional Photoelasticity

Week 9 : Photoelastic Coatings

Week 10 : Brittle Coatings and Strain Gauges Introduction

Week 11 : Strain Gauge Alloys, Performance of Strain Gauge System

Week 12 : Correction factor for Special Applications

MECHANICAL ENGINEERING

THEORY OF PRODUCTION PROCESSES

TYPE OF COURSE : New
PRE-REQUISITES : Introduction to manufacturing technology or manufacturing processes.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Manufacturing Industries where casting/forming /welding takes place, for example SAIL, BHEL, Foundry and Forge industries like HEC, Bharat Forge etc.

COURSE OUTLINE

The course focuses on understanding the science behind technology of primary production processes namely casting, forming and welding. Conventionally, the courses on manufacturing processes deal with study of operational procedures. However, it is desirable to know how any process occurs and the products are finally manufactured, the basic principles behind these processes are required to be highlighted. The course will make the students aware with the theoretical aspects of the different manufacturing processes mentioned above.

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 processes.

COURSE PLAN

Week 1: Theory of casting and solidification, Fluidity of liquid metals.

Week 2: Technology of patternmaking and mouldmaking, Pattern allowances, Testing of molding sand, cores.

Week 3: Gating system design, Risering Design, different methods of calculating riser volume, Feeding distance calculations.

Week 4: Theory of melting and production of ferrous and non-ferrous materials, Casting design, Casting defects.

Week 5: Mechanical fundamentals of metalworking: Concept of stress and strain, stress and strain tensors, Hydrostatic and deviatoric stresses, Flow curve.

Week 6: Yield criteria for ductile materials, plastic stress strain relationships, classification of metalworking, mechanics of metalworking.

Week 7: Analysis and classification of rolling and forging processes, Force calculations in rolling and forging processes.

Week 8: Analysis and classification of Extrusion process, Analysis of wire, rod and tube drawing processes, Forming defects.

Week 9: Classification of welding processes, Thermal effects in welding, Basic metallurgy of fusion welds, Heat affected zone in welding.

Week 10: Principles of welding processes: Arc welding, Gas metal arc welding, Solid state welding, Resistance welding, Soldering, Brazing and adhesive bonding.

Week 11: Residual stresses in welding, Methods of measurement of residual stresses in welding, Welding distortion and its types, Methods of reducing residual stresses and distortion in welding.

Week 12: Weldability of materials: Introduction and assessment of weldability, Test for weldability, Weldability of ferrous and non-ferrous materials.

OPERATIONS MANAGEMENT

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	No-prerequisitet
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	All industries that efficiently produce and deliver goods and services to the customers.

COURSE OUTLINE

The current competitive business environment is forcing the organizations to adopt the latest tools, techniques and strategies for managing their resources in the most effective and efficient manner. The topics of the course deals with the management of resources and activities that lead to production of goods of right quality, in right quantity, at right time and place in the most cost-effective manner.

ABOUT INSTRUCTOR

Prof. 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 three video and one web course under the National Programme on Technology Enhanced Learning (NPTEL). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN

Week1 : Introduction to Course, Operations Management: Objectives, Operations Management: Functions and Scope, Types of Production Systems, Operations Strategy.

Week2 : Product Life – Cycle, Value Engineering Concepts, Design for X (DFX), Ergonomics in Product Design, Rapid Prototyping: Concept, Advantages.

Week3 : Sales Forecasting, Forecasting System, Qualitative Methods of Forecasting, Quantitative Methods - I, Quantitative Methods – I.

Week4 : Facility Planning, Factors Affecting Plant Location, Plant Location: Case Study on Uttarakhand, Location Evaluation Methods-I, Location Evaluation Methods-II.

Week5 : Facility Layout and Planning-I, Facility Layout and Planning-II, Factors Influencing Plant Layout, Material Flow Patterns, Tools and Techniques used for Plant Layout Planning.

Week6 : Production Planning and Control, Process Planning, Aggregate Production Planning, Capacity Planning: Introduction, Capacity Planning: Examples.

Week7 : Project Scheduling, Network Diagrams, Critical Path Method (CPM), Critical Path Method: Problems, Critical Path Method: Problems.

Week8 : Program Evaluation and Review Technique (PERT), PERT Problems, PERT Problems, Time Cost Trade Off (Crashing), Project Network: Crashing Problems.

Week9 : Production Control, Sequencing, Sequencing Problems-I, Sequencing Problems-II, Master Production Scheduling (MPS).

Week10 : Concept of Quality, Total Quality Management (TQM), Total Productive Maintenance (TPM), Statistical Quality Control (SQC), Six Sigma.

Week11 : Materials Management, Inventory Control, Economic Order Quantity (EOQ) Models, Economic Order Quantity (EOQ): Problems, Production Quantity Model.

Week12 : Just in Time (JIT), Kanban System, Materials Requirement Planning (MRP)-I, Materials Requirement Planning (MRP)-II, Enterprise Resource Planning (ERP).

CONVECTIVE HEAT TRANSFER

MECHANICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Heat Transfer and Fluid Mechanics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : 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 SERIIUS (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

MECHANICAL ENGINEERING

COMPLIANT MECHANISMS : PRINCIPLES AND DESIGN

TYPE OF COURSE : Rerun
PRE-REQUISITES : Preferred - Kinematics; finite element analysis; optimization theory
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Bosch India Ltd. EATON India Ltd. General Electric, General Motors Tata Motors, TVS Motors, L&T, Crompton-Greaves

COURSE OUTLINE

This course introduces the concept and principles of compliant mechanisms and presents the design methods in detail. Various applications of compliant mechanisms in consumer products, microsystems, aerospace, automotive, and biomedical industries will be touched upon throughout the course. It is a comprehensive treatment of the growing field of compliant mechanisms starting from the classics and basics and ending with the state of the art.

ABOUT INSTRUCTOR

Prof. G. K. Ananthasuresh Department of Mechanical Engineering, Indian Institute of Science, Bangalore, has taught this course once and has extensive presentation material based on numerous workshops he has conducted on the subject in the US and India. The instructor has been working in this field right from the inception of the field. He is associated with it for nearly 25 years and has contributed to its development and identifying applications. He has also played a major role in defining systematic design methods for compliant mechanisms.

COURSE PLAN

Week 1
Overview of compliant mechanisms; spirit of compliant design; a glimpse of applications.
Mobility analysis of compliant mechanisms: Grübler's formula, Maxwell's rule, and rank of the compatibility matrix
Week 2
Modeling of flexures (flexible joints or elastic pairs) & Simulation of compliant mechanisms using finite element analysis
Week 3
Large-displacement analysis of cantilever beams: the elastica approach & Pseudo Rigid-Body (PRB) modeling
Week 4
Analysis & synthesis using pseudo rigid-body models
Week 5
Structural optimization approach to "design for deflection"; Topology optimization approach to compliant mechanism design
Week 6
Designing compliant mechanisms using continuum topology optimization
Design of distributed compliant mechanisms
Week 7
Spring-lever (SL) and spring-masslever (SML) models for compliant mechanisms
Selection and re-design using SL and SML models
Week 8
Non-dimensional analysis of compliant mechanisms; Kinetoelastic maps of compliant mechanisms
Week 9
Other synthesis methods of compliant mechanisms; Mechanical advantage analysis of compliant mechanisms
Week 10
Bistable compliant mechanisms; Static balancing of compliant mechanisms
Week 11
Compliant mechanisms and microsystems & Manufacturing and materials for compliant mechanisms
Week 12
Case-studies of compliant mechanisms: Part 1, Part 2

MECHANICAL ENGINEERING

ATOMIZATION AND SPRAYS (SPRAY THEORY)

TYPE OF COURSE : Repurposed
PRE-REQUISITES : Undergraduate fluid mechanics. Undergraduate differential equations.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : DRDO, Defence, Spray drying users such as pharma, consumer product manufacturers such as Unilever, Proctor and Gamble, Patanjali etc., Aerospace industries, Agrotech for pesticide application etc.

COURSE OUTLINE

The goal of this course is to provide an overview of physics of liquid atomization, spray formation and propagation. The course will introduce the student to the theoretical models pertaining to jet breakup and drop formation. The application of multiphase models for studying spray transport will also be discussed. Finally, the course will present an overview of the design aspects as they pertain to spray nozzle and atomizers and discuss potential applications in combustion systems.

ABOUT INSTRUCTOR

Prof. Mahesh V Panchagnula, Professor in Department of Applied Mechanics, Indian Institute of Technology, Madras
B.S. - Mechanical Engineering, Indian Institute of Technology, 1992
M.S. - Mechanical Engineering, Purdue University, 1994
Ph.D.- Mechanical Engineering,Purdue University, 1998

COURSE PLAN

Week 1 : Introduction to sprays and atomization

Week 2 : Drop size and velocity distributions

Week 3 : Atomizers and their designs

Week 4 : Atomizers and their designs

Week 5 : Atomization theory

Week 6 : Atomization theory

Week 7 : Spray theory

Week 8 : Spray theory

Week 9 : Practical aspects of atomizer fabrication and manufacturing

Week 10 : Multiphase flow models of sprays

Week 11 : Multiphase flow models of sprays

Week 12 : Spray evaporation and combustion

MECHANICAL ENGINEERING

FUNDAMENTALS OF NUCLEAR POWER GENERATION

TYPE OF COURSE : New
PRE-REQUISITES : Basic UG-level Heat Transfer & Fluid Mechanics.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Bhabha Atomic Research Centre (BARC), Nuclear Power Corporation of India Ltd. (NPCIL), National Thermal Power Corporation (NTPC), Atomic Energy Regulatory Board (AERB), General Electric India,

COURSE OUTLINE

The depleting stock of fossil fuels and global concern over the preservation of environment has projected nuclear energy as a very relevant option, particularly considering the near-zero emission and huge resource availability. From technological point of view, nuclear power production is quite different from the conventional thermal plants and therefore it is the need of the hour to grasp the essentials at an early level. Present course introduces the students to the fundaments of nuclear power generation. Starting from the atomic structure, students will be gradually familiarized with different concepts, finally leading to the design of different reactors.

ABOUT INSTRUCTOR

Prof. Dipankar N. Basu is an Assistant 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 Ph.D. from Indian Institute of Technology Kharagpur in 2011. He served as an Assistant Professor at IIEST Shibpur for nearly four years before joining IIT Guwahati. His principal research interest is in the field of nuclear thermalhydraulics, two-phase flow, supercritical heat transfer, optimization of thermal systems and microchannel heat transfer. He is currently working on computational tool development for simulation of flows with free-surfaces.

COURSE PLAN

Week 1 : Fundamentals of Nuclear Power

Week 2 : Radioactivity & Nuclear reactions

Week 3 : Nuclear Fission

Week 4 : Chain Reaction in Reactors

Week 5 : Reactor Thermalhydraulics

Week 6 : Reactor Control

Week 7 : Thermal Reactors

Week 8 : Breeder Reactors

Week 9 : Nuclear Fusion

Week 10 : Biological Effects of Radiation

Week 11 : Reactor Safety and Security

Week 12 : Waste Management and Economics

MACHINERY FAULT DIAGNOSIS AND SIGNAL PROCESSING

MECHANICAL ENGINEERING

TYPE OF COURSE	:	New
PRE-REQUISITES	:	BE/B. Tech in Mechanical Engineering
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	Government PSUs Private industries in the Oil Steel, Construction, Mining, Fertilizer, Transportation Sector

COURSE OUTLINE

Machinery Condition Monitoring is gaining importance worldwide due to its cost benefit to the industries in large in the long run. This course will introduce students/faculty/industry professionals to the basics of machinery condition monitoring, including an introduction to signal processing and fault diagnostics techniques. The techniques of vibration monitoring, wear and debris analysis, motor current signature analysis, thermography and few non-destructive test techniques as used in condition based monitoring will be discussed. Few case studies will also be discussed.

ABOUT INSTRUCTOR

Prof. Amiya Ranjan Mohanty is a Professor and also the Shyamal Ghosh and Sunanda Ghosh Chair Professor at the Mechanical Engineering Department of the Indian Institute of Technology Kharagpur. Professor Mohanty obtained his B.Sc Engg (Hons) degree in Mechanical Engineering from NIT Rourkela, M.Tech degree from IIT Kharagpur and PhD from the University of Kentucky, USA. He was also a Post Doctoral Fellow at the Purdue University at its West Lafayette Campus in the USA. Prior to joining IIT Kharagpur he worked in the R&D department of Ford Motor Company in Dearborn, USA. Prof. Mohanty has also worked in the R&D of Larsen and Toubro Limited, Mumbai, India.

COURSE PLAN

Week 1 : Basics of Maintenance

Week 2 : Basics of Machinery Vibration

Week 3 : Signal Analysis

Week 4 : Data Acquisition and Signal Recording

Week 5 : Examples on Signal Processing MATLAB

Week 6 : Basics of Instrumentation and Transducers

Week 7 : Vibration and Noise Measurements

Week 8 : Faults in Rotating Machines

Week 9 : Bearings and Gears, Diagnostic Chart

Week 10 : Motor Current Signature Analysis, Wear and Debris Analysis

Week 11 : Non-Destructive Test Techniques

Week 12 : Case Studies and Failure Analysis

INTRODUCTION TO MECHANICAL MICRO MACHINING

MECHANICAL ENGINEERING

TYPE OF COURSE : New
PRE-REQUISITES : Conventional machining processes (lathe, milling, drilling, etc.)
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Bhabha Atomic Research Center (BARC), Mumbai Central Mechanical Engineering Research Institute (CMERI), Durgapur Central Manufacturing Technology Institute (CMTI), Bangalore

COURSE OUTLINE

The emergence of miniature and micro products / components has increased the demand of the production of micro components with feature size from a few millimeters to tens of micrometers. Mechanical micro machining is one of the key technologies to enable the realization of high accuracy complex micro products made from a variety of engineering materials. Mechanical micro machining is capable to machine metals, polymers, and ceramics in very less time as compared to lithographic processes and other micro machining processes such as EDM, ECM, LBM, etc. As a result, it has found strong base in a wide array of practical applications.

ABOUT INSTRUCTOR

Prof. Ajay M Sidpara is a faculty in Mechanical Engineering Department at IIT Kharagpur. My research interest is on surface finishing at nano scale and micro machining for different applications such as optics, biomedical, micro fluidics, etc. I have extensively worked on development of different tooling for nanofinishing and micro machining and improvement of process efficiency using different strategies. I have published 20 journal papers, 10 book chapters, and 21 conference papers related to nanofinishing and micro machining. 2 patents are filed related to development of tool and process for nanofinishing of complex surfaces. I have received funding of more than 55 lakhs from SERB, BRNS and GE Power India.

COURSE PLAN

Week 1 : Experimental observations and theoretical prediction of constituents of an atom

Week 2 : Scaling law

Week 3 : Mechanical micro machining (process, mechanism)

Week 4 : Burr formation, surface roughness, built up edge

Week 5 : Cutting fluid, run out, grain size

Week 6 : Micro machine structure - I

Week 7 : Micro machine structure - II

Week 8 : Fabrication of micro cutting tools

Week 9 : Miniature machine tools

Week 10 : Diamond Turning (process, types, mechanism, applications)

Week 11 : Metrology for micro machining

Week 12 : Sensor integration for process monitoring

ADVANCED FLUID MECHANICS

MECHANICAL ENGINEERING

TYPE OF COURSE	**:**	Repurposed
PRE-REQUISITES	**:**	Basic knowledge of Mathematics & Fluid Mechanics
COURSE DURATION	**:**	12 weeks
INDUSTRY SUPPORT	**:**	Oil Companies (IOCL, SHELL, BPCL and others) Automobile and Aviation companies (GE, AIRBUS TATA Motors and others)

COURSE OUTLINE

This is an advanced course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. 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 fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

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 offered a significant number of video courses through the NPTEL programme. These courses include: Introduction to Fluid Mechanics and Fluids Engineering, Computational Fluid Dynamics, and Microfluidics. He has also taught in an online programme (under NMEICT) titled "Talk to 10 Thousand Teachers". He has also taught live modular courses in the International Summer Winter Term and Knowledge Dissemination Programme.

COURSE PLAN

Week 1 : Brief recapitulation of some preliminary concepts of Fluid Mechanics : Fluid Kinematics

Week 2 : Brief recapitulation of some preliminary concepts of Fluid Mechanics: Dynamics of Inviscid Flows and Reynolds Transport Theorem

Week 3 : Dynamics of viscous flows - Derivation of Navier-Stokes equation

Week 4 : Some exact solutions of Navier-Stokes equation-Steady Flows

Week 5 : Some exact solutions of Navier-Stokes equation – Steady Flows (contd) and Practical Applications

Week 6 : Some exact solutions of Navier-Stokes equation-Unsteady Flows, Introduction to Turbulence

Week 7 : Introduction to turbulence (contd.), Boundary Layer theory

Week 8 : Boundary Layer theory (contd.)

Week 9 : Boundary Layer theory (contd.), Potential flow and flow past immersed bodies

Week 10 : Potential flow and flow past immersed bodies (contd.)

Week 11 : Compressible flows

Week 12 : Compressible flows (contd.)

MANUFACTURING PROCESS TECHNOLOGY I & II

MECHANICAL ENGINEERING

TYPE OF COURSE	:	Rerun
PRE-REQUISITES	:	None
COURSE DURATION	:	12 weeks
INDUSTRY SUPPORT	:	SMIL (Gurgaon), HAL (Kanpur and Lucknow), Cyeint (Hyderabad), Small and medium scale production industries.

COURSE OUTLINE

This is an introductory level course in Manufacturing Process Technology and is mostly meant for Undergraduate engineers. At the heart of any manufacturing system is a set of processes which change the size, shape and form of raw materials into the desirable thus giving an industrial nation the power of growing. This course is an introductory course for engineering professionals who would like to take up careers in manufacturing particularly at the process level and also for professionals who are already in manufacturing careers and would like to see the technological changes that the manufacturing processes have witnessed in the last about 5 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. Prof. Bhattacharya currently takes care of the 4-I laboratory at IIT Kanpur as its coordinator and has also been associated with the TA 202 laboratory as coordinator from 2012 to 2015. Both these laboratories are very high end in terms of offering manufacturing training programs.

COURSE PLAN

Week 1 to 2 : Manufacturing properties of materials.

Week 3 to 4 : Casting Processes, Gating Design and Casting Defects.

Week 5 to 6 : Machining Processes e.g. turning, drilling, grinding etc. Tool life.

Week 7 to 8 : Advanced Machining Processes e.g. AJM, ECM, EDM, LBM, USM etc.

Week 9 to 10 : Metal Forming Processes such as rolling, forging, extrusion etc.

Week 11 to 12 : Micro-fabrication processes, Additive manufacturing.

INTRODUCTION TO COMPOSITES

MECHANICAL ENGINEERING

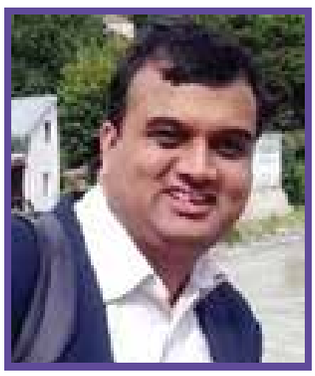
TYPE OF COURSE : New
PRE-REQUISITES : Must be enrolled into a B. Tech. program or equivalent and should have completed at least econd year of his 4-year program.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Automotive, Composites, Aerospace, Sports, Railways, Power Generation and all industry that has to address issues related to noise.

COURSE OUTLINE

This course is intended for all those who want to conduct experiments in area of NVH. 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

Prof. Nachiketa Tiwari i**s an Associate Professor of Mechanical Engineering at IIT Kanpur.** He has extensive experience in area of composites, product design, acoustics and noise. Earlier, he worked for over 13 years at the R&D Headquarters Bose Corporation in Massachussetts. He has a PhD in engineering mechanics from Virginia Tech. His area of PhD research was related to nonlinear behavior of composite structures.



COURSE PLAN

Week 1 : Intro and terminology

Week 2 : Concept Review

Week 3 : Fibers

Week 4 : Matrix materials

Week 5 : Short fiber composites

Week 6 : Short fiber composites

Week 7 : Orthotropic lamina

Week 8 : Orthotropic lamina

Week 9 : Orthotropic lamina

Week 10 : Composite laminates

Week 11 : Composite laminates

Week 12 : Composite laminates

METALLURGICAL AND MATERIALS ENGINEERING

METTALLURGICAL & MATERIALS ENGG

8weeks

01. Fundamentals Of Electronic Materials And Devices
02. Theory And Practice Of Non Destructive Testing
03. Material Science and Engineering
04. Iron Making
05. An Introduction to Materials: Nature and Properties (Part 1: Structure of Materials)
06. Heat Treatment and Surface Hardening-I
07. Principles Of Polymer Synthesis

12weeks

01. Introduction to Materials Science and Engineering
02. Physics Of Materials
03. Material Characterization

FUNDAMENTALS OF ELECTRONIC MATERIALS AND DEVICES

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : Rerun
PRE-REQUISITES : Preferably completed Physics of Materials or Solid state physics course
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Semiconductor device companies like TSMC and Applied Materials will value this course.

COURSE OUTLINE

The course is intended to provide an understanding of the materials and devices used in the current semiconductor industry. It caters to undergraduate and graduate students from diverse backgrounds including Chemical, Chemistry, Computer science, Electrical, Mechanical, Metallurgy, Materials, and Physics departments.

ABOUT INSTRUCTOR

Prof. Parasuraman Swaminathan joined the Department of Metallurgical and Materials Engineering, IIT Madras, in 2013. He has a B. Tech and M. Tech dual degree in Metallurgical and Materials Engineering from IIT Madras, and a PhD in Materials Science from the University of Illinois at Urbana-Champaign, USA.

COURSE PLAN

Week 1 : Introduction, Energy bands in solids, Semiconductors band gap formation

Week 2 : Problem set on week #1 and Intrinsic semiconductors.

Week 3 : Extrinsic semiconductors, Fermi level variations, and conductivity.

Week 4 : Problem set on week #3. Metal-semiconductor junctions and Introduction to pn junctions

Week 5 : pn junctions under bias, Junction breakdown, and Heterojunctions. Problem set on week#4 and 5.

Week 6 : Transistors, Types of transistors, MOSFETs, Problem set on week#6.

Week 7 : Optoelectronic devices – Introduction. LEDs and Lasers.

Week 8 : Photo detectors and solar cells. Problem set on opto electronic devices, week #7 and 8.

METTALLURGICAL
& MATERIALS ENGG

THEORY AND PRACTICE OF NON DESTRUCTIVE TESTING

TYPE OF COURSE : Rerun
PRE-REQUISITES : BE/Diploma in Engineering (Mech/Manufac/ Production/Civil/ Aerospace/App. Mech/ Material Engg)
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Manufacturing and Automotive Industries

COURSE OUTLINE

Nondestructive Testing (NDT) plays an extremely important role in quality control, flaw detection and structural health monitoring covering a wide range of industries. There are varieties of NDT techniques in use. This course will first cover the fundamental science behind the commonly used NDT methods to build the basic understanding on the underlying principles. It will then go on to cover the process details of each of these NDT methods.

ABOUT INSTRUCTOR

Prof. Ranjit Bauri is an Associate Professor in the Dept. of Metallurgical and Materials Engineering, IIT Madras. He has more than nine years of experience in teaching NDT theory and practical courses. He is a life member of Indian Society for Non Destructive Testing (ISNT). He is also a seasoned researcher with more than a decade of research experience. His research areas include Composite materials, Al alloys, Friction stir welding and processing, Powder Metallurgy and Microscopy.

COURSE PLAN

Week 1 : Introduction to NDT, Visual Optical methods, Dye penetrant testing, Basic principle, Types of dye and methods of application, Developer application and Inspection.

Week 2 : Magnetic particle testing, Basic theory of magnetism, Magnetization methods,Field indicators, Particle application, Inspection.

Week 3 : Eddy current testing, Basic principle; Faraday's law, Inductance, Lenz's law,Self and Mutual Inductance, Impedance plane, Inspection system and probes,System calibration.

Week 4 : Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes,Ultrasonic transducers.

Week 5 : Test method, Distance and Area calibration, Weld inspection by UT.

Week 6 : Acoustic emission testing: Basic principle, Sources of acoustic emission, Source parameters, Kaiser-Felicity theory, Equipment and Data display, Source location schemes.

Week 7 : Radiography: X-rays and their properties, X-ray generation, X-ray absorption and atomic scattering.

Week 8 :Image formation, Image quality, Digital Radiography, Image interpretation,Radiation Shielding. Comparison and selection of NDT methods, Concluding remarks.

MATERIAL SCIENCE AND ENGINEERING

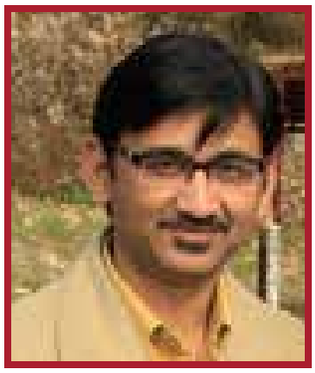
METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE	:	New
PRE-REQUISITES	:	None
COURSE DURATION	:	8 weeks
INDUSTRY SUPPORT	:	Automobile companies, Auto ancillary companies, Manufacturing companies.

COURSE OUTLINE

The course is primarily designed for Mechanical and Production Engineering students. Therefore, focus of the course is on structural materials. The course covers three important parts of materials which students and practicing engineers should know. The course is hoping to address both theoretical and practical aspects of Materials Engineering. To serve this purpose, the course is divided into three broad categories. a) Crystallography and crystal defects – It covers crystal systems, crystal structures, indexing of planes and directions, vacancies, dislocations, grain boundaries and microstructures. b) Phase diagram and heat treatment – It covers, Gibbs phase rule, one component systems, binary phase diagrams, lever rule, invariant reactions, iron-carbon phase diagram and heat treatment. c) Mechanical properties – Elastic and plastic deformation, engineering and true strain and stress, ultimate tensile strength, ductility, toughness, cold/hot working and strengthening mechanisms.

ABOUT INSTRUCTOR



Prof. Vivek Pancholi, B.Tech 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 10 years teaching experience at IIT Roorkee.

COURSE PLAN

Week 1 : Lattice, Crystal structures, Miller indices for planes and directions.

Week 2 : Microscopes, microstructures and quantitative metallography.

Week 3 : Defects, diffusion and phase diagram.

Week 4 :Equilibrium phase diagram, lever rule, phase transformation.

Week 5 : Iron-carbon phase diagram, TTT and CCT curves, heat treatments.

Week 6 : Introduction to mechanical properties, cold and hot working.

Week 7 : Strengthening mechanism Fracture, and Fatigue.

Week 8 : Creep, ceramics and plastic, NDT techniques, alloy designation.

IRON MAKING

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : New
PRE-REQUISITES : Bachelors in Engineering
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All iron and steel sector industries can support it

COURSE OUTLINE

This subject will provide you with the relevant knowledge that is necessary to any Metallurgist, Materials/Chemical engineer to pursue the higher levels of study. The course develops the student's understanding of ironmaking through a learning progression beginning with introduction of iron making blast furnace and ending with the brief description of alternative route of iron making. Thus, the subject deals with the description of raw materials and agglomeration along with their properties.

ABOUT INSTRUCTOR

Prof. Govind S. Gupta, Department of Materials Engineering, Indian Institute of Science, Bangalore is involved in various inter-disciplinary research projects which are fundamental and industrial in nature. He is involved both in theoretical and experimental work.

COURSE PLAN

Week 1 : Introduction to Iron Making, Raw Materials

Week 2 : Materials preparation and properties, Agglomeration: Pelletisation & Induration

Week 3 : Agglomeration: Sintering and Transport processes in a blast furnace: Temperature, Burden Distribution

Week 4 : Transport processes in a blast furnace: Aerodynamics of Blast Furnace

Week 5 : Transport processes in a blast furnace: Description of physical and chemical processes in the upper zones of a blast furnace.

Week 6 : Transport processes in a blast furnace: Description of physical and chemical processes in the lower zones of a blast furnace (dropping, raceway and hearth zones

Week 7 : Productivity of the blast furnace, Irregularities and process control in the blast furnace

Week 8 : Environmental issues related to ironmaking, A brief description of alternative rout of iron making

AN INTRODUCTION TO MATERIALS: NATURE AND PROPERTIES (PART 1: STRUCTURE OF MATERIALS)

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : New
PRE-REQUISITES : 12th standard science background
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Materials related companies

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.

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

HEAT TREATMENT AND SURFACE HARDENING-I

METTALLURGICAL & MATERIALS ENGG

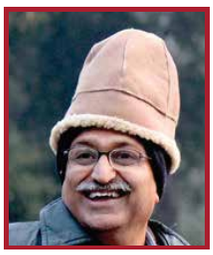
TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Heat treatment industries, steel industries, car industries

COURSE OUTLINE

Heat treatment is a fundamental principle required for processing of metals and alloys. By controlling time-temperature sequence with/without application of stress, it can modify the structure of the materials, which would influence the properties in a desired way. This principle lies strongly on the basics of thermodynamics and kinetics of phase transformations in metals and alloys, which is the guiding factor for deciding process schedule in Industry.

ABOUT INSTRUCTOR

Prof. Kallol Mondal is an Associate 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.



Prof. Sandeep Sangal, Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur His specializations are phase transformations in steels, development of bainitic rail steels and steriology.

COURSE PLAN

Week 1 : Introduction - Definition (Materials tetrahedron perspective) - Aim Theory of Heat Treatment (Why, How, What) - Structure of Metals and Alloys and Materials - Phase diagram and phase transformation

Week 2 : Phase diagram and phase transformation - Relation between thermodynamics and Kinetics for phase transformation

Week 3 : Relation between thermodynamics and Kinetics for phase transformation - Phase transformation and heat treatment (Time and temperature influence)

Week 4 : Relation between thermodynamics and Kinetics for phase transformation - Phase transformation and heat treatment (Time and temperature influence) - Concept of JKMA equation and TTT diagram - Heat treatment time and temperature and microstructure/property developed

Week 5 : Heat treatment time and temperature and microstructure (stereology) - CCT diagram from TTT diagram and experimental data and its implication to heat treatment

Week 6 : Heat treatment time and temperature and microstructure (stereology) - CCT diagram from TTT diagram and experimental data and its implication to heat treatment

Week 7 : Some heat treatments, like annealing, normalizing, hardening, tempering of steel on the basis of TTT and CCT diagram and properly-microstructure correlation

Week 8 : Introduction to Precipitation hardening

PRINCIPLES OF POLYMER SYNTHESIS

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All industries where polymer and polymer products are being designed, developed and used

COURSE OUTLINE

This course will introduce and discuss the basic principles of polymer chemistry. Specifically, it will stress upon the fundamentals of important polymerization reactions (emphasis on step polymerization and radical polymerization) and the principles that govern the structure of the resulting polymers. Synthesis and structure-property relation of several industrially important polymers will be discussed illustrating the applications of these principles. The course will also contain an introduction to basic chemical reactor design principles.

ABOUT INSTRUCTOR

Prof. Rajat Kumar Das is an Assistant Professor at Materials Science Centre, IIT Kharagpur. His research interests include smart stimuli responsive polymeric materials and multiple network hydrogels. He is taking the course 'Manufacture of Industrial Polymers' for 1st year MTech students of the centre.

COURSE PLAN

Week 1 : Historical development of polymer science (since the early 20th century), classification of polymers (based upon the structure of polymers/based upon mechanism of polymerization), concept of average molecular weight of polymers, how to determine different averages for molecular weight (specific methods such as gel permeation chromatography, vapour pressure osmometry, viscosity measurement, membrane osmometry etc. will be discussed in some detail).

Week 2 : Step polymerization: Control of molecular weight (stoichiometric excess or monofunctional impurity),number fraction and weight fraction distribution functions, side reactions in step polymerization (cyclization vs linear polymerization, the effect of ring stability and kinetic factor), interfacial polymerization (general principle along with specific examples, applicability).

Week 3 : Chain polymerization: general discussion of radical vs ionic polymerization; types of initiators; rate expression for radical chain polymerization, initiator efficiency; different modes of termination (coupling and disproportionation), chain transfer reactions and molecular weight control, autoacceleration, ceiling temperature.

Week 4 : Chain polymerization (contd..): Effect of temperature on rate of radical chain polymerization and on molecular weight of polymers, dead end polymerization; Chain copolymerization: terminal model and derivation of instantaneous copolymer composition, concept of reactivity ratio, ideal copolymerization, alternating and azeotropic copolymerization, copolymer composition drift with conversion, experimental determination of reactivity ratio, microstructure of copolymers; Living polymerization methods such as ATRP, NMD, and RAFT. Discussion of examples from research papers that utilize some of these strategies to obtain specific properties.

Week 5 : Design of Chemical Reactors: Different kinds of reactors (batch, CSTR, PFR, PBR etc.), basic mole balance equations and concept of reactor design with respect to the desired outcome of a chemical reaction (sizing of CSTR and PFR with respect to a targeted conversion in steady state), PFRs in series vs CSTRs in series.

Week 6 : Design of Chemical Reactors (contd..): Effect of the reactor on the molecular weight distribution in polymerization (radical vs step growth), Selectivity in chemical reaction vs choice of reactor, basic energy balance equation, multiplicity of steady states in CSTR, ignition and extinction temperature, application of these concepts in polymerization.

Week 7 : Industrial synthesis and structure-property relation of important engineering step polymers and specialty polymers (week 7 + week 8)

Week 8 : Industrial synthesis and structure-property relation of important engineering step polymers and specialty polymers (week 7 + week 8: polyesters, polycarbonates, epoxy resins, aliphatic and aromatic polyamides, polyurethanes, polyimides etc.); different fiber spinning processes

INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : New
PRE-REQUISITES : Science at school level equivalent to 10, +2 of Central Board of Secondary Education (CBSE), India.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Any industry concerned with materials, in particular automobile and manufacturing industry. Condensed versions of this course have been offered at Maruti Udyog Limited, Gurgaon and Terminal Ballistic Research Lab of CSIR, Chandigarh, India.

COURSE OUTLINE

This course is designed as a first introduction to microstructure and mechanical properties of engineering materials for undergraduate engineering students. The focus will be on clear presentation of basic fundamentals of structure and defects of crystalline materials. This will then be used to understand the transformations, heat treatments and mechanical behavior of structural materials. The course will also include several classroom and laboratory demonstrations.

ABOUT INSTRUCTOR

Prof. Rajesh Prasad, Department of Applied Mechanics, Indian Institute of Technology, Delhi began teaching Materials Science as a graduate student at University of Cambridge where he was supervisor and demonstrator for undergraduate course IA Crystalline Materials. He now has about three decades of experience of teaching materials science courses at both undergraduate and graduate levels at the Indian Institutes of Technology, at Varanasi, Kanpur and Delhi. He has been awarded a Teaching Excellence Award in 2012 by the Indian Institute of Technology Delhi. In 2013, he received the Distinguished Alumnus Award of the Department of Metallurgical Engineering, IIT-BHU, Varanasi.

COURSE PLAN

Week 1 : Crystal Geometry Part I

Week 2 : Crystal Geometry Part II

Week 3 : Structure of Solids Part I

Week 4 : Structure of Solids Part II

Week 5 : Structure of Solids Part III

Week 6 : Defects in Crystalline Solids Part I

Week 7 : Defects in Crystalline Solids Part II

Week 8 : Phase Diagrams

Week 9 : Diffusion

Week 10 : Phase Transformation Part I and Part II

Week 11 : Plastic Deformation Part I and Part II

Week 12 : Fracture and Fatigue

PHYSICS OF MATERIALS

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : Rerun
PRE-REQUISITES : First Year under graduate level of physics and mathematics will be beneficial but is not absolutely necessary.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

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

Properties of materials, thermal expansion, DC and AC techniques to measure electronic conductivity, free electron gas, Drude model for electronic conductivity and for thermal conductivity; Successes and Limitations of the Drude model – The Wiedemann Franz Law; Statistical Mechanics, Maxwell-Boltzmann statistics; history of quantum mechanics; Drude Sommerfeld model, Fermi-Dirac Statistics; Confinement and quantization; calculating density of available states for electrons; Fermi Energy, Fermi Surface, Fermi Temperature; Reciprocal space ; Wigner seitz cells Brillouin zones; Calculating allowed and forbidden energy levels; Description of tight binding approximation, impact of inter atomic spacing on band gaps. Comparison of free electron approximation and tight binding approximation. Effect of pressure on band gaps; Direct Band gap, indirect Band gap semiconductors; Magnetic properties; Electron compounds/Hume Rothery phases. Phonons, Optoelectronic properties; Superconductivity, Bose-Einstein Statistics; Physics of nano scale materials.

MATERIAL CHARACTERIZATION

METTALLURGICAL & MATERIALS ENGG

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : All the Metallurgical and automotive industries will be interested in this course

COURSE OUTLINE

It is the first course at the under graduate level on microstructural characterization of materials. This course will cover the basic principles and techniques of X-ray diffraction, optical, scanning electron and transmission electron microscopy along with demonstrations of the instrument details and imaging experiments through videos. This course also deals with the sample preparation techniques for the microstructural analysis with practical examples through videos.

ABOUT INSTRUCTOR

Prof. S. Sankaran is presently an Associate Professor in the Department of Metallurgical and Materials Engineering, IIT Madras. His research interests are deformation processing of materials, mechanical behavior of materials and electron microscopy. He is also presently the faculty in-charge of central electron microscopy of IIT Madras.

COURSE PLAN

Week 1 : Fundamentals of optic; Optical microscope and its instrumental details

Week 2 : Variants in the optical microscopes and image formation; Phase contrast, Polarised light, Differential interference contrast, Fluorescence microscopy

Week 3 : Sample preparation and applications of optical microscopes

Week 4 : Introduction to Scanning electron microscopy (SEM)

Week 5 : Instrumental details and image formation of SEM

Week 6 : Various imaging techniques and spectroscopy; Sample preparation and applications of SEM

Week 7 : Fundamentals of X-ray scattering; Bragg's law derivation and the factors affecting the intensity

Week 8 : Crystallite size, effect of strain on the intensity; Profile fit, indexing, peak broadening

Week 9 : Quantitative analysis, residual stress analysis; Instrumentation details and demo experiments of XRD

Week 10 : Introduction to transmission electron microscopy (TEM)

Week 11 : Diffraction and image formation; Various imaging techniques and spectroscopy

Week 12 : Sample preparation and applications of TEM; Instrumentation details and demo experiments of TEM

MULTIDISCIPLINARY

MULTIDISCIPLINARY

4weeks

01. Digital and the Everyday: from codes to cloud
02. Effective Engineering Teaching In Practice
03. Outcome based pedagogic principles for effective teaching

8weeks

01. Health Research Fundamentals
02. Introduction To Research
03. Matlab Programming For Numerical Computation
04. Principles and applications of NMR Spectroscopy

12weeks

01. Virtual Reality Engineering

MULTIDISCIPLINARY

DIGITAL AND THE EVERYDAY: FROM CODES TO CLOUD

TYPE OF COURSE	**:**	New
PRE-REQUISITES	**:**	Anybody with a Bachelor's degree in any discipline.
COURSE DURATION	**:**	4 weeks
INDUSTRY SUPPORT	**:**	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

Digital and the Everyday: from codes to cloud takes an interdisciplinary approach to unpack and analyze different elements of our digitally mediated social existence such as algorithms, data, privacy, identity and so on. Such an approach also includes a multitude of actors –from engineers to policy-makers, from designers to users, from big corporations to activists. It draws upon IIITB's research in the area of IT & Society, consulting and other activities being undertaken at its Centre for IT and Public Policy (CITAPP) and its pioneering Masters Programme in Digital Society.

ABOUT INSTRUCTOR

Prof. Bidisha Chaudhuri is an Assistant Professor in the Department of IT and Society, 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 in the Department of IT and Society,at the International Institute of Information Technology Bangalore (IIITB). At IIITB, he is also the Convenor of the Centre for IT and Public Policy (CITAPP, http://citapp.iiitb.ac.in/) and is in the core team of the E-Health Research Centre (EHRC, http://ehrc.iiitb.ac.in/). His research interests are in the areas of ICT and Development, e-Governance, Public Policy and Information Systems. Amit has a doctoral degree in Information Systems from IIM Bangalore and an undergraduate degree in Civil Engineering from IIT Roorkee.

COURSE PLAN

Week 1 : Introduction to the Winter School

Digital and the Everyday: Foundations

Socio-algorithmic processes and the Everyday

Week 2 : Data Protection and Privacy Regulation in the Digital Era

Data-driven Identities

Digital and the Everyday: Domains

Week 3 : Promises and Challenges of e-Health

Digital Finance:

Digital and our everyday interactions with the state

Week 4 : Creating a Machine Zone through Affected Feedback: Leisure and Entertainment on Social Media:

Concluding Remarks on Future of Digital Society

EFFECTIVE ENGINEERING TEACHING IN PRACTICE

MULTIDISCIPLINARY

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Any industry or start-up interested in education.

COURSE OUTLINE

Traditionally, teachers are not trained to teach professional courses. Thus, they learn even the essential principles of teaching through experience, 'on the job'. This leads to a less than satisfactory in-class learning experience for most students in many courses, except if the teacher has a natural orientation to teaching.

ABOUT INSTRUCTOR




Prof. G. K. Suraishkumar is a Professor in the Department of Biotechnology, Indian Institute of Technology Madras (IITM).

Prof. Edamana Prasad, Head, Teaching Learning Centre (TLC) and Associate Professor, Department of Chemistry, Indian Institute of Technology Madras,

Prof. Shreepad Karmalkar is a Professor of Electrical Engineering, Indian Institute of Technology Madras (IITM).

Prof. Richa Verma, Indian Institute of Technology, Madras

COURSE PLAN

Week 1
An inexperienced engineering teacher's view (GK)
From traditional lecturing to helping students learn (GK)
Better learning (Bloom's taxonomy) (GK)
Problem based learning (PBL) and problem solving (GK)

Week 2
Learning outcomes (TLC – E. Prasad)
Active learning (GK)
Co-operative group learning (GK + TLC videos)

Week 3
Flipped classroom (GK)
Lab courses (GK)
Evaluations/assessments (TLC – Richa Verma)

Week 4
How can we use research in education? (GK)
Class composition
Psychological type and learning
Models of cognitive development
Learning theories
Feed-back and Reflection (TLC – Shreepad Karmalkar)

OUTCOME BASED PEDAGOGIC PRINCIPLES FOR EFFECTIVE TEACHING

MULTIDISCIPLINARY

TYPE OF COURSE : Rerun
PRE-REQUISITES : None
COURSE DURATION : 4 weeks
INDUSTRY SUPPORT : Companies/industry/ Educational Institute want to Implement 21st Century Education procedure
Educational Institute want to apply for Accreditation

COURSE OUTLINE

Globalisation, changing demographics and technological advancements are some of the key driving forces of the future. Our students will have to be prepared to face these challenges and seize the opportunities brought about by these forces. In Twenty-first Century Learning, students use educational technologies to apply knowledge to new situations, analyze information, collaborate, solve problems, and make decisions.

ABOUT INSTRUCTOR

Prof. Shyamal Kumar Das Mandal received the B.E degree in Electronics and Telecommunication engineering in 1998 and Ph.D degree in 2007 from Jadavpur University, India and **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 spoken language acquisition.

COURSE PLAN

Week 1 : 21st Century Education and Outcome based Learning

Week 2 : Instructional design for active learning

Week 3 : Outcome based Education

Week 4 : Learning Theories

MULTIDISCIPLINARY

HEALTH RESEARCH FUNDAMENTALS

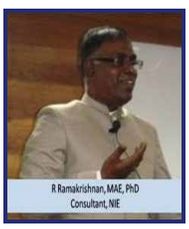
TYPE OF COURSE : Rerun
PRE-REQUISITES : Undergraduate students in medical/denta /nursing/AYUSH streams, Graduate in any discipline
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Government/ private sector, public health service institutions

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 – NIeCer - Courses.

ABOUT INSTRUCTOR

Multifaculty
National Institute of Epidemiology



COURSE PLAN

Week 1: Conceptualizing a research study
Introduction to health research – Dr. Sanjay Mehendale
Formulating research question, hypothesis and objectives – Dr. P Manickam
Literature review – Dr. P Ganeshkumar

Week 2: Epidemiological considerations in designing a research study (1/2)
Measures of disease frequency – Dr. R Ramakrishnan
Descriptive study designs – Dr. Prabhdeep Kaur
Analytical study designs – Dr. Manoj Murhekar

Week 3: Epidemiological considerations in designing a research study (2/2)
Experimental study designs: Clinical trials - Dr. Sanjay Mehendale
Validity of epidemiological studies – Dr. Tarun Bhatnagar
Qualitative research methods: An overview – Dr. Tarun Bhatnagar

Week 4: Bio-statistical considerations in designing a research study
Measurement of study variables – Dr. R Ramakrishnan
Sampling methods – Dr. R Ramakrishnan
Calculating sample size and power – Dr. R Ramakrishnan

Week 5: Planning a research study (1/2)
Selection of study population – Dr. P Ganeshkumar
Study plan and project management – Dr. Sanjay Mehendale
Designing data collection tools – Dr. Tarun Bhatnagar

Week 6: Planning a research study (2/2)
Principles of data collection – Dr. Prabhdeep Kaur
Data management – Dr. P Manickam
Overview of data analysis - Dr. P Manickam

Week 7: Conducting a research study
Ethical framework for health research – Dr. Sanjay Mehendale
Conducting clinical trials - Dr. Sanjay Mehendale

Week 8: Writing a research protocol
Preparing a concept paper for research projects – Dr. P Manickam
Elements of a protocol for research studies – Dr. Tarun Bhatnagar

MULTIDISCIPLINARY

INTRODUCTION TO RESEARCH

TYPE OF COURSE : Rerun
PRE-REQUISITES : Students who have completed undergraduate studies (in Engineering or Science) will be in a better position to benefit from this course
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

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 Mettallurgical & Material Engineering

Prof. Prathap Haridoss
Dept. of Metallurgical & Materials Engg.
IIT Madras

Prof. M. S. Ananth
Dept. of Chemical Engg
IIT Madras

Prof. Abhijit Deshpande
Dept. of Chemical Engg
IIT Madras

Prof. Arun K. Tangirala
Dept. of Chemical Engg
IIT Madras

Prof. Balaji C
Dept. of Mechanical Engg
IIT Madras

Prof. G. Phanikumar
Dept. of Mettallurgical & Material Engg
IIT Madras

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

MULTIDISCIPLINARY

MATLAB PROGRAMMING FOR NUMERICAL COMPUTATION

TYPE OF COURSE : Rerun
PRE-REQUISITES : The students for this course are expected to know basics of linear algebra and calculus. These are covered in Introductory Math course(s) for Engineers (typically done in first year).
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate it's use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed.

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 5 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 1 : Introduction to MATLAB Programming

Week 2 : Approximations and Errors

Week 3 : Numerical Differentiation and Integration

Week 4 : Linear Equations

Week 5 : Nonlinear Equations

Week 6 : Regression and Interpolation

Week 7 : Ordinary Differential Equations (ODE) – Part 1

Week 8 : Ordinary Differential Equations (ODE) – Practical aspects

MULTIDISCIPLINARY

PRINCIPLES AND APPLICATIONS OF NMR SPECTROSCOPY

TYPE OF COURSE : Rerun
PRE-REQUISITES : Should have studied Chemistry at undergraduate level and Mathematics at least up to 12th Standard
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : All pharmaceutical companies (e.g., Reddy's laboratories, CIPLA, Sun Pharma) and R &D laboratories like Hindustan Unilever, Biotech companies (Biocon)

COURSE OUTLINE

The objective of the course is to teach the basic aspects of nuclear magnetic resonance (NMR) spectroscopy, which is an important analytical tool in chemical and pharmaceutial industry for structural characterization of molecules. The topics to be covered will include one-dimensional NMR, Chemical shifts, J-coupling, Interpretation of 1D NMR spectrum, Basics of 2D NMR, Different 2D NMR experiments and their application/interpretation, Application of 2D NMR for assignment of molecules and peptides.

ABOUT INSTRUCTOR

Prof. Hanudatta S. Atreya is an Associate Professor at the Indian Institute of Science in the NMR Research Centre. He has nearly 20 years of experience in the area of NMR spectroscopy. He has authored approximately 75 peer review publications, edited one book and has two US patents. Research interests include development and application of new magnetic resonance methodologies for studying structure, function and dynamics of biomolecules.

COURSE PLAN

Week 1 : Introduction to NMR spectroscopy

Week 2 : Chemical shifts and J-coupling

Week 3 : One-dimensional proton NMR

Week 4 : One dimensional NMR of X-nuclei (13C, 15N, 31P and 19F)

Week 5 : Homonuclear 2D NMR

Week 6 : Heteronucler 2D NMR

Week 7 : Structure determination of molecules

Week 8 : Advanced topics (Solvent suppression, Drug Discovery, DOSY)

VIRTUAL REALITY ENGINEERING

MULTIDISCIPLINARY

TYPE OF COURSE : New
PRE-REQUISITES : Engineering Mathematics taguht in first year of Engineering, Basic programming
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Many IT companies

COURSE OUTLINE

Virtual Reality is an emerging technology that promises to disrupt our lives unlike any other technologies in the past. In this course you will learn how to design a better VR system by understanding several engineering concepts (hardware, software, perception) that are used in the current VR systems. This is a highly interdisciplinary course involving computer science, electrical engineering, mechanical engineering, neuroscience, and psychology.

ABOUT INSTRUCTOR

Prof. Manivannan. M is a Professor of Biomedical Engineering in IIT Madras, Department of Applied Mechanics. He has been working in Virtual Reality for past 15 years, specifically on Haptics. He was a visiting scientist at the Massachusetts Institute of Technology (MIT), Massachusetts General Hospital (MGH) of Harvard Medical School (HMS) in Boston, and National Institute of Standards and Technology (NIST) in Maryland. He was a visiting faculty in the Christian Medical College (CMC) Vellore, and the Indian Institute of Science (IISc) Bangalore

The videos were originally created by Prof. Steve Lavalle for NPTEL.

COURSE PLAN

Week 1 : Introduction, Goals, Definitions, History, Overview of the course

Week 2 : Geometric Modeling, Transforms, Quaternions

Week 3 : Study of Perception and Sensation, Perceptual Engineering, Importance in Virtual Reality

Week 4 : Light and Optics, Human Optical System

Week 5 : Human Visual Physiology

Week 6 : Visual Perception, Depth and Motion Perception

Week 7 : Tracking Systems. Pose tracking, technologies for pose tracking

Week 8 : Visual Rendering, Rastering, Shading, CUDA programming

Week 9 : Auditory Sensation and Perception, Rendering Audio, 3D audio

Week 10 : Haptic Sensation and Perception, Rendering Haptics, Stereognosis, Sensation and Perception of Other Senses, Rendering other senses

Week 11 : Interfaces for Virtual Reality, Locomotion, Manipulation, Social Interaction

Week 12 : Applications and Challenges in VR, Evaluation of VR systems

OCEAN ENGINEERING

OCEAN ENGINEERING

12weeks

01. Computer Methods Of Structural Analysis Of Offshore Structures
02. Reliability Of Offshore Structures

OCEAN ENGINEERING

COMPUTER METHODS OF STRUCTURAL ANALYSIS OF OFFSHORE STRUCTURES

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : ONGC, Reliance, UGC, Technip

COURSE OUTLINE

The course will give a brief overview of different types of offshore structures that are deployed in sea for exploiting oil, gas and minerals. Detailed analysis methods, as applicable to both 2dimensional and 3-dimensional structures will be discussed. While fundamentals of advanced structural analysis are discussed, detailed mathematical modeling of problem formulation and solution using MATLAB coding will be discussed.

ABOUT INSTRUCTOR

Prof. Srinivasan Chandrasekaran, Department of Ocean Engineering, Indian Institute of Technology, Madras : 18-07-2014 till date
Associate Professor, Dept. of Ocean Engg, IIT Madras: 24-08-2009 till 17-07-2014
Reader in Structural Engineering, Dept. of Civil Engg, IIT-BHU, Varanasi: 10-12-2007 till 23-08-2009
Lecturer, Dept. of Civil Engg., IIT-BHU, Varanasi: 05-08-2002 till 09-12-2007
Visiting faculty: 1991-2002
Dept of Civil Engg, Delhi College of Engineering, Delhi University
Dept of Architecture, Sir Chotturam State College of Engineering, Murthal, Haryana
Dept of Architecture, Rao Tula Ram College of Technical Education, New Delhi

COURSE PLAN

Week 1 : Indeterminate structures

Week 2 : Stiffness method: Plane orthogonal structures

Week 3 : Stiffness method: Plane non-orthogonal structures

Week 4 : Analysis using sub-structure techniques

Week 5 : Types of offshore structures

Week 6 : Environmental loads

Week 7 : Analysis of Articulated towers

Week 8 : New-generation offshore platforms

Week 9 : Analysis of Offshore Buoyant Leg structures

Week 10 : Stochastic process

Week 11 : Random loading, Response spectrum

Week 12 : Analysis under fatigue loads

OCEAN ENGINEERING

RISK AND RELIABILITY OF OFFSHORE STRUCTURES

TYPE OF COURSE : Rerun
PRE-REQUISITES : UG/PG/Ph.D of all engg branches and PG of applied sciences; Diploma students can also register
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : All academic institutes, all consultancy organizations like Technip, L&T, DNV etc.

COURSE OUTLINE

Considering the importance of offshore structures, one has to recognize that there are other intrinsic uncertainties such as material properties, analysis methods, design procedures etc, which are addressed rationally. A detailed knowledge of reliability of offshore structures using probabilistic tools becomes need of the hour for both industry and academia. Offshore activities, on one hand, lead to increase in societal wealth, and, on the other hand, make society vulnerable to risks. An offshore engineer is usually accountable for the decisions that he takes.

ABOUT INSTRUCTOR

Prof. Srinivasan Chandrasekaran Department of Ocean Engineering Indian Institute of Technology, Madrasis 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 complaint 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 1: Introduction to reliability

Week 2: Rules of probability

Week 3: Random variables

Week 4: Levels of reliability

Week 5: Reliability methods

Week 6: System reliability

Week 7: Reliability - Application problems

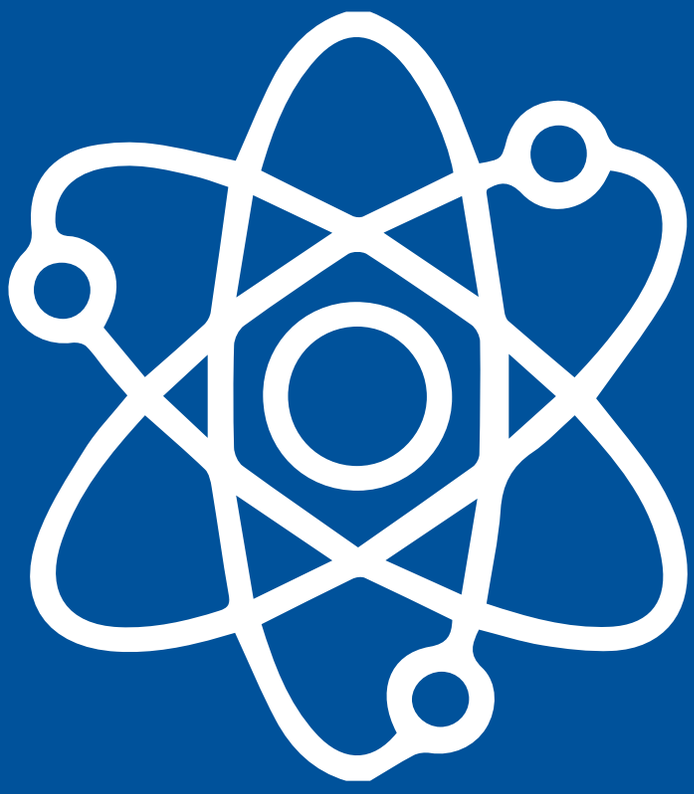
Week 8: Variables in reliability analysis

Week 9: Fatigue reliability

Week 10: Risk Assessment

Week 11: Risk analysis methods

Week 12: Risk and Hazard



PHYSICS

PHYSICS

8weeks

01. Advanced Condensed Matter Physics
02. Fiber Optics

12weeks

01. Atomic And Molecular Physics
02. Nuclear and Particle Physics
03. Semiconductor Optoelectronics

PHYSICS

ADVANCED CONDENSED MATTER PHYSICS

TYPE OF COURSE : New
PRE-REQUISITES : Solid State Physics Course
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The course deals with the prerequisite material for studying advanced level research in Condensed Matter Physics. The course begins with a preliminary discussion on second quantization, followed by zero temperature and Matsubara Greens functions. Applications to Hubbard model, Kane Mele model and superconductivity are discussed.

ABOUT INSTRUCTOR

Prof. Saurabh Basu is a Professor at the Department of Physics, IIT Guwahati. The area of expertise is Theoretical Condensed Matter Physics, with special emphasis on the correlated boson and fermion systems, topological insulators. He has about 80 research publications in different refereed international journals.

COURSE PLAN

Week 1 : Second quantisation

Week 2 : Applications of second quantisation to free particle systems

Week 3 : Applications: Quantum Theory of magnetism, Hubbard model

Week 4 : Greens functions at zero temperature

Week 5 : Wick's theorem, Feynman diagrams

Week 6 : Finite temperature Greens functions – Matsubara formalism

Week 7 : Applications of Greens functions to superconductivity

Week 8 : Meissner effect, non-local electrodynamics, BCS theory

FIBER OPTICS

PHYSICS

TYPE OF COURSE : Rerun
PRE-REQUISITES : A basic course on Electromagnetic Theory
COURSE DURATION : 8 weeks
INDUSTRY SUPPORT : Sterlite Technologies Ltd., Tejas Networks, Ciena Networks, Infinera India Pvt. Ltd, Eagle Photonics, Nest Photonics, etc, may recognize the course.

COURSE OUTLINE

The course is aimed at equipping the undergraduate Engineering and Physics students with the basic understanding of optical fibers and optical fiber communication. The course provides knowledge of optical fiber waveguide at fundamental level, essentials of an optical fiber communication system and understanding of various components of an optical fiber telecommunication system.

ABOUT INSTRUCTOR

Prof. Vipul Rastogi Department of Mechanical & Industrial Engineering Indian Institute of Technology Roorkee, received PhD degree from the Indian Institute of Technology, Delhi, India in 1998. He carried out post-doctorate in Université de Nice Sophia Antipolis, France during 1998 – 1999. From 2000 to 2003 he worked in the Department of Electronic Engineering in City University of Hong Kong as a Research Fellow. In November 2003 he joined Department of Physics at Indian Institute of Technology Roorkee, where he is now an Associate Professor. His current research interests are in optical fiber designs for high power lasers and high data rate optical communication, erbium doped fiber amplifier for SDM communication system, optical fiber sensors, and optoelectronic devices.

COURSE PLAN

Week 1: Introduction, need for optical communication, salient features of optical fibers, ray theory of light guidance, numerical aperture, modes of a fiber, single and multimode fibers, step-index and graded-index fibers, fiber fabrication techniques

Week 2: Transmission characteristics of optical fibers, attenuation, pulse broadening mechanism, intermodal dispersion, bit rate - length product, material dispersion, electromagnetic wave analysis of light propagation in an infinitely extended medium, em waves in dielectrics, boundary conditions

Week 3: Electromagnetic analysis of planar optical waveguides, TE and TM modes, planar mirror waveguide, dielectric symmetric step-index, planar waveguide, symmetric and anti-symmetric modes, b-V curves, modal fields

Week 4: Power associated with modes of dielectric symmetric planar waveguide, asymmetric planar waveguide, single polarization single mode waveguide, excitation of guided modes by prism coupling technique, radiation modes, optical fiber waveguide, EH and HE modes, weakly guiding fibers, LP modes, mode cut-offs, b-V curves

Week 5: Optical fiber modes, field patterns, degeneracies, fractional power in the core, single mode fiber, cut-off wavelength, mode field diameter, bend loss, splice loss, waveguide dispersion, group delay

Week 6: Total chromatic dispersion, pulse broadening and chirping, dispersion in graded-index and multilayer fibers, optical fiber components and devices, directional coupler, power splitter, WDM coupler, polarization controllers, fiber Bragg gratings

Week 7: Various types of fiber Bragg gratings, fabrication methods, applications, long period gratings, optical fiber amplifier, erbium doped fiber amplifier, dispersion management, dispersion shifted fiber, dispersion compensating fiber, sources for optical fiber communication, light emitting diode, internal and external quantum efficiencies, LED characteristics, laser diode

Week 8: Detectors for optical communication, p-i-n photodetector, APD, System design, dispersion and attenuation limited systems, BER, power budgeting of fiber link, recent advances

PHYSICS

ATOMIC AND MOLECULAR PHYSICS

TYPE OF COURSE : New
PRE-REQUISITES : None
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Atomic and molecular physics is a fundamental subject and Knowledge of this subject is compulsory for them who are working in physical, chemical and optical laboratories/industries.

COURSE OUTLINE

Atom and molecule are the fundamental unit for all matters in universe. Matter, whatever the states, is made of atoms. The properties of all matters are governed by the electronic structure of atom and molecule. They have individual properties like electronic, magnetic and optical properties, which are quite different from the collective properties of matter made of atoms and molecules. This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field.

ABOUT INSTRUCTOR

Prof. Amal Kumar Das, Department of Physics Indian Institute of Technology, Kharagpur, He after completion of B. Sc (Hons) in Physics and M. Sc in Physics from Calcutta (Kolkata) University in 1994, 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 (IIT) Kharagpur in 2004 and teaching different subject to UG and PG students, especially atomic and molecular physics.

COURSE PLAN

Week 1 : Experimental observations and theoretical prediction of constituents of an atom

Week 2 : Bohr-Sommerfeld model of atomic structure

Week 3 : Quantum number and vector model

Week 4 : Quantum mechanics and hydrogen atom

Week 5 : Effect of electric and magnetic field on atomic spectra

Week 6 : Selection rules

Week 7 : Alkali atoms and spectra

Week 8 : Many electron system

Week 9 : Rotational spectra of molecules

Week 10 : Vibrational spectra of molecules

Week 11 : Electronic spectra of molecules

Week 12 : Molecular structure and spectroscopy

PHYSICS

NUCLEAR AND PARTICLE PHYSICS

TYPE OF COURSE : New
PRE-REQUISITES : Basic Quantum Mechanics
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : None

COURSE OUTLINE

The first part of the course will discuss nuclear physics. Properties of nuclei and details of popular nuclear models, properties of nuclear decays and nuclear reactions will be discussed in brief, but in a self-consistent manner. The second part will discuss the basics of particle physics. In this part, the fundamental forces and the dynamics of elementary particles under these forces will be considered. After introducing relativistic quantum mechanics, relativistic formulation of Maxwell's Equations and quantum electrodynamics will be discussed.

ABOUT INSTRUCTOR

Prof. Poulose Poulose, Professor & Head of Physics Department at Indian Institute of Technology Guwahati since 2004. He completed his Ph.D. in Particle Physics Phenomenology from the Physical Research Laboratory, Ahmedabad ion 1997 before spending his time as postdoctoral fellow at Tata Institute of Fundamental Research (1997-1999), Indian Institute of Science, Bangalore (1999-2001), RWTH-Aachen, Germany (2001-2002). Professor Poulose has about 25 years of research experience including his PhD years with about 32 publications in international research journals, and has teaching experience of about 12 years teaching at the UG and PG courses at IIT Guwahati.

COURSE PLAN

Basic Properties of the Nucleus

Nuclear Force

Nuclear Models

Radioactive Decays

Nuclear Reactions

Particle Accelerators and Detectors

Modern Complex Detectors

Elementary Particles and Fundamental Forces

Quark Model, Structure of protons and neutrons

Relativistic Quantum Mechanics, QED

Scattering Theory

Gauge Symmetry

Electroweak Symmetry Breaking: Higgs Mechanism

PHYSICS

SEMICONDUCTOR OPTOELECTRONICS

TYPE OF COURSE : Repurposed
PRE-REQUISITES : Basic undergraduate-level knowledge of Semiconductors, Optics, Electronics and Quantum Mechanics would be required.
COURSE DURATION : 12 weeks
INDUSTRY SUPPORT : Companies and R&D Laboratories working on Laser Applications, Optoelectronic and Optical Communication are expected to value this course.

COURSE OUTLINE

This course introduces the students to the field of Semiconductor Optoelectronics, which deals with the physics and technology of semiconductor optoelectronic devices such as light emitting diodes, laser diodes and photodiodes, which are becoming important components in consumer optoelectronics, IT and communication devices, and in industrial instrumentation. Assuming a general science/engineering undergraduate level background, the course begins with a recap of essential (to this course) semiconductor physics, followed by the study of interaction of photons with electrons and holes in a semiconductor, leading to the realization of semiconductor photon amplifiers, sources, modulators, and detectors.

ABOUT INSTRUCTOR

Prof. M R Shenoy Department of Physics Indian Institute of Technology, Delhi, received the M. Sc. in Physics in 1979 from Mysore University and the PhD in the field of Fiber and Integrated Optics from IIT Delhi in 1987. He joined the faculty of IIT Delhi in 1988, where he is currently Professor in the Department of Physics. Dr. Shenoy was a Visiting Scientist with the Department of Electrical and Electronic Engineering, University of Glasgow, Glasgow, U.K., in 1990 for 10 months, and on short- duration visits at the University of Nice – Sophia Antipolis, Nice, France, in 1992, 1997, 2006 and 2008 for collaborative research on Integrated Optical Devices.

COURSE PLAN

Week 1 : Introduction, Energy bands in solids, Density of states

Week 2 : Occupation probability and Carrier concentration, Quasi Fermi levels

Week 3 : Semiconductor optoelectronic materials and Heterostructures

Week 4 : Heterostructure p-n junctions, Schottky junctions, Ohmic contacts

Week 5 : Interaction of photons with electrons and holes in a semiconductor

Week 6 : Amplification by stimulated emission, The semiconductor laser amplifier

Week 7 : Absorption in semiconductors and quantum wells, Electro-absorption modulator

Week 8 : Injection electroluminescence, Light emitting diode and their characteristics

Week 9 : Semiconductor laser: Device structure and characteristics

Week 10 : Single frequency lasers, VCSEL and Quantum well lasers

Week 11 : Semiconductor photodetectors, General characteristics

Week 12 : Photodiodes: PIN diode and APD. Photonic Integrated Circuits

LIST OF COURSE JAN - JUN 2018

CHEMISTRY 49

4weeks

8weeks

12weeks

CHEMICAL ENGINEERING 29

4weeks

8weeks

12weeks

CIVIL ENGINEERING 60

4weeks

8weeks

12weeks

COMPUTER SCIENCE & ENGINEERING 77

4weeks

8weeks

12weeks

ELECTRICAL ENGINEERING 108

4weeks

8weeks

12weeks

HUMANITIES & SOCIAL SCIENCES 130

4weeks

8weeks

12weeks

MANAGEMENT

MATHEMATICS

MECHANICAL ENGINEERING 187

4weeks

8weeks

12weeks

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