AY24-25 - SEMESTER-II - COURSE SYLLABUS

ELECTRICAL AND ELECTRONICS ENGINEERING

FIRST YEAR (E1) – SEMESTER – II -R22								
Sl. No.	**Course Code**	**Course Title**	**Course Category**	**L**	**T**	**P**	**Total Contact Hours**	**Credits**
1	EE1201	Network Theory-II	PCC	3	0	0	3	3
2	EE1801	Network Theory Lab	ESC	0	0	3	3	1,5
3	*MA1202*	*Differential equations and Laplace Transforms*	*BSC*	3	1	0	4	4
4	CY1201	*Engineering Chemistry*	*BSC*	3	0	0	3	3
5	CY1801	*Engineering Chemistry Lab*	*BSC*	0	0	3	3	1,5
6	CS1202	Programming for Problem Solving	ESC	3	0	0	3	3
	CS1802	Programming for Problem Solving Lab	ESC	0	0	3	3	1,5
8	ME1802	Engineering Workshop	ESC	0	1	2	3	2
9	*BM1205*	*Constitution of India*	*MC*	2	0	0	2	0
10	EC1203	Analog Electronic Circuits-I	ESC	3	0	0	3	3

EE1201

NETWORK THEORY-II

Externals:60Marks **L-T-P-C**

Internals:40Marks **3-0-0-3**

CourseObjectives:

- To introduce the various techniques used in the transient and steady-state response of electrical circuits.
- To understand the first order and second order differential equations.
- To learn about two port networks and network topology.
- The emphasis of this course is laid on the basic analysis of circuits which includes Circuit concepts, magnetic circuits.

CourseOutcomes:

At the end of this course, students will demonstrate the ability to

- Evaluate transient behavior of single port networks for DC and AC excitations.
- Examine behavior of linear circuits using Laplace transform and transfer functions of single port and two port networks.
- Understand the concept of magnetic circuits.
- Analyze two port circuit behaviour.

UNIT I: Solution of First and Second order networks (10 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. Transient Response of R-L, R-C, R-L-C Series Circuits for Sinusoidal Excitation.

UNIT II: Electrical Circuit Analysis Using Laplace Transforms (10 Hours)

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, inverse Laplace transform, and transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots).

UNIT III: Two Port Network (10 Hours)

Open circuit impedance , short-circuit admittance, Transmission, Hybrid parameters & inter-relationships, series, parallel and cascade connection of two port networks, system function, impedance and admittance functions.

UNIT IV: Magnetic Circuits:(8 Hours)

Faraday's Laws of Electromagnetic Induction, Concept of Self and Mutual Inductance, Mutual coupled circuits, Coefficient of Coupling, Dot Convention, Ideal Transformer, Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits.

UNIT V: Network topology and Network Synthesis (10 Hours)

Network Topology:Definitions – Graph, Tree, chord, Basic Cut-set, Basic Tieset and incident Matrices for Planar Networks, Loop and Nodal Analysis of Networks with Dependent & Independent Voltage and Current Sources, Duality & Dual Networks.

Network synthesis: Network synthesis of driving point functions, Positive real functions Hurwitz polynomials, Realization of passive RL, RC and LC networks using Foster and Caner forms.

Text Books:

1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
2. Chakravarthy A.,Circuit Theory,Dhanpat Rai & Co., First Edition, 1999.

Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. Network Theory by N.C. Jagan & C. Lakshminarayana, B.S. Publications.
5. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

MA1202

Differential Equations and Laplace Transforms

Externals: 60 marks
Internals: 40 Marks

L	T	P	C
3	1	0	4

Course Objectives:

- Methods of solving the differential equations of first and higher order.
- To Solve the Differential & integral equations using Laplace Transform
- To understand the Applications of Laplace Transforms

Course Outcomes: At the end of the course student will be able to

- Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati&Clairaut's equations
- Use shift theorems to compute the Laplace transform and inverse Laplace transform
- Use the Laplace transform to compute solutions of equations involving impulse functions

UNIT-I: Ordinary Differential Equations of first order

Exact first order differential equation, findingintegrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

UNIT-II: Ordinary Differential Equations of higher order

Linear dependence and independence of functions,Wronskian of n- functions to determine Linear Independence and dependence of functions, Solutions of Second and higher order differential equations (homogeneous & non-homogeneous) with constant coefficients, Method of variation of parameters, Euler-Cauchy equation.

***UNIT-III: Laplace Transform** –I:*

Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem UNIT-IV Inverse Laplace Transforms

UNIT-IV Inverse Laplace Transforms

Finding Inverse Laplace Transform using various methods, Evaluation of integrals by Laplace Transform. Solving initial and boundary value problems, Differential Equations & Partial differential equations, Integral Equations using Laplace Transforms.

UNIT-V: Integral Calculus

Convergence of improper integrals, tests of convergence, Beta and Gamma functionselementary properties, differentiation under integral sign, differentiation of integrals with variable limits.Leibnitz rule. Rectification, double and triple integrals, computations of surface and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters – applications.

Text Books:

1. Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books:

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.
2. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17thEdition2014.

CY1201

Engineering Chemistry

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I: Electrochemistry (12)

Introduction to electrochemistry: Galvanic cell (Daniel cell), Nernst equation. Types of electrodes: metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-reduction electrodes (quinhydrone electrode), amalgam electrodes and ion exchange electrode (glass electrode). EMF and applications of EMF: determination of pH of the solution, potentiometric titrations, Classification of commercial cells - primary cells (dry cell) and secondary cells (Lithium ion battery, Pb-acid storage battery). Fuel cells: H_2-O_2 fuel cell.

UNIT - II: Corrosion and water treatment. (10)

Dry and wet corrosion and their mechanisms. Pilling - Bedworth Rule. Types of Corrosion: galvanic corrosion, concentration cell corrosion, pitting corrosion and stress corrosion. Factors influencing the rate of corrosion: Temperature, pH and dissolved oxygen. Corrosion Prevention methods: Cathodic protection – Sacrificial Anodic method and Impressed current method. Metallic coatings: galvanization and tinning methods.

Water: Hardness of water, Degrees of hardness. Calculation of hardness by EDTA method. Disadvantages of hard water in boilers: priming, foaming, scales, sludges and caustic embrittlement. Treatment of boiler feed water: Zeolite process, Ion exchange process.

UNIT - III: Energy sources (10)

Introduction. Definition and classification of fuels. Calorific value of a fuel, Characteristics of a good fuel. Coal, types of Coal. Analysis of Coal: Proximate and Ultimate analysis. Bomb Calorimeter and Junker's gas Calorimeter. Problems on calculation of calorific value. Liquid fuels Introduction .Synthetic Petrol: Fisher Tropsch process. Introduction to Bio-fuels: Bio-diesel, Bio-gas

Unit IV: Chemical kinetics (8)

Introduction to rate of reaction and rate constant determination. Factors influencing rate of reaction. Complex reactions: definition and classification of complex reactions, definition of reversible reactions with examples, rate law derivation for reversible reactions. Consecutive reactions: definition, rate law derivation and examples of consecutive reactions. Parallel reactions:definition, rate law derivation and examples of parallel reactions. Steady-state approximation: introduction, kinetic rate law derivation by applying steady state approximation in case of the oxidation of NO and pyrolysis of methane.

UNIT - V: Nanochemistry (10)

Introduction to nanomaterials, classification: Carbon based nanomaterials, metallic nanoparticles,

metal oxide nanoparticles. Properties at nanoscale. Synthetic approaches: Top-Down (Photolithography, ball milling) and Bottom-Up (Sol-gel, Hydrothermal). Brief overview on characterization of nanomaterials: X-ray, SEM and TEM. Applications of nanomaterials.

Reference Books

1. Engineering Chemistry, Jain & Jain
2. Engineering Chemistry, Shashi Chawla
3. Chemistry for Engineers, B. K. Ambasta
4. Engineering Chemistry, H. C. Srivastava
5. Fundamentals of engineering Chemistry by Shikha Agarwal.

CY1801 **ENGINEERING CHEMISTRY LAB**

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 3 – 1.5**

List of the experiments for Engineering Chemistry

1. Determination of the strength of weak acid (CH_3COOH) by pH metry.
2. Conductometric titration (strong acid (HCl) vs strong base (NaOH)).
3. Throwing power of Copper.
4. Estimation of alkalinity of water.
5. Determination of total hardness of water by complexometric method using EDTA.
6. Determination of the calorific value of fuel sample by using bomb calorimeter.
7. Preparation of bio-diesel from palm oil by trans esterification method.
8. The rate constant and order of the reaction of the hydrolysis of an ester catalyzed by an acid (dil.HCl).
9. Preparation of Nano particle (ZnO).

Reference books:

1) Essentials of experimental engineering chemistry by Shashi chawla.
2) Practical chemistry by Dr.O.P.Pandey, S.Chand publication.
3) A textbook of engineering chemistry by Shashi chawla.
4) College practical chemistry by VK Ahluwalia.
5) Practical engineering chemistry by K. Mukkanti.
6) Laboratory manual by R. Kulakarni, Adil.

CS1202

Programming for Problem Solving

Internal Marks 40

External Marks 40

L-T-C-P

3-0-0-3

Course Objectives

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of the C programming language.
- To learn the usage of structured programming approaches in solving problems.

Course Outcomes

1. To write algorithms and to draw flowcharts for solving problems.
2. To convert the algorithms/flowcharts to C programs.
3. To code and test a given logic in the C programming language.
4. To decompose a problem into functions and to develop modular reusable code.
5. To use arrays, pointers, strings and structures to write C programs.
6. Searching and sorting problems.

Detailed Contents

UNIT-I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Representation of Algorithm - Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number Flowchart/Pseudo code with examples, Program design and structured programming.

Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, type conversion, The main method and command line arguments, Bitwise operations: Bitwise AND, OR, XOR and NOT operators.

UNIT-II

Conditional Branching, Loops, Arrays: Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do- while loops.

I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr. Command line arguments

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays.

UNIT-III

Strings, Structures, Pointers: Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings

Structures: Defining structures, initializing structures, unions, Array of structures

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures.

UNIT-IV

Functions, Recursion, Preprocessor, Storage classes and Dynamic Memory Allocation: Functions: Designing structured programs, declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference.

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, if and if

Storage classes (auto, extern, static and register),

Dynamic memory allocation: Allocating and freeing memory

UNIT-V

Files, Searching and Sorting: Files: Text and Binary files, Creating and Reading and writing files, Appending data to existing files.

Basic searching in an array of elements (linear and binary search techniques), Basic algorithms to sort array elements (Bubble, Selection and Insertion sort).

Text Books

- .Jeri R. Hanly and Elliot B.Koffman, Problem solving and Program Design in C 7th Edition, Pearson
- B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

References

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. E. Balagurusamy, Computer fundamentals and C, 2nd Edition, McGraw-Hill
3. Yashavant Kanetkar, Let Us C, 18th Edition, BPB
4. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
5. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
6. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4th Edition
7. 7. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

CS1802 **Programming for Problem Solving Lab**

L-T-P-C

0-0-3-1.5

Course Objectives

- To work with an IDE to create, edit, compile, run and debug programs
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To Write programs using the Dynamic Memory Allocation concept.
- To create, read from and write to text and binary files

Course Outcomes

The candidate is expected to be able to:

1. Formulate the algorithms for simple problems
2. Translate given algorithms to a working and correct program
3. Correct syntax errors as reported by the compilers
4. Identify and correct logical errors encountered during execution
5. Represent and manipulate data with arrays, strings and structures
6. Use pointers of different types
7. Create, read and write to and from simple text and binary files
8. Modularize the code with functions so that they can be reused

Lab Experiments

Practice sessions:

A. Write a simple program that prints the results of all the operators available in C (including pre/ post increment, bitwise and/or/not , etc.). Read required operand values from standard input.
B. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values from standard input.

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Simple numeric problems:

A. Write a program for finding the max and min from the three numbers.
B. Write the program for the simple, compound interest.
C.
D. Write a program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.
E. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:

5 x 1 = 5

5 x 2 = 10

5 x 3 = 15

F. Write a program that shows the binary equivalent of a given positive number between 0 to 255.

Expression Evaluation:

A. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
B. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
C. Write a program that finds if a given number is a prime number
D. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
E. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
F. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
G. Write a C program to find the roots of a Quadratic equation.
H. Write a C program to calculate the following, where x is a fractional value. i. 1-x/2 +x^2/4-x^3/6
I. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+ … +x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Text Books

- Jeri R. Hanly and Elliot B.Koffman, Problem solving and Program Design in C 7th Edition, Pearson
- B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

References

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PHI
2. E. Balagurusamy, Computer fundamentals and C, 2nd Edition, McGraw-Hill
3. Yashavant Kanetkar, Let Us C, 18th Edition, BPB
4. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
5. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
6. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition
7. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

ME1203

Engineering Workshop

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 1 - 2 - 2**

Course Outcomes: Upon completion of this laboratory course

- Students will be able to fabricate components with their own hands.

List of Experiments:

1. **Fitting –** To produce a Step Fit on the given workpiece.
   - To produce a V Fit on the given workpiece.
2. **Carpentry** – To produce a Half lap joint on the given wooden work part.
   - To produce a Dove tail joint on the given wooden work part.
3. **House Wiring** – To perform and understand the Series and Parallel wiring connections.
   - To perform and understand Staircase and Godown wiring connections.
4. **Tin Smithy** – To produce a Tray from the given sheet metal.
   - To produce a Cylinder from the given sheet metal.
5. **Welding** – To practice formation of a Bead on the given workpiece.
   - To perform a Butt and a Lap joint on the given workpiece.
6. **Foundry** – To prepare a Mold cavity using a Single piece pattern.
   - To prepare a Mold cavity using a Split piece pattern.
7. **Machining** – To perform a Plain turning operation, Facing operation on the given workpiece.
   - To perform a Step and a Taper turning operation on the given workpiece.
8. **Plastic molding** – Demonstration
9. **WIRE EDM, CNC, 3D Printer** - Demonstration

BM1205 **CONSTITUTION OF INDIA (COI)**

Internal Marks 40 **L-T-P-C**
External Marks 60 **2-0-0-0**

Course Out comes: At the end of the course the student will be able to

CO1: Understand the formation and principles of Indian Constitution.
CO2: Understand Fundamental Rights and its implications in life
CO3: Understand Fundamental Duties of Individual toward country and society
CO4: Understand Directive principles to govern the policy formation
CO5: Understand the Way of running the Government and basic Governance

UNIT-I

Introduction to Indian Constitution:

- • Meaning of the term Constitution
- • Historical background of Indian constitution
- • Making of Indian constitution
- • Constituent Assembly

UNIT-II

Features of Indian Constitution

- • Preamble of the Constitution , Importance, Scope, Relevance
- • The Salient Features of Indian Constitution , Importance, Scope, Relevance

UNIT-III

Fundamental Rights:

- • Fundamental Rights
- • Importance and scope of fundamental rights
- • Categorization of Fundamental Rights

UNIT-IV

Fundamental Duties & The Directive Principles of State Policy:

- • Fundamental Duties
- • Importance and scope of fundamental Duties
- • The Directive Principles of State Policy - Importance, Scope, Relevance

UNIT-V

Union/Central Government:

- • Union Government
- • Union Legislature (Parliament)
- • Lok Sabha and Rajya Sabha (with Powers and Functions)
- • Union Executive
- • President of India (with Powers and Functions)
- • Prime Minister of India (with Powers and Functions)

TextBooks:

1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap

3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti

EC1203 ANALOG ELECTRONIC CIRCUITS-I

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- To introduce the semiconductor devices like Diode, BJT, MOSFET and Their applications
- introduce components such as diodes, BJTs and FETs their Switching characteristics,applications
- Learn the concepts of high frequency analysis of transistors.
- Learn the concept of Rectification and some wave shaping circuits.

Course Outcomes:

On completion of this course, the students will be able to…

- Analyze conduction in semiconductors and estimate the diode parameters from its characteristics.
- Examine the performance characteristics of rectifiers with and without filters
- Design the biasing circuits; compare the various configurations of BJT
- Design of FET biasing circuits.

UNIT-I: Review of Semiconductor Physics:(8 Hours)

Conductivity of a semiconductor, carrier concentrations in an intrinsic semiconductor, donor and acceptor impurities, charge densities in a semiconductor, Fermi level in a semiconductor with impurities, continuity equation, the Hall Effect.

UNIT-II: Diode Characteristics and its Applications:(10 Hours)

Qualitative theory of P-N junction diode, current equation, I-V characteristics, temperature dependent parameters, diode resistance, transition capacitance, diffusion capacitance, Zener diode.

Rectifiers: Diode as a switch, half wave and Full wave(Center tapped and Bridge type), Peak Inverse voltage, form factor, ripple factor, Transformer Utilization factor and Efficiency.

Wave shaping circuits: Clamping, clipping circuts and slicer.

UNIT-III: BJT CIRCUITS:(12 Hours)

Construction and working of BJT, I-V characteristics, BJT as a switch. Transistor configurations, Early Effect transistor Biasing, thermal runaway and thermal stability the operating point, Biasing Techniques, bias compensation. BJT as amplifier. Small signal equivalent circuits.

UNIT IV: FIELD EFFECT TRANSISTORS: (6 Hours)

Construction and working of FET, I-V Characteristics, Types of FETS, MOSFET as a Switch and as a amplifier

UNIT V: MOSFET CONFIGURATIONS AND SMALL SIGNAL ANALYSIS(12 Hours)

MOSFET configurations, biasing circuits, small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

TEXT BOOKS:

1. Robert L Boylested and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th ed., New Delhi: Pearson Ind. Pvt. Ltd., 2009
2. Jacob Millman, Christos C Halkias & Satyabrata JIT, Electronic Devices and Circuits, New Delhi: Tata McGraw Hill Education (INDIA) Private Ltd, 2007.

REFERENCE BOOKS:

1. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson.
2. Linear Integrated Circuits 4th Edition By Dr. Roy Choudhury, shail B.Jain.
3. P.R. Gray, R.G Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley &Sons,2001

SECOND YEAR (E2) – SEMESTER – II -R22								
Sl. No.	**Course Code**	**Course Title**	**Course Category**	**L**	**T**	**P**	**Total Contact Hours**	**Credits**
1	EE2201	Electrical Machines-II	PCC	3	1	0	4	4
2	EE2202	Power Electronics	PCC	3	1	0	4	4
3	EC2205	Digital Electronics	ESC	3	0	0	3	3
4	EE2203	Power Systems-I	PCC	3	0	0	3	3
5	EC2206	Signals and Systems	ESC	2	1	0	3	3
6	EE2801	Electrical Machines-II Lab	PCC	0	0	3	3	1,5
7	EE2802	Power Electronics Lab	PCC	0	0	3	3	1,5
8	EC2803	Digital Electronics Lab	ESC	0	0	2	2	1
9	HS2201	Essence of Indian Traditional Knowledge	MC	2	0	0	2	0

EE2201 **ELECTRICAL MACHINES-II**

Externals:60Marks **L-T-P-C**

Internals:40Marks **3-1-0-4**

CourseObjectives:

- To deal with the detailed analysis of poly-phase induction motors and Alternators
- To understand operation, construction and types of single phase motors and their applications in house hold appliances and control systems.
- To introduce the concept of parallel operation of alternators
- To introduce the concept of regulation and its calculations.

CourseOutcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyze performance characteristics of ac machines.
- Understand the concept of speed control in induction motors.

UNIT I :Fundamentals of AC machine windings (10 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; concentratedwinding,distributedwinding,single-layerwinding,full-pitchcoils,pitchfactor, distribution factor, elimination of harmonics, Air-gap MMF distribution with fixed current through winding - concentrated anddistributed.

UNITII: Pulsating and revolving magnetic fields(6 Hours)

Constantmagneticfield,pulsatingmagneticfield-alternatingcurrentinwindingswithspatial displacement, Magnetic field produced by a single winding - fixed current and alternating current, Pulsatingfieldsproducedbyspatiallydisplacedwindings,Windingsspatiallyshiftedby 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magneticfield.

UNIT III: Three Phase Induction Machines (18 Hours)

Construction,Types(squirrelcageandslip-ring), Equivalentcircuit,PhasorDiagram,Torque SlipCharacteristics,StartingandMaximumTorque,LossesandEfficiency.Effectofparameter variationontorquespeedcharacteristics(variationofrotorandstatorresistances,statorvoltage, frequency). Methods of starting, braking and speed control for induction motors, Concept of CoggingandCrawling,Doublecagerotorinductionmotor,Testingofinductionmotor, Circle diagrams. Generator operation, Self-excitation, Doubly-Fed InductionMachines.

UNITIV: Single-phase induction motors (6 Hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

UNIT V: Synchronous machines (15Hours)

Constructional features, cylindrical rotor synchronous machine , generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation, Operating characteristics of synchronous machines, V & inverted V curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics, Parallel operationof alternators -

synchronization and loaddivision, synchronous motor & it's starting methods.

Text Books:

1. P. S. Bimbhra, " Electrical Machinery", Khanna Publishers,2011.
2. I.J.NagrathandD.P.Kothari,"ElectricMachines",McGrawHillEducation,2010.

Reference Books:

1. S.Langsdorf,"Alternatingcurrentmachines",McGrawHillEducation,1984.
2. P.C.Sen,"PrinciplesofElectricMachinesandPowerElectronics",JohnWiley&Sons, 2007

EE2202 **POWER ELECTRONICS**

Externals:60Marks **L-T-P-C**

Internals:40Marks **3-1-0-4**

CourseObjectives: Thiscoursewilldevelop students'knowledgein/on

- Characteristicsandapplicationsofbasicpowersemiconductorswitches
- Controlled rectifier circuits, DC-DC converter, inverter, AC voltage controllerandcycloconverters
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.

CourseOutcomes: Atthe end ofthiscoursestudents willdemonstratethe abilityto

- Understandthedifferencesbetweensignallevel andpowerleveldevices.
- Analyzecontrolledrectifiercircuits.
- AnalyzetheoperationofDC-DCchoppers.
- Analyze theoperationofvoltage sourceinverters

UNIT-I:Powerswitching devices(8 Hours)

Diode,Thyristor,BJT, MOSFET,IGBT:I-VCharacteristicsandswitchingcharacteristics;Firingcircuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits forMOSFETandIGBT,DaicandTraic.

UNIT-II:Thyristorrectifiers(12Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier withR, RL and RLE loads; Three-phase full-bridge thyristor rectifier with R, RL loads; Input currentwave shape andpowerfactor,effectofsourceimpedance anddualconverter.

UNIT-III:DC-DCconverter(8Hours)
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage,powercircuitof abuckconverter,boostconverterandbuck-boostconverteranalysisandwaveforms at steady state, relation between duty ratio and average outputvoltage, Voltageripple andcurrentripple,introductiontoisolatedDC-DCconverters.

UNIT-IV: Inverter (10 Hours)
Single-phase voltage source inverter, three-phase voltage source inverter (180 & 120 degreeconduction modes),modulationtechniques(PWM,SPWM),currentsourceinverter

UNIT-V: AC voltage controller and cycloconverters (5 hours)

Principle of phase control, principle of integral cycle control, single phase voltage controllers;principle of cyclo-converter operation, single phase to single phase cyclo-converter and singlephase tothreephasecyclo-converter.
Applications:BatteryCharger,UPSandSMPS

TEXT BOOK:

1. Dr. P.S Bimbhra, "Power Electronics", Khanna Publishers,2012
2. M.H. Rashid, "Power Electronic Devices, Circuits and Application" Pearson Education India,2009.

EC2205 **DIGITAL ELECTRONICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

To provide practical exposure on

- Various combinational and sequential circuits and filters.
- Applications of Operational Amplifier as adder, integrator
- Applications of Operational Amplifier as voltage to current converters.
- To understand the concept of Sequential circuits.

Course Outcomes:

Upon completion of this course the student will be able to

- Design counters, NAND gate and adders.
- Design multiplexer, 7-segment LED display.
- Analyze the application of Operational Amplifier as adder, integrator and voltage to current converters.
- Design of Low pass, High pass and Band pass Filters

UNIT I: Circuits and logic families (10 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT II : Combinational Digital Circuits (10 Hours)

Standard representation for logic functions, K-map representation and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractions, weighted and Non weighted codes, BCD, Gray codes, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders.

UNIT III: Sequential circuits and systems (10 Hours)

Bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops , asynchronous sequential counters, applications of counter

UNIT IV: A/D and D/A Converters (7Hours)

Analog to Digital converters: Quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter,

A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters.

UNIT V: Semiconductor memories and Programmable logic devices. (5 Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM)

TEXT BOOKS:

3. Robert L Boylested and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th ed., New Delhi: Pearson Ind. Pvt. Ltd., 2009
4. Jacob Millman, Christos C Halkias & Satyabrata JIT, Electronic Devices and Circuits, New Delhi: Tata McGraw Hill Education (INDIA) Private Ltd, 2007.

REFERENCE BOOKS:

4. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson.
5. Linear Integrated Circuits 4th Edition By Dr. Roy Choudhury, shail B.Jain.
6. P.R. Gray, R.G Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley &Sons,2001

Reference Books:

1. R.W. Erickson and D. Maksimovic, "Fundamentals of Power electronics", Springer Science &Business Media,2007.
2. L. Umanand, "Power Electronics: Essentials and Application", Wileey India,2009.

EE2203 **POWER SYSTEMS-I**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: This course introduce

- To understand the power generation through conventional and non- conventional sources.
- To know about the substations, Overhead Line Insulators and underground cables.
- To know about the corona, sag and AC & DC distribution systems.
- To illustrate the economics aspects of power generation, tariff methods.

Course Outcomes: After completion of this course, students will be able to

- Describe the operation of conventional generating stations
- Describe about the different types of substations available
- Determine Different Types of Tariff's in power system
- Design Distribution of voltage along the string insulators and design concept of underground cables & Solve Problems.

UNIT-I: Conventional and Non-conventional Energy Sources (8 Hours)

Introduction: Typical Layout of an Electrical Power System, Present Power Scenario in India. Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant.

Non Conventional Sources (Qualitative): Ocean Energy, Tidal Energy, Wave Energy, wind Energy, Fuel Cells, and Solar Energy.

UNIT-II: Outdoor and Indoor Substations (6 Hours)

Air insulated substations - Indoor, Outdoor, layout, substation equipment. Bus bar arrangements in the Sub-Stations: Single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

Gas insulated substations (GIS) - Advantages, various types, single line diagram, bus bar, construction aspects, Installation and maintenance of GIS, Comparison of Air insulated substations and Gas insulated substations.

UNIT-III: Overhead Line Insulators and Insulated Cables (10 Hours)

Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, string efficiency, methods of equalizing the potential, testing of insulators.

Insulated Cables: Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

UNIT-IV: Corona and Sag (10 Hours)

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines.

Sag: The Catenary curve, Sag Tension calculations, Supports at Different Levels, Stringing chart, Sag template, Equivalent span, Stringing of conductors, Vibration and Vibration dampers.

UNIT-V: Economics of Generation and Distribution (8 Hours)

Economics of Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, plant utilization factor, plant capacity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy- calculation of energy, fixed cost, running cost, Tariff on charge to customer.

A.C. Distribution: Introduction, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site for substation.

D.C. Distribution: Calculations, uniformly loaded distributor fed at one end, distributor fed at both ends, distributor with both concentrated and uniform loading, ring distributor and with Interconnector.

EE2206 SIGNALS AND SYSTEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-1-0-3**

Course Objectives: This course introduces

- Concepts of signals and systems and their characteristics
- Various mathematical tools like Fourier, Laplace and z- transformsto analyze anLTI systems

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.

UNIT I: Introduction to Signals and Systems (6 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. continuous and discrete time signals, continuous and discrete amplitude signals, properties of signal, Power and energy of a signal, some special signals of importance: unit step, unit impulse, ramp, parabolic sinusoid, complex exponential,. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

UNIT II: Behavior of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT III: Fourier Transforms(8 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Properties of Fourier series, Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Properties of Fourier Transforms, Fourier domain duality. The
Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

EE2801 ELECTRICAL MACHINES-II LAB

Externals:60Marks **L-T-P-C**

Internals:40Marks **0-0-3-1.5**

Course Objectives:

- To understand the operation of synchronous machines
- To understand the analysis of power angle curve of a synchronous machine
- To understand the equivalent circuit of a single phase transformer and single phase induction motor
- To understand the circle diagram of an induction motor by conducting a blocked rotor test.

Course Outcomes: After completion of this lab the student is able to

- Assess the performance of different machines using different testing methods
- To convert the Phase from three phase to two phase and vice versa
- Compensate the changes in terminal voltages of synchronous generator after estimating the change by different methods
- Control the active and reactive power flows in synchronous machines
- Start different machines and control the speed and power factor

List of Experiments :

1. Toperformnoloadandblockedrotortestsonathreephasesquirrelcageinductionmotor and determine equivalentcircuit.
2. Toperformloadtestonathreephaseinductionmotoranddraw Torque-speed characteristics.
3. Todeterminespeed-torquecharacteristicsofthreephaseslipringinductionmotorand study the effect of including resistance in the rotorcircuit.

4. Todeterminespeed-torquecharacteristicsofsinglephaseinductionmotorandstudythe effect of voltagevariation.
5. Toperformnoloadandblockedrotortestsonasinglephaseinductionmotorand determine equivalentcircuit.
6. Determinevoltageregulationatfull loadandatunity,0.8laggingandleadingpower factorsby
    a. EMFmethod
    b. MMFmethod.
7. To study synchronization of analternator with the infinite bus by using:
    a. dark lampmethod
    b. two bright and one dark lampmethod.
8. To determine V-curves and inverted V-curves ofa three phase synchronous motor.
9. determineXdandXqofathreephasesalientpolesynchronousmachineusingtheslip test and to draw the power-anglecurve.

EE2802 POWER ELECTRONICS LAB

Externals:60Marks **L-T-P-C**

Internals:40Marks **0-0-3-1.5**

CourseObjectives: To Provide Practical exposure on

- Characteristicsofbasicpowersemiconductorswitches
- Applications ofbasic power semiconductor switches like controlled rectifier circuits,
- DC-DCconverter,inverter,AC voltage controlleretc.
- Examine the characteristics of various devices and application of firing circuits used in power electronics

CourseOutcomes: After completionofthislaboratorycourse,studentswillbeableto

- Determinethepowersemiconductorswitchescharacteristicsandtheirapplications
- Designgatefiring&commutationcircuits forSCRs.
- Analyzetheoperationofconverters,invertersandchoppers.
- Designandsimulatepowerelectroniccircuitsandplottheircharacteristics.

LISTOFEXPERIMENTS:

1. StudyofCharacteristicsofSCR,MOSFET&IGBT
2. GatefiringcircuitsforSCR's
3. SinglePhaseSemi-converterwithRandRLload
4. SinglePhasefullycontrolledbridgeconverterwithRandRL loads
5. SinglePhasedualconverterwithRLloads
6. ThreePhaseSemi-converter withR-load
7. ThreePhaseBridgeconverter withRandRL loads
8. IsolatedDC-DCconverter
9. Singlephasehalfbridgeandfullbridgeinverter
10. Buck ConverterwithRandRL loads
11. Boost ConverterwithRandRL loads
12. SinglePhaseACVoltageController withRandRLLoads
13. SinglePhaseCycloconverterwithRandRL loads

EC2803 **DIGITAL ELECTRONICS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives:

To provide practical exposure on

- Various combinational and sequential circuits and filters.
- Applications of Operational Amplifier as adder.
- Applications of integrator and voltage to current converters.
- Understanding of and design of filters working

Course Outcomes:

Upon completion of this course the student will be able to

- Design counters, NAND gate and adders.
- Design multiplexer, 7-segment LED display and LPF, HPF, BPF
- Analyze the application of Operational Amplifier as adder.
- Integrator and voltage to current converters.

LIST OF EXPERIMENTS: Any TEN of the following experiments

1. Design of a counter asynchronous and synchronous
2. I/O characteristics of a NAND gate
3. Design of a full adder circuit
4. Design of a digital comparator
5. Simplification Boolean function using K-map
6. Design of a multiplexer
7. Design of a 7-segment LED display
8. To study application of Operational Amplifier as adder, integrator and voltage to current converters.
9. Design of filters
   a. To design a low pass filter Second order filters using operational amplifier for cutoff frequency 1 KHz.
   b. To design a high pass filter Second order filters using operational amplifier for frequency 12 KHz.
   c. To design a band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
10. To study application of Operational Amplifier as voltage comparator.
11. To generate triangular & square wave using operational amplifier.
12. To study regulation of unregulated power supply using IC 7805/7812 voltage regulator and measure the load and line regulations

THIRD YEAR (E3) – SEMESTER – II-R22

Sl. No.	Course Code	Course Title	Course Category	L	T	P	Total Contact Hours	Credits
1	EE3201	Power Semiconductor Drives	PCC	4	0	0	4	4
2	EE3202	Power Systems Operation and Control	PCC	3	1	0	4	4

3	EE3801	Power Systems Lab	PCC	0	0	2	2	1
4	EE3803	Electrical Simulation Lab	PCC	0	0	3	3	1,5
5	EE3211	Program Elective-I (Power Systems Protection)	PEC	3	0	0	3	3
6	EE3221	Program Elective-II (Wind and Solar Energy System)	PEC	3	0	0	3	3
7	EE3231	Program Elective-III (HVDC Transmission)	PEC	3	0	0	3	3
8	EE3902	Mini Project	SIP	0	0	2	2	1
9	CS3401	Open Elective-II(Object-Oriented Programming Structures through Java)	OEC	3	0	0	0	3

EE3201 **POWER SEMICONDUCTOR DRIVES**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Objectives: This course will develop students' knowledge in/on

- The fundamentals and dynamics of electric drives
- The various types of the rectifier control and chopper control DC drives
- The AC voltage control, frequency control and slip power recovery control of Induction motor drives.
- Various types of synchronous motor drives and its speed torque characteristics

Course Outcomes: At the end of the course the student will be able to:

- Understand the fundamentals and dynamics of electric drives
- Develop the rectifier control and chopper control DC drives
- Realize the Concept of AC voltage control, frequency control and slip power recovery control of induction motor drives & Solve Problems
- Know the concept of Synchronous motor drives & Solve Problems

UNIT I: Fundamentals of Electric Drives(6 hours)

Electric Drives, advantages of electric drives, parts of electric drives, choice of electric drives, status of D.C. drives and A.C. drives. Starting, Braking, speed control of AC and DC motors.

UNIT II: Dynamics of Electric drives (8 hours)

Fundamental torque equations, types of load, Quadrant diagram of speed-Torque characteristics, Dynamics of load torque combinality, steady state stability and Transient stability of an Electric drives. Load equalization. Calculation of time and energy loss in Transient operation, Drive specifications.

UNIT III: Control of DC drives (10 hours)

Controlled rectifier circuits, braking operation of rectifier controlled separately excited dc motor, single phase and three phase half and fully controlled rectifier fed separately excited dc motor, multi quadrant operation of fully controlled rectifier fed separately excited dc motor.
Chopper control of DC drives : chopper control of separately excited and series dc motors , multi quadrant control of chopper fed motors with an examples.

UNIT IV: Control of Induction Motor Drives: (10 hours)

Control of induction motor by AC voltage controllers, Frequency controlled Induction motor drives: control of Induction motor by Voltage Source Inverter (VSI), Current controlled PWM inverters and cyclo converters, Slip power controlled wound-rotor induction motor drives, static rotor resistance control, static scherbius drives, krammers drives.

UNIT V: Control of Synchronous Motor Drives (8 Hours)

Operation of cylindrical rotor synchronous motor from VSI and CSI, self controlled Synchronous Motor Drives using cyclo converters, Permanent magnet AC motor drives.

EE3202 POWER SYSTEMS OPERATION AND CONTROL

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective: At the end of the course the student will be able to:

 To understand the computation of load flows in a power systems

 To study the various methods of reactive power control in power systems and economic load scheduling

 To study load frequency control and its analysis in an isolated power system

 To study stability, stability limits and the dynamics of synchronous machines

Course Outcomes: After completion of this course, students will be able to:

 Compute the bus variables and the power flows in the system using various iterative methods

 Determine the optimal economic load scheduling.
 Determine the static and dynamic frequency response of a power system for a single area and two area system
 Predict the stability of power systems and determine the transient stability limits

UNIT I: Load flow studies (8 hours)

Introduction, Bus classification, Nodal admittance matrix, Transmission Network Representations: Bus Admittance frame and Bus Impedance frame. Formation of Y bus: Direct and Singular Transformation Methods, Load flow equations, Iterative methods – Gauss, Gauss Seidel and Newton Raphson methods. Newton decoupled and fast decoupled. Merits and Demerits of these methods, system data for load flow study.

UNIT II : Economic Operation of Power Systems (6 hours)

Distribution of load between units within a plant, transmission loss as a function of plant generation, calculation of loss coefficients, penalty factor, distribution of load between plants. Unit commitment: Introduction, constraints in unit commitment problems.

UNIT III: Load Frequency control (11 hours)

Introduction, Load frequency problem, Megawatt frequency (or P-F) control channel, MVAR voltage (or Q – V) control channel. Dynamic interaction between P-F and Q-V loops, Mathematical model of speed governing system, turbine models division of power system into control areas, P-F control of single control area (the uncontrolled and controlled cases), P-F control of two area systems (the uncontrolled and controlled cases).

UNIT IV: Power System Stability (8 hours)

The stability problem, steady state stability limit, Expression using ABCD parameters, steady state stability of synchronous machine, transient stability, swing equation, equal area criterion of stability and its further applications, step by step solution swing equation, some factors affecting transient stability & Methods of improving stability . Concept of Dynamic stability, effect of excitation on generator power limits.

UNIT V: Reactive Power–Voltage Control (9 hours)

Basics of reactive power control, Excitation systems, modeling, Static and dynamic analysis, stability compensation, generation and absorption of reactive power. Relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformer. System level control using generator voltage magnitude setting, tap setting of online tap changing transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

Textbooks:

1. John Grainger & William Stevenson Jr., “Power Systems Analysis”, McGraw Hill, 1/e
2. D.P.Kothari and I.J.Nagrath, Modern Power System Analysis, 4th Edn, Tata McGraw Hill Education Private Limited 2011.
3. C.L.Wadhwa, Electrical Power Systems, 3rd Edn, New Age International Publishing Co., 2001.

Reference Books:

1. Olle I Elgerd " Electric Energy Systems Theory", Tata McGraw Hill ,2/e ,2011

2. Chakrabarthi, Abhijit halder, "Power system analysis: Operation and Control", Prentic hall of India, 3/e, 2010

EE3801 **POWER SYSTEMS LAB**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-2-1**

Course Objective:

- Performance of long transmission lines and reactive power control
- Characteristics of protective relays
- Short circuit analysis and sequence components of power system elements
- Study of different faults on Transmission lines

Course Outcomes: After completion of this lab, students will be able to

- Determine the performance characteristics of a long transmission line
- Determine the performance of reactive power control
- Determine the operating characteristics of protective relays
- Compute fault currents and determine the sequence components of power system elements

List of experiments

1. Determination of Sequence Impedances of a cylindrical rotor Synchronous Machine.
2. Determination of Positive, Negative and zero sequence reactance of 3 phase Transformers
3. Fault analysis of 3 phase Alternator, (LG, LL, LLG, LLLG faults).
4. Determination of Sub transient reactance's of a Salient Pole Synchronous Machine.
5. To obtain the operating characteristics of IDMT over current relay
6. Characteristics of Percentage biased of Static Differential Relay
7. Performance and Testing of Generator Protection System
8. To obtain the performance characteristics of long transmission line
9. To determine the breakdown strength of oil
10. Reactive power control of long Transmission line

Any two simulation experiments listed below should be conducted using two electrical related software

1. Distribution System Reliability Analysis.
2. Power System Fault Analysis.
3. Transmission Line Fault Analysis

EE3803 **ELECTRICAL SIMULATION LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objective:

- To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and the simulation of power electronics circuits using PSIM & MATLAB.
- Gives practical exposure to the usage of different circuits with different condition.
- Acquire skills of using computer packages PSIM, POWER WORLD and MATLAB coding and SIMULINK in power Electronics and power system studies.

Course Outcome:

Upon the successful completion of this course, the student is expected to gain the following skills:

- Understand the fundamentals and programming Knowledge in MATLAB.
- Able to understand the Transient & Steady State Performance of a system.
- Able to generate plots and export this for use in reports and presentations.
- Able to give practical experience with simulating physical systems

List of Experiments:

1. Stability analysis (Bode, Root locus, Nyquist) of linear time invariant system using MATLAB.
2. Effect P, PD, PI, PID controllers on a second order system using MATLAB.
3. Simulation of Single Phase Semi & Full bridge rectifier using PSIM.
4. Simulation of three semi converter using PSIM.
5. Simulation of three full bridge rectifier using PSIM.
6. Simulation of single phase bridge inverter using PSIM.
7. Simulation of DC-DC Converter using PSIM.
8. Simulation of three phase inverter 120 Degree mode using MATLAB programming.
9. Simulation of three phase inverter 180 Degree mode using MATLAB programming.
10. Load curve analysis using MATLAB programming.
11. Performance evaluation of long and short transmission line using MATLAB programming.
12. Newton Raphson method of load flow analysis using Power World.
13. Gauss Seidal method of load flow analysis using Power World.
14. Fault analysis using Power World.
15. Modelling of DC motor using MATLAB.

POWER SYSTEMS PROTECTION

EE3211

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective:

- To compare and contrast electromagnetic, static and microprocessor based relays
- To apply technology to protect power system components
- To select relay settings of over current and distance relays.
- To analyze quenching mechanisms used in air, oil and vacuum circuit breakers

Course Outcomes:

After completion of this course, students will be able to

- Compare electromagnetic with static relays

 Evaluate the of performance of Various Relays
 Understand about the concept of over voltage protection and insulation coordination
 Analyze Fundamental principles of circuit breakers & fuses

UNIT I: Relays (10 Hours)

Electromagnetic Relays - Basic Requirements of Relays, Primary and Backup Protection, Constructional details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays. Universal Torque Equation, Characteristics of Over Current, Direction and Distance Relays.

Static relays: Amplitude and Phase comparators, Duality between AC and PC, Static amplitude comparator, integrating and instantaneous comparators, static phase comparators, coincidence type of phase comparator, static over current relays, static directional relay, static differential relay, static distance relays, Multi input comparators, concept of Quadrilateral and Elliptical relay characteristics. Advantages and Disadvantages over electromagnetic relays.

UNIT II: Circuit breakers

Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast circuit breakers, SF6 circuit breaker, Vaccum circuit breaker, operating mechanism, selection of circuit breakers, high voltage d.c breakers, ratings of circuit breakers, testing of circuit breakers.

FUSES: Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination.

UNIT-III: Protection of Generators and Transformers (10 Hours)

Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection. Numerical Problems On percentage Winding Unprotected.

Protection of Transformers: Differential Protection , Percentage Differential Protection, Numerical Problems on Design of CT Ratios, Buchholtz Relay Protection.

UNIT IV: Protection of Transmission Lines (8 Hours)

Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of transmission Lines– 3 Zone Protection Using Distance Relays, Carrier Current Protection, Protection of Bus Bars.

UNIT V: Overvoltage Protection and Insulation Coordination (8 Hours)

Over voltage due to arcing ground and Peterson coil, lightning, horngaps, surge diverters, rod gaps, expulsion type lightning arrester, valve type lightning arrester, ground wires, ground rods, counter poise, surge absorbers, insulation coordination, volt-time curves.

Text Books:

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH

2001
2. U.A.Bakshi, M.V.Bakshi: Switchgear and Protection, Technical Publications, 2009.
3. Switchgear and Protection – by Sunil S Rao, Khanna Publishers, 1992.
Reference
1. L.P.Singh ―Protective relaying from Electromechanical to Microprocessors, New Age International
2. “Electrical Power”, by S. L. Uppal, Khanna pulishers,1988.
Ravindranath & Chander, “Switch Gear & Protection” New Age International , 2/e,2014

EE3221 **WIND AND SOLAR ENERGY SYSTEMS**

Externals:60Marks **L-T-P-C**

Internals:40Marks **3-1-0-3**

Course Objectives:

- To study the physics of wind power and energy
- To understand the principle of operation of wind generators
- To know the solar power resources and analysesof solar photo-voltaic cells
- To discuss the solar thermal power generation and identify the network integration issues

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growths of the power generate renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems

UNIT – I (8Hours)

Physics of Wind Power

History of wind power, Indian and Global statistics, Wind physics, Betz limit ratio, stall and pitch control, Wind speed statistics-probability distributions, and Wind power-cumulative distribution functions.

UNIT – II (8Hours)

Wind Generator Topologies

Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters, Generator configurations, Converter Control.

UNIT – III (12Hours)

The Solar Resource

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar Photovoltaic

Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms, Converter Control.

UNIT – IV (10Hours)

Network Integration Issues

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

UNIT – V (8Hours)

Solar Thermal Power Generation

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

EE4131 HVDC TRANSMISSION

Externals:60Marks **L-T-P-C**

Internals:40Marks **3-0-0-3**

CourseObjectives:

- To compare EHV AC and HVDC systems
- To analyze Graetz circuit and also explain 6 and 12 pulse converters
- To control HVDC systems with various methods and to perform power flow analysis in AC/DCsystems
- To describe various protection methods for HVDC systems and Harmonics

CourseOutcomes:

- Compare EHV AC and HVDC system and to describe various types of DC links
- Analyze Graetz circuit for rectifier and inverter mode of operation
- Describe various methods for the control of HVDC systems and to perform power flow analysisin AC/DC systems
- Describe various protection methods for HVDC systems and classify Harmonics and designdifferent types of filters

UNITI: Basic Concepts & HVDC Converters (10Hours)

Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, Types of HVDC Links, Apparatus required for HVDC Systems, Comparison of AC and DC Transmission, Application of DC Transmission System, Planning and Modern trends in D.C.Transmission.

Analysis of HVDC Converters: Choice of Converter Configuration, Analysis of Graetz

circuit, Characteristics of 6 Pulse and 12 Pulse converters, Cases of two 3 phase converters in Y/Y mode & their performance.

UNITII: II Converter and Reactive Power Control (10Hours)

Principle of DC Link Control, Converters Control Characteristics, Firing angle control, Current and extinction angle control, Effect of source inductance on the system, Starting and stopping of DC link, Power Control.

Reactive Power Control in HVDC: Introduction, Reactive Power Requirements in steady state, sources of reactive power- Static VAR Compensators, Reactive power control during transients.

UNITIII: Power Flow Analysis in AC/DC Systems **(8Hours)**

Modeling of DC Links, DC Network, DC Converter, Controller Equations, Solution of DC load flow, P.U. System for DC quantities, solution of AC-DC Powerflow-Simultaneous method & Sequential method.

UNITIV: Converter Faults and Protection**(8Hours)**

Converter faults, protection against over current and over voltage in converter station, surge arresters, smoothing reactors, DC breakers, Audible noise, space charge field, corona effects on DC lines, Radio interference

UNITV: Harmonics & Filters(8Hours)

Generation of Harmonics, Characteristics of harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics, Calculation of voltage and Current harmonics,Effect of Pulse number on harmonics

Filters: Types of AC filters, Design of Single tuned filters –Design of High pass filters.

TextBooks:

1. "K.R.Padiyar",HVDC Power Transmission Systems: Technology and system Interactions,New Age International (P) Limited, and Publishers, 1990.
2. "S K Kamakshaiah, V Kamaraju", HVDC Transmission, TMH Publishers, 2011
3. E. Uhlmann", Power Transmission by Direct Current, B. S. Publications, 2009

CS3401	Object Oriented Programming				PCC
Prerequisite	Contact Hours per Week			Internal	External	Credits
	L	T	P			
	3	0	0	40	60	3

Course Objectives

- To introduce object-oriented programming principles and apply them in solving problems.
- To introduce the implementation of packages and interfaces.
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using swing controls.

Course Outcomes

1. Able to solve real world problems using OOP techniques.
2. Able to solve problems using java collection framework and I/O classes.
3. Able to develop multithreaded applications with synchronization.
4. Able to design GUI based applications.

Detailed Contents

UNIT - I

Foundations of Java: History of Java, Java Features,Java Virtual Machine (JVM), Java Environment, JDK, API.

Introduction to Java : Types of java program, Creating and Executing a Java program, Java Tokens, Constants, Variables, Data types, Scope of variables, Operators, Keywords, Character set, Identifiers, Literals, Separator, Command Line Arguments, Comments in Java program, Type casting, Expressions – Evaluation of Expressions.

Decision making and Branching: Simple if statement, if, else statement, Nesting if, else, else if Ladder, switch statement, Decision making and Looping: While loop, do-While loop, for loop, break, labeled loop, continue Statement, Simple programs

Arrays: One Dimensional Array, Creating an array, Array processing, Multidimensional Array, Vectors, Wrapper classes, Simple programs

UNIT – II

Strings: Exploring String class, String Class Methods, String Buffer Class, Simple programs

Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Static members, Nesting of Methods, this keyword, Command line input.

Polymorphism – Static Polymorphism, Dynamic Polymorphism, Method overloading, Polymorphism with Static Methods, Private Methods and Final Methods.

Inheritance: Defining a subclass, Deriving a subclass, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Control: Public access, Private access, default and

protected.

UNIT – III

Abstract classes & Interfaces - Interfaces vs Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interfaces. Inner classes - uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

Packages- Java API Packages, System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package.

Collections: Collections overview, Collection Interfaces, Collections Implementation Classes, Sorting in Collections, Comparable and Comparator Interfaces.

UNIT – IV

Exception Handling: Limitations of Error handling, Advantages of Exception Handling, Types of Errors, Basics of Exception Handling, try blocks, throwing an exception, catching an exception, finally statement

Multi threading: Creating Threads, Life of a Thread, Defining & Running Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface, Thread scheduling.

Files and I/O Streams: The file class, Streams, The Byte Streams, Filtered Byte Streams, The Random Access File class.

Java Database connection: JDBC, ODBC Drivers, JDBC ODBC Bridges, Seven Steps to JDBC, Importing java SQL Packages, Loading & Registering the drivers, Establishing connection. Creating & Executing the statement.

UNIT - V

AWT Components and Event Handlers: Abstract window toolkit, Event Handlers, Event Listeners, AWT Controls and Event Handling: Labels, TextComponent, ActionEvent, Buttons, CheckBoxes, ItemEvent, Choice, Scrollbars, Layout Managers- Input Events, Menus, Programs

GUI Programming with Java - Introduction to Swing, limitations of AWT, Swing vs AWT, MVC architecture, Hierarchy for Swing components, Containers - JFrame, JApplet, JDialog, Jpanel. Overview of some swing components Jbutton, JLabel, JTextField, JtextArea, simple swing applications.

Text Books:

- H. Schildt, "Java: The Complete Reference, 7th ed.," Tata McGraw-Hill, 2014.
- E. Balagurusamy, "Programming with Java," Tata McGraw-Hill, 2007.

References:

1. J. Nino and F.A. Hosch, "An Introduction to programming and OO Design using Java," John wiley & Sons.
2. Y. Daniel Liang, "Introduction to Java Programming," Pearson Education.
3. A. Johnson-Thompson, "An Introduction to Java programming and Object Oriented Application Development."
4. Dr. G. Thampi, "Object oriented Programming in Java."
5. Yashavant Kanetkar, "Let us Java," BPB Publications, New Delhi, 2012.
6. Dr. R. Nageswara Rao, "Core Java, An Integrated Approach."
7. C. Thomas WU, "An Introduction to Oops with Java," TataMc-Graw Hill, New Delhi, 4th Edition.
8. ISRD Group, "Object oriented Programming through Java," TataMc-Graw Hill, New Delhi, Eight Reprint 2011

FOURTH YEAR(E4)- SEMESTER-II-R19								
Sl. No.	**Course Code**	**Course Title**	**Course Category**	**L**	**T**	**P**	**Total Contact Hours**	**Credits**
1	EE4252	Program Elective-V(Electric Hybrid Vehicles (EHV))	PEC	3	0	0	3	3
2		Open Elective-IV	OEC	3	0	0	3	3
	CE4402	**Disaster Management (DM-4)**						
	BM4414	**Intellectual Property Rights (IPR-4 and IPR-5)**						
	BS4401	**Sustainable Technology (ST-4)**						
3	EE4902	Project-II	PROJ	0	0	16	16	8
4	EE4000	Comprehensive Viva	PCC	0	0	0	0	0

EE4154 **Hybrid Electrical Vehicles**

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **3-0-0-3**

Course Objective:

- To present a comprehensive overview of Electric and Hybrid Electric Vehicles
- To deliver and discuss power electronics based drive control systems
- To discuss the battery management systems
- To discuss grid integration issues of Electric and Hybrid vehicles.

Course Outcomes: At the end of the course the student will be able to:

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.
- Analyze and model the power management systems for electric and hybrid vehicles

UNIT I: Introduction to Conventional Vehicles and Hybrid Electric Vehicles :(10 hours)
Conventional Vehicles: Basics of vehicle performance, vehicle power sourcecharacterization, transmission characteristics, mathematical models to describe vehicle performance.
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, socialand environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II: Hybrid Electric Drive-trains: (6 hours)
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III: Electric Trains (10 hours)
Electric Drive-trains: Basic concept of electric traction, introduction to various electricdrive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.
Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV: Energy Storage (9 hours)
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)

UNIT V: Energy Management Strategies (7 hours)
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. C. Mi, M. A. Masrur and D. W. Gao, " Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

2. S. Onori, L. Serrao and G. Rizzoni, " Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, " Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Code: BM4414

INTELLECTUAL PROPERTY RIGHTS (IPR)
(Open Elective)

Externals:60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Course Objectives: At the end of the course the student will be able to
 To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
 To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
 To disseminate knowledge on copyrights and its related rights and registration aspects
 To disseminate knowledge on trademarks and registration aspects.
 To disseminate knowledge on Design, Geographical Indication (GI) ,Plant Variety and Layout Design Protection and their registration aspects.
 To aware about current trends in IPR and Govt. steps in fostering IPR.

Course Outcomes:

 Upon completion of this course the students shall get adequate knowledge on patent and copyright for their innovative research works.
 During their career, the knowledge gained through this course shall provide useful insights on the novelty of their idea from a state-of-the-art patent search. This provides a further way for developing their idea or innovations.
 This course shall pave the way for the students to catch up Intellectual Property (IP) as a career option.

Unit-1:
Introduction to IPR: Definition of Intellectual Property, Meaning of Intellectual Property, Evolution of IPR, Kinds of Intellectual Property Rights - Patents, Trademarks, Copy Rights, Industrial Design, Trade Secrets, Geographical Indications, Agencies responsible for Intellectual

Property Rights- USPTO, INTA, WIPO, TRIPS, International Conventions-Patent treaty, Madrid15 Protocol, Berne Convention.

UNIT-II:

Patent Rights: Introduction, Definition of Patent, Importance of Patents, Types of Patents, Patentable Inventions, Non- Patentable Inventions, Persons entitled to apply for Patent, Who can apply for a Patent, Expiry of a Patent, Rights of patentee, Registration of patent.

Unit-III:

Industrial designs: Definitions of Designs, Essentials of a Design, Who can file for Design Registration, Term of Design, Registration of Designs, Cancellation of a Registered designs, Restoration of a lapsed design.

Unit-IV:

Trademarks: Introduction to Trademark, Meaning of Trademark, Types of Trademark, Features of Trademarks, Functions of Trademarks, Objectives of Trademarks, What to avoid when selecting a Trademark, Trademark Registration procedure, Infringement of Trademarks, Passing off.

Unit-V:

Copy Right: Introduction, Subject matter of Copy Right, Objectives of Copy Rights, Rights of a copyright holder, Works covered under Copy Right, Works not covered under Copy Right, Duration of Copy Right, and Registration of Copy Right.
Case studies are discussed wherever applicable.

Text Books:
2. Cornish.W.R, “Intellectual Property Patents”, CopyRight and Trademarks and Allied rights, Sweet & Maxwell 1993.
3. P.Narayanan: Intellectual Property Law, Eastern Law House, 2ndedition 1997.
4. Roy Chowdhary, S.K. & Other: Law of Trademark, Copyrights, Patents and Designs, Kamal Law House, 1999.
5. Dr.G.B.Reddy, Intellectual Property Rights and theLaw5thEd.2005GogiaLawAgency.
6. B.L.Wadhera: Intellectual Property Law, UniversalPublishers,2nd Ed.2000.

SUSTAINABLE TECHNOLOGIES

Course code: BS4401
Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Learning objectives: To give an overview of existing technologies and their associated problems. The main objective of the course is to stress on the need of innovation in development of sustainable technologies.

Learning outcome: This paper sets out to discuss the commonalities that can be found for sustainable development. The commonalities include systemic or holistic thinking, the integration of different perspectives, skills such as critical thinking, diverse attitudes and values. Student will get the knowledge to resolve the environmental problems of the planet, work towards community-oriented problems with coherent and inferential problem solving skills.

UNIT 1: DRAW BACKS OF CURRENT TECHNOLOGIES
Environmental degradation, financial constraints, social issues with automation in technology, extinction of fossil fuels, risks involved in operations. Global environmental issues- Resource degradation, Climate change (Carbon credits and carbon trading, carbon foot print), Global warming, Ozone layer depletion, Regional and Local Environmental Issues.

UNIT 2: ENVIRONMENT REMEDIATION
Environment Impact Assessment (EIA) - Procedures of EIA in India, Physical and Chemical technologies for reclamation, Need for ecosystem restoration, Bioremediation.
Alternative Hirarchy Process (AHP), Selection of best technology using AHP, Alternative resources and technologies, resource recovery from waste, energy recovery from waste, Sustainable Development vs Environmental Engineering - Energy Issues.

UNIT 3: SUSTAINABLE TECHNOLOGIES
Sustainability - Introduction, Need and concept of sustainability; People, planet and profit; Social, environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Green technologies.

UNIT 4: BIOMIMICRY
Defining biomimicry, why biomimicry matters? Biomimicry examples - Bioplastics, biomaterials, bioluminescence for LED's, neural networks, swarm intelligence, aerodynamics for automobile engineering, DNA computing.

UNIT 5: BIOLOGICAL RESOURCES FOR SUSTAINABILITY
Organic Farming for sustainable agriculture, Microbial leaching of low grade mineral ores, Bioelectricity (Microbial fuel cells), Biomagnetism (for therapy), Biofuels (for energy), Microbial engineering for cleaning environmental pollution, biosynthesis of industrial products.

Reference:

1. *Perspectives on Sustainable Technology- M. Rafiqul Islam*
2. Sustainable Energy Consumption and Society- David L. Goldblatt
3. Sustainable development (energy, engineering and technologies, manufacturing and environment) - Chaouki Ghenai
4. Sustainability and Environmental Impact of Renewable Energy Sources - R. E. Hester,

R. M. Harrison
5. Sustainable Natural Resources Management - Prof. Abiud Kaswamila.
6. Sustainable Communities Design Handbook - Woodrow W. Clark
7. Handbook of Bioplastics and Biocomposites Engineering Applications - Srikanth Pilla
8. Modeling & Imaging of Bioelectrical Activity: Principles and Applications (Bioelectric Engineering) - Bin He
9. Handbook of Swarm Intelligence: Concepts, Principles and Applications – YuhuiShi, Meng Hiot Lim, Bijaya ketan Panigrahi.
10. DNA Computing and Molecular Programming - DNA 16 – Yasubumi sakkibara, yongli Mi
11. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
12. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning .
13. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
14. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998 .
15. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
16. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
17. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
18. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication.
19. Biomimicry: Innovation Inspired by Nature by Janine Benyus

Disaster Management

Course Code- CE4402 **L-T-P- C**

Externals: 60 Marks **3-0-0-3**
Internals: 40 Marks

UNIT 1: Introduction (3 lectures) - Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

UNIT 2: Disasters (12 lectures)- Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT 3: Disaster Impacts (5 lectures)- Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climatechange and urban disasters.

UNIT 4: Disaster Risk Reduction (DRR) (15 lectures)- Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and nonstructural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNIT 5: Disasters, Environment and Development (5 lectures)- Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmentalfriendly recovery; reconstruction and development methods.

Text/Reference Books: 1. http://ndma.gov.in/ (Home page of National Disaster Management Authority). 64 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs). 3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall. 4. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication. 5. Ghosh G.K., 2006, Disaster Management ,APH Publishing Corporation.