DIVISION
OF
ELECTRICAL & ELECTRONICS
ENGINEERING
<table>
<thead>
<tr>
<th>Code No.</th>
<th>Subject Name</th>
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<td>EE202</td>
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<td>EE316</td>
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<td>Signal Processing</td>
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<tr>
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**EE101 BASIC ELECTRICAL ENGINEERING**

**Unit 1: DC Machines and Circuits**
Electrical quantities – Electric current, Electric potential, Electric power, Electrical Energy
Resistance, Temperature Co-efficient of Resistance – DC Generators – Principle of DC
generator – Parts of DC generator – EMF Equation – Types of generators – Characteristics
of generator – Applications of DC generators.

**Unit II : AC Machines and Circuits**
Generation of alternating EMF – Equation of alternating voltage – Alternating quantity
(current or voltage) – Cycle – Time period – Frequency – Maximum value – Average value
– Root mean square value – Form factor and peak factor – phase and phase difference
– constructional details – parts – types (core and shell type) – applications.

**Unit III : Generation, Transmission and Distribution**
Generation of Electrical energy – Thermal power generating station – Hydro power
generating station – Nuclear power generating station – Transmission of Electrical energy
– Classification of Transmission lines – conductors – insulator – underground cables
– classification of cables – laying of underground cables – distribution of electrical energy
– AC distribution system – DC distribution system – overhead distribution system
– underground distribution system.

**Unit IV : DC and AC Motors**
DC motor – principle of a DC motor – parts of a DC motor – back EMF – types of motor
– characteristics of motor – application of DC motor – single phase induction motor
– principle of operation of three phase induction motor – constructional details – slip
– frequency of rotor current – torque slip characteristics – applications of three phase induction motor

**Unit V : Measuring Instruments and Wiring Circuits**
Basic principles of indicating instruments – moving iron and moving coil instrument
– voltmeters and ammeters – dynamometer type wattmeter – induction type energy meter.

Text Book

Reference Book

EE102 BASIC ELECTRICAL ENGINEERING
Credit 2:0:0
Marks 40 + 60

Unit 1: DC Circuits

Unit II: AC Circuits
Sinusoidal functions: Phasor representation – RMS Effective values - form and peak factors – RLC circuits, power and power factor – simple problems.

Unit III: DC Machines:
Construction and principle of operation of DC machines – generator/motor characteristics and applications

Unit IV: AC Machines
Construction and principle of operation of AC machines, alternators – three phase and single phase induction motors – synchronous motors and applications, Single phase and three phase transformers and power conditioning equipments.

Unit V: Wiring Circuits, Instruments and Power Conditioning Equipments

Text Books
Reference Books

EE103 BASIC ELECTRICAL ENGINEERING
Credit 3:1:0
Marks 40 + 60

Unit I : DC Circuits and Magnetic Circuits

Unit II : DC Machines, Domestic Wiring and Computers
Construction and principle of operation of DC Machines, generator/motor action – EMF and torque equations – types of DC generators/motors – characteristics and applications.

Computers

Unit III : AC Circuits and Machines

Unit IV : Basic Components and Sensors

Sensors:
**Basic Electronic circuits:**
Basic concepts of PN Junction diodes – zener diode-bipolar junction transistor-junction field effect transistor – thyristor, photovoltaic devices, single phase HWR, FWR rectifiers (only working principles) transistor biasing.

**Integrated Circuits:**
Introduction to fabrication of ICs – operational amplifier – SSI, MSI, LSI, VLSI.

**Unit V: Power Conditioning Equipments and Communication systems:**

**Text Books**
2. Hughes, “Electrical Technology”, ELBS

**Reference Books**

**EE201 ELECTRIC CIRCUIT ANALYSIS**

**Unit I: Basic Circuit Concepts**

**Unit II: Sinusoidal Steady State Analysis**
Phasor- sinusoidal steady state response -concepts of impedance and admittance -analysis of simple circuits- power and power factor -series resonance and parallel resonance - bandwidth and Q factor. Solution of three-phase balanced circuits -power measurements by twowattmeter methods - solution of three phase unbalanced circuits.
Unit : III : Mesh-Current And Node-Voltage Methods

Unit IV : Network Theorems And Applications
Superposition theorem -reciprocity theorem -compensation theorem -substitution theorem -
maximum power transfer theorem -Thevenin's theorem. -Norton's theorem and Millman's
theory with applications.

Unit V : Transient Analysis
Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.

Text Book
1. Paranjothi S.R., 'Electric Circuit Analysis', New Age International Ltd. , Delhi, 2nd

Reference

EE202 ELECTRIC CIRCUITS LABORATORY AND WORKSHOP
Credits 0:0:2
Marks 50 + 50
1. Verification of Kirchhoff’s Laws.
2. Verification of Network Theorems (Thevenin, Norton and Superposition Theorems)
3. Introduction to PSPICE analysis of electric circuits.
4. Power Measurement by two wattmeter method
5. Active and Passive filters
6. Power measurement by three ammeter and three voltmeter
7. Study of resonance and circuit transients by Digital Simulation.
8. Study of unbalanced circuits using symmetrical components (balanced circuit with
   unbalanced source only)
9. Measurement of two port parameters
10. Exercises in house wiring, power wiring and earthing.
11. Winding of AC motors - Single phase and three-phase induction type
12. Trouble shooting in electrical machines equipment and instruments.
13. Assembly and construction of small transformers & chokes

Division of Electrical & Electronics Engineering
13. PCB fabrication
14. Cable jointing and fault location
15. Transformer Oil testing - dielectric strength & acidity.
16. Use of Earth megger
17. Different types of switches and lamps used in wiring circuit.
18. Study of domestic appliances like mixie, wet grinder, refrigerator, washing machine, microwave oven, table fan, monoblock pump, single phase motor, sewing machines, iron box, water heater, emergency lamp, telephone, PC, printer, stabilizer, domestic power generator.

EE 203 NETWORK ANALYSIS AND SYNTHESIS

Prerequisite: EE201 Electric Circuit Analysis

Credits 3:1:0
Marks 40+60

Unit I: S-Domain Analysis
S-domain network - driving point and transfer impedances and their properties - transform network analysis - poles and zeros of network functions - time response from pole-zero plots.

Unit II: Frequency Domain Analysis
Imittance - loci of RLC network - Frequency 3 phase of RLC networks - frequency response from pole-zero- Bode plots.

Unit III: Network Topology
Network graph, tree and cut-sets - tie-set and cut-set schedules - v-shift and I-shift - Primitive impedance and admittance matrices - Application to network solutions.

Unit IV: Two-Port Networks & Filters
Filters and attenuators - Design of constant -k, m-derived and composite filters - qualitative treatment of active filters - Butterworth and Chebyshev filters.

Unit V: Elements Of Network Synthesis

Text Book

Reference
EE204 ELECTROMAGNETIC FIELDS

Prerequisite: MA201/MA202 Engineering Mathematics I and II

Unit I: General Principles And Electrostatics

Unit II: Magnetostatic

Unit III: Electromagnetic Fields

Unit IV: Electromagnetic Waves
Generation – Propagation of waves in dielectrics – Conductors and transmission lines – Poynting vector – Skin effect.

Unit V: Field Modelling And Computation

Text Books

Reference Books

**EE205 ELECTRICAL TECHNOLOGY**

**Unit I : DC Machines**  
Construction, Principles of operation of DC motor and DC generator- Various types of DC motors and generators – Performance characteristics of DC motors and DC generators – Starting and speed control of DC motor.

**Unit II : Transformers**  
Constructional details and principles of operation of single and three phase transformers – losses and efficiency- Special types of transformers – Servo stabilizers

**Unit III : Synchronous Machines**  
Constructional features – Operating principle of three phase alternator and synchronous motor- synchronous motor starting, hunting, synchronizing and parallel operation.

**Unit IV : Induction Motors**  
Constructional features – operating principle of three phase induction motors(squirrel cage and slip ring) – slip torque characteristics – starters – speed control methods.

**Unit V : Special Machines**  

**Text Books**  

**Reference Books**  
EE206 ELECTRICAL CIRCUITS AND MACHINES LABORATORY

Credit: 0:0:2
Marks: 50+50

1. Measurement of active and reactive power and phase-shift in AC circuits.
2. Series and parallel resonant circuits.
3. Measurement of time constants (RC/RL)
4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
5. Predetermination of efficiency and regulation of single-phase transformers
6. Load test on single phase/three phase transformers
7. Load characteristics of DC motors (shunt, series and compound)
8. Load characteristics of DC shunt/compound generators.
9. Load test on alternators
10. Synchronous motor characteristics
11. Load test on three phase induction motors
12. Load characteristics of a single phase induction motors.
13. House wiring and earthing.
14. Speed control of DC shunt motor using (a) armature control (b) field control
15. Swinburne’s test

EE207 DC MACHINES AND TRANSFORMERS

Prerequisite: EE201 Electric circuit analysis
EE204 Electromagnetic fields

Credits 3:1: 0
Marks 40+60

Unit : I
Constructional features of a DC machine - principle of operation of DC generator - EMF equation - methods of excitation - no load and load characteristics of DC generators - commutation - armature reaction - parallel operation of DC generators – applications.

Unit : II

Unit : III
Principle of operation - constructional features of single phase transformer - emf equation - transformer on no load and load - effects of resistance and leakage reactance of the windings - phasor diagram - equivalent circuit – regulation.

Unit : IV
Losses and efficiency - all day efficiency -testing- polarity and voltage ratio tests - open circuit and short circuit tests –Sumpner’s test - parallel operation of single phase transformers - autotransformer - comparison with two winding transformers – Introduction to toroidal transformer.
Unit :V

Text Books

Reference Books

EE208 DC MACHINES AND CONTROLS LABORATORY
Credits 0:0:2
Marks 50+50

1. Open Circuit and load characteristics of a separately excited DC Generator.
2. Open Circuit and load characteristics of DC Shunt generator
3. Load characteristics of DC compound generator
4. Load test on DC shunt motor
5. Load test on DC series motor
6. Speed control of DC Shunt motor
7. Swinburne's Test
8. Study of DC motor starters
9. Load test on single phase transformer
10. Open circuit and short circuit test on single phase transformer
11. Separation of no load losses in a single phase transformer
12. Sumner's Test
13. Three Phase connections
14. Scott connection
15. Transfer function of separately excited DC generator.
16. Transfer function of field controlled DC motor.
17. Transfer function of armature controlled DC motor.
EE209 SYNCHRONOUS AND INDUCTION MACHINES

Credits 3:1:0
Marks 40+60

Prerequisite: EE201 Electric circuit analysis
EE204 Electromagnetic fields

Unit : I
Types - constructional features - armature winding - emf equation - armature reaction - alternators operating by itself - voltage regulation - concept of synchronous reactance - predetermination of regulation by synchronous impedance, mmf and Potier methods - load characteristics.

Unit : II
Synchronizing and synchronizing power - parallel operation - alternators on infinite busbars - two reaction theory of analyzing salient pole synchronous machines - regulation - determination of power/power angle relation.

Unit : III
Synchronous motor - principle of operation - phasor diagram - V curves and inverted V curves - circle diagram - synchronous condenser - hunting and methods of suppression - starting methods.

Unit : IV

Unit : V

Text Books

Reference Books
EE210 AC MACHINES LABORATORY
Credit: 0:0:2
Marks: 50+50

1. Regulation of alternator by EMF/ MMF methods
2. Operation of alternator on infinite busbar
3. V-curve for synchronous motor
4. Load test on three phase and single-phase induction motor
5. No load and blocked rotor tests on three phase induction motors
6. Speed control of three-phase induction motors
7. Load test on synchronous induction motor
8. Load test on three phase induction generators
9. Study and control of stepper motor
10. Study on brushless alternator.

EE211 ELECTRICAL MACHINE DESIGN
Credits 3:1:0
Marks 40+60

Pre-requisite: EE207 DC Machines and Transformers
EE209 Synchronous and Induction Machines

Unit I : Basic Considerations
Constructional elements of transformers and rotating machines - classification of design problems - general design procedure - standard specifications - output coefficient - choice of specific electric and magnetic loading - separation of D and L for rotating machines.

Unit II: Magnetic And Electric Circuit Calculations
MMF calculation - magnetization curve - magnetic leakage - MMF for air gap - effect of slot and ventilating ducts - MMF for teeth - leakage reactance - unbalanced magnetic pull - estimation of number of conductors per turn - coil slots - conductor dimension - slot dimension.

Unit III : DC Machines
Armature winding - magnetic circuit - choice of number of poles - length of air gap - field system - interpoles - commutator - brushes

Unit IV : Transformers
Core Section - windings - window dimension - overall dimension - cooling tubes
Unit V : Induction Machines
Choice of \( L/\tau \) ratio - air gap length - cage rotor - dispersion coefficient - end ring current - wound rotor - slip rings.

**Synchronous Machines:** Short circuit ratio - air gap length - salient pole rotor - cylindrical rotor.

**Text Book**

**Reference Books**

**EE212 COMPUTER AIDED MACHINE DESIGN LAB**
Credit: 0:0:2
Marks: 50+50
1. Study of AutoCAD machine
2. Design of D.C.Machine through computer
3. Design of single and three phase transformer through computer
4. Design of single phase Induction motor through computer
5. Design of synchronous machine through computer
6. Study of circuit breaker operation
7. Testing of different types of relays
8. Effect of airgap variation on induction machines performance
9. Electrical machines cross sectional view using AUTOCAD
10. Study of protective equipment & layout of 230/110KV substation
11. Introduction to ANSYS package

**EE213 POWER ELECTRONICS**
Prerequisite: EC201 Electron devices
Credit: 3:1:0
Marks 40+60

**Unit I: Power Semiconductor Devices**
Principle of operation -characteristics and modeling of power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT.
Unit II: Phase Controlled Converters
2 pulse, 3 pulse and 6-pulse converters - inverter operation input power factor - effect of source inductance and firing circuits.

Unit III: DC To DC Choppers
Voltage, current and load-commutated choppers - step up chopper and firing circuits.

Unit IV: Inverters
Series inverter - voltage source inverters - current source inverters - PWM inverters.

Unit V: AC Voltage Controllers
Single phase AC voltage controller - multi stage sequence. Control - step up and step down cyclo-converters - three phase to single phase and three phase to three phase cyclo-converters - Switched Mode Power Supply.

Text Book

Reference

EE214 POWER ELECTRONICS LAB

List of experiments:
1. Characteristics of MOSFET and IGBT.
2. Diode Bridge Rectifier with R and RL Load.
3. Single phase half and fully controlled bridge rectifiers.
5. UJT pulse trigger circuit for SCR.
7. AC regulator / AC phase control, using SCR, Triac and Diac.
8. Speed control of D.C motor using chopper drives.
10. Three phase fully controlled Thyristor converter.
11. PSPICE simulation of power electronics circuits.
EE215 ELECTRIC DRIVES AND CONTROLS

Prerequisite: EE213 Power electronics

Unit I : Characteristics of Electric Drives
Speed -torque characteristics of various types of loads and drive motors - Joint speed-torque characteristics - selection of power rating for drive motors with regard to thermal overloading and load variation factors - load equalization - starting, braking and reversing operations.

Unit II : DC Drives

Unit III : Three Phase Induction Motor Drives
Speed control of three phase induction motors - stator control - stator voltage and frequency control - Ac chopper, inverter and Cycloconverter fed induction motor drives, rotor control - rotor resistance control and slip power recovery schemes - static control of rotor resistance using dc chopper - static Kramer and Scherbius drives.

Unit IV : Three Phase Synchronous Motor Drives
Speed control of three phase synchronous motors - voltage source and current source inverter fed synchronous motors - commutatorless dc motors - Cycloconverter fed synchronous motors - effects of harmonics on the performance of ac motors - closed loop control of drive motors.

Unit V : Digital Control And Drive Applications
Digital techniques in speed control - advantages and limitations - microprocessor based control of drives - selection of drives and control schemes for steel rolling mills, paper mills, lifts and cranes.

Text Books

Reference Books
EE216 POWER SYSTEM ANALYSIS

Prerequisite : EE218 Transmission and Distribution  Marks 40+60

Unit I : Introduction
Need for system analysis in planning and operation of power system -distinction between steady state and transient state -per phase analysis of symmetrical three-phase system. General aspects relating to power flow, short circuit and stability analysis -per unit representation.

Unit II : Network Modelling

Unit III : Short Circuit Analysis

Unit IV : Power Flow Analysis
Problem definition -bus classification -derivation of power flow equation -solution by Gauss-Seidel and Newton - Raphson methods- P-V bus adjustments for both methods -computation of slack bus power, transmission loss and line flow.

Unit V : Stability Analysis

Text Book

Reference Books
EE217 COMPUTER AIDED POWER SYSTEM ANALYSIS LAB

Credit: 0:0:2
Marks: 50+50

All the experiments are based on MATLAB and Simulink

1. Short circuit analysis – symmetrical faults
2. Short circuit analysis – unsymmetrical faults
3. Transient stability analysis
4. Power plot – relay co-ordination
5. Harmonic analysis
6. Solution of load flow problem by Gauss-seidal method
7. Solution of load flow problem by Newton-Raphson method
8. Solution of economic load dispatch by Lambda iterative method
9. Simulink
10. Solution of load flow problem by fast decoupled method

EE218 TRANSMISSION AND DISTRIBUTION

Credits 3:1:0
Marks 40+60

Prerequisite: EE203 Network Analysis and Synthesis

Unit I: Introduction
Structure of electric power system - transmission and distribution systems - recent trends in power transmission – EHV AC and HVDC transmission.

Unit II: Transmission Line Parameters
Resistance - inductance and capacitance of single and three phase transmission lines - stranded and bundled conductors - symmetrical and unsymmetrical spacing - transposition - application of self and mutual GMD - skin and proximity effect - inductive interference with neighbouring circuits.

Unit III: Characteristics And Performance Of Transmission Lines
Equivalent circuits for short, medium and long lines - attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation - real and reactive power flow in lines - power angle diagram - receiving end power circle diagram - limiting factors of transmission line loadability – shunt and series compensation - Ferranti effect and corona loss.

Unit IV: Insulators And Cables
Unit V: General Aspects
Mechanical design of transmission lines - tariff and economic utilization and conservation of energy.

Text Books

Reference

EE219 PROTECTION AND SWITCH GEAR

Credits 3:1:0
Marks 40+60

Prerequisite: EE216 Power System Analysis

Unit I: Introduction And Relay Characteristics
Need for protection - essential qualities of protective relays - over current relays - directional, distance and differential, under frequency, negative sequence relays - static relays - microprocessor based relays.

Unit II: Apparatus Protection
Generator and Transformer Protection, Protection of bus bars, transmission lines, CTs & PTs and their application in protective schemes.

Unit III: Theory of Arc Quenching
Theory of arcing and arc quenching - RRRV - current chopping and capacitive current breaking - D.C. circuit breaking.

Unit IV: Circuit Breakers
Switchgear - fault clearing and interruption of current - various types of circuit breakers - selection of circuit breakers - intelligent circuit breakers.

Unit V: Protection Against Over Voltages
Different methods of protection against over voltages - lightning arresters.

Text Books
Reference Books

EE220 INTRODUCTION TO ELECTRICAL MACHINES AND POWER SYSTEMS

UNIT I : D.C Machines and Transformers
Constructional details of dc machines-principle of operation of dc generator-emf equation- -characteristics of different types of generators. Operation of dc motor-torque equation-characteristics of different types of motors-starting-speed control- Constructional details and principles of operation of single phase and three phase transformers- equivalent circuit of single phase transformer-losses, regulation and efficiency. Autotransformers and special transformers

UNIT II : A.C Rotating Machines
Constructional details and operating principle of 3 phase alternator and synchronous motor- -synchronizing and parallel operation. Starting of synchronous motor-V curve and inverted-V curves. Constructional features and operating principle of 3 phase induction motors-slip-torque characteristics-methods of starting-speed control; principle of operation and type of single phase induction motors.

UNIT II : Special Machines
Principle of working and special features of universal motor, repulsion motor, reluctance and hysteresis motors, stepper motors, linear induction motor, ac and dc servo motors and tacho generator.

UNIT IV : Power System - Introduction
Schematic representation of a power system – various components and data related to power system – per unit representation – Distinction between steady state and transient state of power system – Recent trends in power transmission – EHV AC and HVDC transmission

UNIT V : Analysis of Power System:

Text Books

Reference Books

EE 221 INTRODUCTION TO ELECTRICAL MACHINES AND DRIVES

Credit: 3:0:0
Marks: 40+60

UNIT I : DC Machines and Transformers
Construction, Principles of operation of DC motor and DC generator- Various types of DC motors and generators – Performance characteristics of DC motors and DC generators . Constructional details and principles of operation of single and three phase transformers – losses and efficiency.

UNIT II : Synchronous Machines
Constructional features – Operating principle of three phase alternator and synchronous motor - synchronous motor – synchronous motor starting, hunting, synchronizing and parallel operation

UNIT III : Induction Motors
Constructional features – operating principle of three phase induction motors(squirrel cage and slip ring) – slip torque characteristics.— single phase induction motor.

UNIT IV : Special Machines
Tachogenerator - AC and DC servomotor – stepper motor– linear induction motor – push button switches - contactors – relays

UNIT V : Drive and its Application
Drives – Introduction - DC drives and AC drive – microprocessor based control of drives – selection of drives and control schemes for steel rolling mills, paper mills, lifts and cranes.

Text Books
Reference Books

EE222 ELECTRIC CIRCUITS AND MACHINES LAB
Credit: 0:0:1
Marks: 25+25

1. Measurement of active and reactive power and phase-shift in AC circuits.
2. Series and parallel resonant circuits.
3. Measurement of time constants (RC/RL)
4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
5. Predetermination of efficiency and regulation of single-phase transformers
6. Load test on single phase/three phase transformers
7. Load characteristics of DC motors (shunt, series and compound)
8. Load characteristics of DC shunt/compound generators.
9. Load test on alternators
10. Synchronous motor characteristics
11. Load test on three phase induction motors
12. Load characteristics of a single phase induction motors.
13. House wiring and earthing.
14. Speed control of DC shunt motor using (a) armature control (b) field control

EE301 POWER ELECTRONICS - I
Credits 3:1:0
Marks 40+60

Unit I : Single Phase Controlled Rectifiers
Half controlled and fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters- Harmonics, ripple and input power factor.

Unit II : Three Phase Controlled Rectifiers
Half controlled and fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters - Harmonics, ripple and input power factor.

Unit III : Performance
Effects of source inductance- Power factor improvement techniques - twelve pulse converters - Dual converters - Design of converter circuits.
Unit IV: Inverters
Single phase and three phase bridge inverters with R, RL and RLE loads - Voltage control - Harmonic reduction - Rectifier mode of operation - Current source inverters - Inverter Circuit Design.

Unit V: Resonant Pulse Converters
Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters - Two quadrant zero voltage switching resonant converters - Resonant dc link inverters

References

EE302 LINEAR SYSTEMS
Credits 3:1:0
Marks 40+60

Unit I: State Space Analysis
Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.

Unit II: Decomposition Methods
Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III: State Space Representation For Discrete System
State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations . EIGENVALUES AND EIGEN VECTORS: Characteristic equation, eigen values, eigen vectors - Invariance of eigen values - Diagonalization - Jordan canonical form .

Unit IV: Concepts of Controllability And Observability
Kalman’s and Gilbert’s - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability.
STATE ESTIMATORS: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators
Unit V : Liapunov Stability Analysis

References

EE303 GENERALISED THEORY OF ELECTRICAL MACHINES
Credits 3:1:0
Marks 40+60

Unit I : Generalised Theory
Conversions - Basic two pole machines - Transformer with movable secondary - Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II : Linear Transformations
Invariance of power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes - Transformed impedance matrix - Torque calculations.

Unit III : DC Machines
Generalized representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.

Unit IV : Synchronous Machines
Generalized representation - Steady state analysis - Transient analysis - Electromechanical transients.


Unit V : Special Machines

References
EE304 POWER ELECTRONICS LAB - I

Credits 0:0:2
Marks 50+50

Ex. No. TITLE
1. Static and Switching Characteristics of I.G.B.T., POWER MOSFET and TRIAC.
2. Parallel and Series operation of Thyristors with Static and Dynamic Compensation.
3. Various Turn-ON methods of Thyristors.
4. Commutation techniques of Thyristor
9. Speed control of DC motor using thyristor semi-converter.
10. Speed control of 3 phase Induction motor using static Inverter.

EE305 POWER ELECTRONICS – II

Credits 3:1:0
Marks 40+60

Unit I : DC Choppers
Step down dc chopper with R, RL and RLE loads - Control strategies - Continuous and discontinuous current operations.

Unit II : Chopper Circuits
Two quadrant and four-quadrant dc chopper - Multiphase dc chopper - Switching mode regulators: Buck, Boost, Buck-Boost and Cuk regulators - Chopper circuit design.

Unit III : AC Voltage Controllers
Principles of on-off control and phase control - single-phase half and full wave controller with R, RL and RLE loads - Three phase half wave and full wave controllers.

Unit IV : Ac Voltage Controllers
Single-phase transformer tap changers - AC voltage controllers with PWM control (AC chopper) - Design of ac voltage controller circuits - Effects of source inductance.

Unit V : Cyclo Converters

References

EE306 ADVANCED ELECTRIC DRIVES AND CONTROLS

Credits 3:1:0
Marks 40+60

Unit I : Converter Fed DC Drives

Unit II : Chopper Fed DC Drives
Single quadrant chopper controlled drives - evaluation of performance parameters for separately excited and series motor drives - Two quadrant and four quadrant chopper controlled drives.

Unit III : Induction Motor Drives
Stator control: Stator voltage control of 3 phase induction motors, effect of voltage variation on motor performance by ac voltage controllers - Variable frequency square wave VSI drives - Twelve step inverters for induction motors - PWM drives - CSI drives.
Rotor control: Static rotor resistance control - DC equivalent circuit - Torque equation - slip power recovery - static Kramer drive - AC equivalent circuit - Torque expression - static scherbius drive.

Unit IV : Vector Control of Induction Motors

Unit V : Special Drives
Synchronous Motor Drives: Scalar control - True synchronous and self modes - Vector control - Permanent magnet machine control - Switched reluctance motor and stepper motor drives.
Closed Loop Control: Motor transfer function - P, PI, and PID controllers - Current control - Design procedure - Phase locked loop (PLL) control - Microcomputer control.

References

EE307 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : Introduction
High power devices for power system controllers - characteristics - converters configurations for large power control-Single and three phase converters: Properties - current and voltage harmonics - effects of source and load impedance - choice of best circuit for power systems.

Unit II : Converter Control
Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III : Wind Energy Conversion System
Basic components - Generator control - Harmonics - Power factor improvement.
PV CONVERSION SYSTEMS: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV : HVDC Systems
Application of converters in HVDC systems - Static VAR control - sources of reactive power - Harmonics and filters

Unit V : FACTS
Concept of flexible AC Transmission system - Static VAR compensators - Thyristor controlled reactor - Thyristor switched capacitor - Static condenser - Controllable series compensation.

References
EE308 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : Introduction
Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSPICE, MATLAB and SIMULINK.


Unit II : PSPICE
File formats - Description of circuit elements - circuit description - output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, and Power S-Functions - Converting S-Functions to blocks.

Unit III : MATLAB and Simulink
Toolboxes of MATLAB - Programming and file processing in MATLAB - model definition and model analysis using SIMULINK - S-functions - converting S-functions to blocks.

Unit IV : Simulation of Electronic Circuits using PSPICE, MATLAB and Simulink
Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

Unit V : Simulation of Speed Control Schemes using PSPICE, MATLAB and Simulink
Simulation of speed control schemes for DC and AC motors.

References
EE309 COMPUTER SIMULATION LAB OF POWER ELECTRONIC SYSTEMS

Ex. No. | TITLE
--- | ---
1. | Solution of transcendental equation by numerical techniques.
4. | Simulation of Solid State Circuits by PSPICE / MATLAB & SIMULINK.
5. | Simulation of Controlled rectifiers by PSPICE / MATLAB & SIMULINK.
6. | Simulation of Diode rectifiers, using PSPICE / MATLAB & SIMULINK.
7. | Simulation of AC voltage controllers using PSPICE / MATLAB & SIMULINK.
8. | Simulation of DC voltage controllers using PSPICE / MATLAB & SIMULINK.
9. | Simulation of speed control schemes for DC and AC motors.

EE310 ADVANCED POWER SEMICONDUCTOR DEVICES

Unit I : Introduction
Status of Development of power semiconductor Devices - Types of static switches - Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance - Use of heat sinks - Switching losses.

**Power Diodes:** Types - Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation - Schotky diodes - Fast recovery diodes.

Unit II : Thyristors
Physics of device operation - Electrical rating - Switching and steady state characteristics - Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - light fired Thyristor - switching losses.

Unit III : Special Types Of Thyristors
TRIACS, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements - Turn ON and Turn OFF methods - Series, Parallel operation of GTO Thyristors.

Unit IV : Power Transistors
Types - ratings - static and switching characteristics - driver circuit - switching aid circuit - Power Darlington.

**Power Mosfets:** Types - Comparison with BJTs - Structure - Principle of operation - Switching losses - Driver circuit - Switching aid circuit.
Unit V : IGBTs
Comparison with power BJT and MOSFET - Structure, Principle of working - switching characteristics - Gate drive requirements.


References

EE311 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Unit I : Review of Conventional Transducers

Unit II : Digital Transducers
Direct digital transducers – absolute and incremental displacement transducers – Moire Fringe transducers – transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III : Industrial heating & Photoelectric devices
Industrial Heating using high frequency dielectric heating infrared and ultra violet heating – laser heating. Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV : Microprocessor based instrumentation
Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based AC voltmeter – Microprocessor based AC Ammeter – Microprocessor based Speed monitoring unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring unit – Microprocessor based over and under voltage and over current protection.

Unit V : Smart Transducers
Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – two win transmitters – measurement of flow, pH with smart transducers.
Text Books:

References:

EE312 POWER ELECTRONICS LAB II

Credits 0:0:2
Marks 50+50

Ex. No. TITLE
1. Chopper controlled D.C. Drive.
2. Speed Control of Induction motor by Static Rotor Resistance.
4. Speed control of Induction motor by variable voltage control.
5. Speed control of Induction motor by operation of Cycloconverter on R-L and Motor Load.
6. AC and DC Power Supply.

EE313 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credits 3:1:0
Marks 40+60

Unit I : Introduction
Trends in energy consumption - world energy scenario - energy sources and their availability -conventional and renewable sources - need to develop new energy technologies.

Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking.

Unit II : Power Conditioning Schemes
DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem.
PV Applications: Stand alone inverters - Charge controllers - Water pumping, audio visual equipments, street lighting - analysis of PV systems

Unit III: Wind Energy Systems

Unit IV: Self-Excited WECS

Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement.

Unit V: Stand Alone (Remote Area) Power Supply Systems
Wind/solar PV integrated systems - selection of power conversion ratio - Optimization of system components - storage - reliability evolution.

References

EE314 EMBEDDED CONTROLLER APPLICATION IN POWER ELECTRONICS

Unit I: Review of Microprocessors
Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other important interfacing ICs.

Unit II: Microprocessor based firing scheme for converters
Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, types of pulse width modulation techniques, their implementation using microprocessors, Application of these firing schemes to the control of DC drive, induction motors, synchronous motors and other special machines, Application in Electrical Traction.

Unit III: Microprocessors in closed loop control schemes:
Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various
types of controllers using microprocessors.

Unit IV: Microprocessors in special applications of Power Electronics:
Static excitation of synchronous generators, Solid State tap-changers for transformers, UPS systems, Induction furnace control.

References
3. Lecture notes on 'Microprocessor in power Electronics' prepared by power Electronics division, SEEE, College of Engineering, Madras 600 025.

EE315 DIGITAL INSTRUMENTATION

Unit I: Introduction
Digital codes - memory devices - basic building blocks - gates, FF and counters – discrete data handling - sampling - sampling theorem - aliasing errors - reconstruction - extrapolation - synchronous and asynchronous sampling.

Unit II: Digital methods of Measurements

Unit III: Digital display & recording Devices
Digital storage oscilloscopes - digital printers and plotters - CDROMS - digital magnetic tapes, dot matrix and LCD display CROs, Colour Monitor, Digital Signal Analyser, and Digital Data Acquisition.

Unit IV: Signal Analysis
Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figure meters, RF network analyser, and high frequency signal sources.

Unit V: Current trends in digital instrumentation
Introduction to special function add on cards - resistance card - input and output cards - counter, test, and time of card and Digital Equipment construction with modular designing; interfacing to microprocessor, micro-controllers and computers. Computer aided software engineering tools (CASE) - use of CASE tools in design and development of automated measuring systems - interfacing IEEE cards - intelligent and programmable instruments using computers.
References

EE316 THEORY AND DESIGN OF NEURO-FUZZY CONTROLLERS
Credit: 4:0:0
Marks 40+60

Unit I : Neural Network

Unit II : Neural Networks in Control
Neural network. for non-linear systems -schemes of neuro control- system identification forward model and inverse model- indirect learning neural network control applications - case studies.

Unit III : Fuzzy Logic

Unit IV : Fuzzy logic in Control

References
5. Driankov, Hellendoorn, "Introduction to Fuzzy Control”, Narosa publishers.
EE317 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

Credit: 3:1:0
Marks 40+60

Unit I : Introduction
Conventional design procedures -Limitations -Need for field analysis based design.

Unit II : Mathematical formulation of Field problems

Unit III : Philosophy of FEM

Unit IV : CAD Packages
Elements of a CAD System -Preprocessing -Modelling -Meshing -Material properties - Boundary Conditions -Setting up solution -Postprocessing.

Unit V : Design Applications
Design of Solenoid Actuator -Induction Motor -Switched Reluctance Motor –Synchronous Machines.

References
5. C. W. Trowbridge, "An Introduction to Computer Aided Electromagnetic Analysis" Vector Field Ltd.
6. User Manuals of MAGNET, MAXWELL & ANSYS. Software Packages.

EE 318 POWER ELECTRONICS LABORATORY

Credit: 0:0:2 Marks: 50+50
1. Static switching characteristics of IGBT, MOSFET & TRIAC.
2. Various turn on methods of Thyristors & Triac.
3. Commutation techniques of Thyristors.
5. Operation of 1-phase Full-Converter on R & R-L load.
12. Electronics Starter and Speed Controller of DC motor.

**EE319 SIGNAL PROCESSING**

**Credit:** 4:0:0  
**Marks:** 40+60

**Unit I : Review of Discrete time systems**
Structures for discrete time system –direct, cascade and parallel forms -lattice structure.

**Unit II : The Discrete Fourier Transform**

**Unit III : Digital Filter Design Techniques**

**Unit IV : Effects of Finite Register Length in Digital Signal Processing**
- Introduction- Effects of coefficient on Quantization -Quantization in Sampling, Analog Signals- Finite Register Length effects in realizations of Digital Filters, discrete Fourier Transform Computations.

**References**
EE320 SOLID STATE DC DRIVES

Credit: 3:0:0  
Marks: 40+60

Unit I : Review of conventional DC drives
Different techniques of speed control and methods of braking of series and separately excited DC motor, Ward-Leonard Speed control, Inching and jogging, Models and transfer function of series and Separately excited DC motor.

Unit II : Converter control of DC motors
Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations. Problems on DC machines fed by converter supplies.

Unit III : Chopper control of DC motors
Analysis of series and separately excited DC motors fed from different Choppers, effect of saturation in series motor, CLC and TRC strategies.

Unit IV : Design of converter fed DC drives
Speed loop, current loop, armature current reversal, field current reversal-Inching, Digital controller and firing circuits, simulation.

Unit V : Intelligent controller for DC drive
Microcomputer implementation of control function, Fuzzy, Neuro, Fuzzy neuro controllers.

Text Books

References
3. B. K. Bose, Expert system, fuzzy logic and neural network applications in power electronics and motion control, Proceedings of the IEEE, Special issue on power electronics and motion control, August 1994, pp.1303.

EE321 SOLID STATE AC DRIVES
Credit: 3:0:0 Marks: 40+60

Unit I : Stator voltage control of induction motor
Torque slip characteristics, Operation with different types of loads, Performance, Comparison of different ac power controllers, Speed reversal, Closed loop control.

Unit II : Stator frequency control
Operation of induction motor with non- sinusoidal supply waveforms, variable frequency operation of 3-phase induction motors, Constant flux operation, Current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives, Principle of vector control.

Unit III : Rotor resistance control
Torque-Slip characteristics, Types of rotor choppers, Torque Equations, Constant torque operations, TRC strategy, Combined stator voltage control and rotor resistance control.

Unit IV : Slip power recovery scheme
Torque equation, Torque-slip characteristics-power factor considerations, Sub-synchronous operation and closed loop control.

Unit V : Synchronous motor drives
Need for leading pf operation- open loop VSI fed drive and its characteristics- Self control-torque angle control- Power factor control-Brushless excitation systems-Starting methods-Principles of vector control.

Text Books

References
EE322 POWER ELECTRONICS AND DRIVES LABORATORY

Credit: 0:0:2
Marks: 40+60

1. Performance of Chopper fed D.C. Drive.
2. Operation of a four quadrant Chopper on D.C. Drive
3. Operation of a 1-phase A.C. Voltage controller on motor load.
7. 2-Quadrant operation of a 1-phase Full Converter using D.C. drive.
ADDITIONAL SUBJECTS

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EE223 MATERIAL SCIENCE

Credits: 4: 0:0

UNIT 1 : Conducting Materials

UNIT II : Semiconductor Materials
Elemental and compound semiconductors and their properties – carrier concentration in n type and p type semiconductors- variation of carrier concentration with temperature and its influence – Hall effect – experimental arrangement- applications of hall effect.

UNIT III : Magnetic And Dielectric Materials
Different types of magnetic material and their properties – Heisenberg and domain theory of ferromagnetism – hysteresis – energy product of a magnetic material – ferrite and their applications – magnetic recording materials – tapes and discs – metallic glasses – active and passive dielectrics and their frequency and temperature dependence – internal field and
deduction of clausius mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications.

UNIT IV : Optical Materials
Optical properties of metals, insulators and semiconductors – excitons, traps, colour centers and their importance – phosphorescence and fluorescence – different phosphors used in CRO screens – liquid crystal as display materials- twisted pneumatic display – construction and working of LED – LED materials – thermography and it’s applications – photoconductivity and Photo conducting materials.

UNIT V : Modern Engineering Materials

Text Book

References

EE224 COMMUNICATION ENGINEERING
Credit: 4:0:0 Marks: 40 + 60

Unit I: Radio Communication Systems

Unit II: Pulse Communication Systems

Unit III : Data Transmission

Unit IV : Transmission Medium
Unit V: Television

Text Book

References

EE225 ELECTRONIC CIRCUITS

Credits: 3:1:0 Marks: 40 + 60

UNIT I: Rectifiers and Power Suppliers
Single and polyphase rectifiers and analysis of filters circuits – design of zener and transistor series voltage regulators- switched mode power suppliers.

UNIT II: Amplifiers

UNIT III: Differential and Tuned Amplifiers

UNIT IV: Feedback Amplifiers and Oscillators

UNIT V: Pulse Circuits
RC wave shaping circuits – diode clampsers and clippers – multivibrators – Schmitt triggers-UJT and transistor sawtooth oscillators.

Text Book
References

EE226 ENERGY SYSTEMS

Credits:4:0:0 Marks: 40 + 60

UNIT I : Generation of Electrical Power
Layout and working of Hydro, Thermal, Nuclear – Gas turbine and diesel power plant –
Introduction to non-conventional energy sources – Load and load duration curve – Load,
demand and diversity factors – Plant capacity and plant use factors – Cost of energy
generated – Tariffs.

UNIT II : Illumination, Electric Heating & Welding
Lighting calculations -determination of MHCP and schemes -polar curves of different types
of sources -Rousseau's construction -photometers -lighting schemes -design of lighting
schemes -factory & flood lighting -electric lamps- gaseous discharge construction and
application –control equipment, efficiency and losses -resistance heating, induction heating -
furnaces -high frequency dielectric heating, resistance welding, arc welding.

UNIT III : Electric Traction
Requirements of traction system -Systems of traction -speed time curves - tractive effort
calculations -power of traction motor -specific energy consumption- series, parallel control
of D.C. motors, open circuited, shunt and bridge transition - A.C. traction -recent trends in
electric traction -electric braking.

UNIT IV : Generation of High Voltages and Currents and its measurements
Generation of high DC voltage using voltage multiplier circuits -Van de Graff generator -
generation of high alternating voltages using cascade transformers - High DC voltage
measurement techniques -methods of measurement for power frequency AC voltage -
sphere gap measurement technique - use of CRO for impulse voltage and current
measurements.

UNIT V : High Voltage Testing
Tests on insulators - testing of bushings -testing of isolators and circuit breakers -cable
testing -testing of transformers- surge divertor testing -radio interference measurement -use
of I.S.S. for testing.

Text Books
EE227 POWER ELECTRONICS BASED POWER SYSTEMS

Credits : 4:0:0  Marks: 40 + 60

Unit I : Introduction
High power devices for power system controllers – characteristics of converters – Single and three phase converters – Choice of best circuit for power systems.

Unit II : Converter Control

Unit III – Wind and Solar Energy Conversion System
Basic components – Generator control – Harmonics – Power factor improvement.

Unit IV – HVDC Systems
Application of converters in HVDC systems – Static VAR control – Source of reactive power – Harmonics and filters.

Unit V – FACTS
Concept of flexible AC transmission system – Static VAR compensators – Thyristor controlled reactor – Thyristor switched capacitor – Static condenser – Controllable series compensation.

Text Books

References

**EE228 POWER SYSTEM CONTROL**

**Credits: 4:0:0**

**Marks: 40 + 60**

**UNIT I : Introduction**

Need for voltage and frequency regulation in power system - system load characteristics - basic P-f and Q-v control loops - cross coupling between control loops - plant level and system level controls - recent trends of real-time control of power systems.

**UNIT II : Real Power And Frequency Control**


**UNIT III : Reactive Power – Voltage Control**

Typical excitation system – modeling – static and dynamic analysis – stability compensation - effect of generator loading - static shunt capacitor/reactor VAR compensator, synchronous condenser, tap-changing transformer - static VAR system - modeling – system level voltage control

**UNIT IV : Computer Control of Power System**


**UNIT V : Economic Dispatch Control**

Incremental cost curve – co-ordination equations with loss and without losses, solution by iteration method. (No derivation of loss coefficients). Base point and participation factors. Economic controller added to LFC control.

**Text Books**


**References**

EE29 HVDC TRANSMISSION - I

Credits: 4:0:0  Marks: 40 + 60

UNIT I: General Aspects

UNIT II: Thyristor Converters
Three phase fully controlled thyristor bridge converters – operation as rectifiers and line commutated inverters – converter equivalent circuits – parameters and characteristics of rectifiers and inverters – series and parallel arrangement of thyristors – multibridge converters.

UNIT III: Control Of Converters
Gate control – basic means of control – power reversal – desired features of control – control characteristics – constant current control – constant extinction angle control – stability of control – tap changer control – power control and current limits.

UNIT IV: Protection
Basics of protection of HVDC systems – DC reactors – voltage and current oscillations – DC line oscillations – clearing line faults and re-energizing the line – circuit breakers – over voltage protections.

UNIT V: Harmonics, Filters And Ground Return

Text Books

Reference Books

EE230 ADVANCED COMPUTER LAB

Credits: 0:0:2  Marks: 50 + 50

12 experiments will be notified by HOD from time to time
EE231 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits: 3:1:0  
Marks: 40 + 60

UNIT : I

UNIT : II

UNIT : III
Hopfield nets - associative memory - bi-directional associative memories - BAM structure - continuous BAM - adaptive and competitive BAM - applications.

UNIT : IV

UNIT : V

Text Books

Reference Books:
EE232 SPECIAL ELECTRICAL MACHINE

Credits: 3:1:0  
Marks: 40 + 60

UNIT I : Synchronous Reluctance Motors  

UNIT II : Stepping Motors  

UNIT III : Switched Reluctance Motors  

UNIT IV : Permanent Magnet Brushless D.C. Motors  

UNIT V : Permanent Magnet Synchronous Motors  

Text Book  

References  

EE233 POWER SYSTEM STABILITY

Credits: 3:1:0  
Marks: 40 + 60

UNIT : I  
Concept and importance of stability in power system operation and design - Steady state, transient and dynamic stability - The swing equation of machines connected to an infinite bus bar and two machines connected together.
UNIT: II
Swing curves - solution by point by point and Euler's method - Qualitative treatment of stability studies on network analyzers and digital computers.

UNIT : III
Equal area criterion, calculation of critical clearing angle by equal area criterion of various fault conditions - Effect of enclosures - Factors affecting transient stability and its improvement.

UNIT : IV
Types of excitation systems, AVR, calculation of exciter response by graphical integration and step-by-step methods - Effect of speed governing system, inertia and damping on steady state and transient stability.

UNIT : V
Significance of steady state stability - power limit of transmission systems - Clarke's diagram of two machine systems with and without losses - Steady state stability of one machine connected to an infinite bus bar.

Text Books

Reference Books

EE234 POWER ELECTRONIC INSTRUMENTATION

Credits: 4:0:0 Marks: 40 + 60

UNIT I : Introduction
Importance of measurement and sensing - measurement techniques for thyristorised DC and AC circuits - measurement of voltage, current, power, power factor and speed.

UNIT II : Analog Systems
Introduction to various Analog systems - characteristics of operational amplifiers - fundamental circuits using OPAMPS - 555 timer and applications - PLL.

UNIT III : Digital Systems
Need for Digital systems – Boolean algebra – combinational and sequential logic circuits – analysis, design using memories, multiplexers, PLAs and PAL.
UNIT IV : Measurement Techniques
Application of analog circuits measurement and sensing of voltage, current, frequency, speed, power and power factor - isolation techniques - Sensing and measurement of voltage, current, frequency, speed, power and power factor using digital circuits - Study of digital storage oscilloscope.

UNIT V : Control Of Power Electronic Converters Using Analog and Digital Circuits
Firing Schemes for DC chopper – PWM techniques employed in converters and inverters - use of ADCs and DACs in sensing schemes in power electronic systems – closed loop current and speed control schemes.

Text Book

References

EE235 EHV AC AND DC TRANSMISSION ENGINEERING

Credits: 4:0:0Marks: 40 + 60

UNIT I : Transmission Engineering

UNIT II : Line Parameters

UNIT III : Power Control
Power Frequency and Voltage control – Over voltages – Power Circle diagram – Voltage control using shunt and series compensation – static VAR compensation – higher phase order system – FACTS.

UNIT IV : EHV AC Transmission
Design of EHV lines based on steady state limits and transient over voltages - Design of extra HV cable transmission – XLPE cables – Gas insulated cable Corona and RIV.
UNIT V : HVDC Transmission

Text Books

References

EE323 FLEXIBLE AC TRANSMISSION SYSTEMS
Credits: 4:0:0 Marks: 40 + 60

Unit I : Introduction
FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

Unit II : Series Compensation Schemes
Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional ASC, NGH damping schemes, Modelling and control of thyristor controlled series compensators.

Unit III : Unified Power Flow Control
Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

Unit IV : Design of Facts Controllers
Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control; variable structure resistor control.

Unit V : Static Var Compensation
Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor (TSR), Thyristor switched capacitor(TSC), saturated reactor (SR) , and fixed capacitor (FC)

Text Books
References

EE324 SPECIAL MACHINES AND CONTROLLERS

Credits: 4:0:0 Marks: 40 + 60

Unit I : Stepping Motors
Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.

Unit II: Switched Reluctance Motors
Constructional features, principle of operation, Torque equation, Power controllers, Characteristics and control Microprocessors based controller.

Unit III : Permanent Magnet Brushless DC Motors
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brush less motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV : Permanent Magnet Synchronous Motors
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Text Books

Reference Books
EE35 HVDC TRANSMISSION-II

Credits: 4:0:0  
Marks: 40 + 60

Unit I : DC Power Transmission Technology
Introduction-comparison of AC and DC transmission-application of DC transmission-description of DC transmission system-planning for HVDC transmission-modern trends in DC transmission.

Unit II : Analysis of HVDC Converters
Pulse number-choice of converter configuration-simplified analysis of Graetz circuit converter bridge characteristics – characteristics of a twelve pulse converter-detailed analysis of converters.

Unit III : Converter And HVDC System Control
General principles of DC link control-converter control-characteristics –system control hierarchy – firing angle control-current and extinction angle control-starting and stopping of DC link – power control-higher level controllers – telecommunication requirements.

Unit IV : Harmonics and Filters
Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

Unit V : Simulation of HVDC Systems
Introduction-system simulation: Philosophy and tools-HVDC system simulation-modelling of HVDC systems for digital dynamic simulation.

Text Book

References
5. www.abb.se/pow/hvdc.htm
7. www.hvdc.ca
ADDITIONAL SUBJECTS

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EE236 ELECTRIC CIRCUITS AND NETWORKS

Credit : 3:1:0 Marks : 40 + 60

Unit I: Circuit Analysis

Unit II: Network Theorems and Transformations
Voltage and current source transformations - star and delta transformations - superposition, reciprocity, substitution, Thevenin, Norton, Tellegen, Millman and maximum power transfer theorems - statement and applications.

Unit III: Response of Electric Circuits

Unit IV: Coupled and Three Phase Circuits

Unit V: Two Port Networks and Filters
Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent pi and T networks – passive filters as a two
port network – characteristics of ideal filter – low pass and high pass filters.

**Text Books:**

**Reference Books:**

EE237 CONTROL SYSTEMS

**Credit : 3:1:0**

**Marks : 40 + 60**

**Unit I : Introduction**
Open loop and closed loop systems – translational and rotational mechanical systems and analogous electrical systems – Basic components of control systems – potentiometer – synchros – tachogenerator – a.c and d.c servo motor - Mathematical representation, block diagram, signal flow graph and transfer function of electrical systems.

**Unit II : Time Response Analysis**

**Unit III : Frequency Response Analysis**

**Unit IV : Root Locus**

**Unit V : State Space Analysis**

**Text Book**

**Reference Books**

EE238 MICROPROCESSORS AND MICROCONTROLLERS

Credit : 3:1:0  
Marks : 40 + 60

Unit I: 8085 Microprocessor

Unit II: 8086 Microprocessor
Organisation of 8086 microprocessor – memory segmentation – Addressing bytes and words – Address formation – Address modes in 8086 – Assembly language programming – minimum mode and maximum mode.

Unit III: Microprocessor Interfacing Techniques

Unit IV: Interfacing Memory and I/O Devices and Microprocessor Applications

Unit V: 8031/8051 Microcontroller

Text Books:

References:


EE239 MEASUREMENTS AND COMPUTER AIDED MACHINE DESIGN LAB

Credit : 0:0:2  
Marks : 50 + 50

12 Experiments will be notified by the HOD from time to time.

EE240 DATA STRUCTURES AND ALGORITHMS

Credit : 3:1:0  
Marks : 40 + 60

Unit I: Introduction to Data Structures
Abstract data types - Sequences as value definitions - Data types in C - Pointers in C - Data structures in C - Arrays in C - Array as ADT - One dimensional array - Implementing one dimensional array - Array as parameters - Two dimensional array - Structures in C - Implementing structures - Unions in C - Implementation of unions - Structure parameters - Allocation of storage and scope of variables.

Unit II: Recursive Function, Stack and Queue
Recursive definition and processes: factorial function - fibonacci sequence - recursion in C - efficiency of recursion
Stack definition and examples - primitive operations - example - representing stacks in C - push and pop operation implementation.
Queue as ADT - C implementation of queues - insert operation - priority queue - array implementation of priority queue.

Unit III: Linked List
Inserting and removing nodes from a list - linked implementation of stack, queue and priority queue - Other list structures - Circular lists: Stack and queue as circular list - Primitive operations on circular lists. Header nodes - Doubly linked lists - Addition of long positive integers on circular and doubly linked list.

Unit IV: Trees
Binary trees: operations on binary trees - applications of binary trees - binary tree representation - node representation of binary trees - implicit array representation of binary
tree – binary tree traversal in C - threaded binary tree - representing list as binary tree - finding the $k^{th}$ element - deleting an element.

Trees and their applications: C representation of trees - tree traversals - evaluating an expression tree - constructing a tree.

**Unit V: Sorting and Searching**


Sequential search: Indexed sequential search - Binary search - Interpolation search.

**Text Book**

**Reference Books:**

**EE241 DATA STRUCTURES AND ALGORITHMS LABORATORY**

Credit : 0:0:2  
Marks : 50 + 50

12 Experiments will be notified by the HOD from time to time.

**EE242 OBJECT ORIENTED PROGRAMMING**

Credit : 3:1:0  
Marks : 40 + 60

**Unit I : Object Oriented Programming and Basics of C++**


**Unit II : Structure of C++ Program**

Unit III : Classes and Objects
Specifying a class – Defining member functions – Private member functions – Arrays within
a class – Memory allocation for objects – Static data members – Static member functions –
Arrays of objects – Objects as function arguments – Friendly functions – Returning objects.

Constructors: Parameterized constructors – Multiple constructors in a class – Constructors
with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic
constructors – Destructors.

Unit IV : Operator Overloading, Inheritance and Polymorphism
Defining operator overloading: Overloading unary, binary operators. Manipulation of strings
using operators – Rules for overloading operators – Type Conversions – Defining derived
classes – Single inheritance – Multilevel inheritance – Multiple inheritance – Hierarchical
inheritance – Hybrid inheritance – Virtual base classes – Abstract classes - Introduction to
pointers to objects: This pointer – Pointers to derived classes – Virtual functions – Pure
virtual functions.

Unit V: Java Evolution, Constants, Variables, Data Types, Operators, Classes, Objects,
Methods, Arrays and Strings
Java features: How Java differs from C and C++ – Simple Java program – Java program
structures – Java tokens – Java statements – Implementing a Java program – Java virtual
machine – Command line arguments - Constants – Variables – Data types – Scope of
variables – Operators in Java.
Defining a class – Adding variables and methods – Creating objects – Accessing class
members – Constructors – Method overloading – Static members – Inheritance: Extending a
class – Overriding methods – Final variables and methods – Final classes – Abstract methods
and classes – Visibility control - Arrays – One dimensional array – Creating an array – Two-
dimensional arrays – Strings – Vectors.

Text Books

Reference Books
2003.
4. Kris Jasma, “Java Programming – A Complete Reference”, Galgotia publication,
1994.
EE243 OBJECT ORIENTED PROGRAMMING LABORATORY

Credit : 0:0:2
Marks : 50 + 50

12 Experiments will be notified by the HOD from time to time.

EE244 SOLID STATE DRIVES

Credit : 3:1:0
Marks : 40 + 60

Unit I: Drive Characteristics
Equations governing motor load dynamics - Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability and problems - Multi quadrant dynamics in the speed torque plane - Basics of regenerative braking - Typical load torque characteristics - Acceleration, deceleration, starting and stopping.

Unit II: Converter / Chopper Fed DC Motor Drive
Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive: Continuous and discontinuous conduction mode - Chopper fed D.C drive: Time ratio control and current limit control - Operation of four quadrant chopper.

Unit III: Induction Motor Drives
Stator voltage control - Slip-power recovery drives - Adjustable frequency drives: v/f control, constant slip-speed control and constant air-gap flux control – Basics of voltage/current fed inverters - Block diagram of closed loop drive.

Unit IV: Synchronous Motor Drives
Open loop volts/hertz control and self-control of synchronous motor: Marginal angle control and power factor control - Permanent magnet synchronous motor.

Unit V: Design of Controllers for Drives
Transfer function for dc motor, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control - Design of controllers: Current controller and speed controller - Converter selection and characteristics.

Text Books

Reference Books
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EE326 SOLID STATE DC DRIVES

Credit: 4:0:0  
Marks: 40+60

Unit I: Review of Conventional DC Drives

Unit II: Converter Control of DC Motors
Motor and input supply performance parameters - Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations – Power factor improvement – Dual converters – Reversible Drives – Braking in phase-controlled drives - Problems on DC machines fed by converter supplies.

Unit III: Chopper Control of DC motors

Unit IV: Design of Converter Fed DC drives
Closed Loop Speed Control - Current Control - Load Torque Disturbance - Phase-Locked-Loop Control – Harmonics and associated problems - Digital controller and Firing circuits, Simulation.

Unit V: Intelligent controller for DC drive
Microcomputer implementation of control function – Fuzzy – Neuro – Neuro-Fuzzy controllers – Introduction to PSIM.

Text Books

References

EE327 SOLID STATE AC DRIVES

Credit: 4:0:0 Marks: 40+60

Unit I: Stator Voltage Control of Induction Motor

Unit II: Stator Frequency Control
Operation of Induction Motor with non- sinusoidal supply waveforms – Air gap MMF harmonics – Harmonic behaviour of IM – Constant volt and variable frequency operation of 3-phase Induction Motors - Constant flux operation - Current fed operations – Constant torque, constant power, high speed motoring – Stator current control - Dynamic and regenerative braking of CSI and VSI fed drives - Principle of vector control.

Unit III: Rotor Resistance Control
Torque-Slip characteristics with mechanical rotor resistance control – Static rotor resistance control - Torque Equations - Closed loop operation -Constant torque operations – TRC strategy - Combined stator voltage control and rotor resistance control.

Unit IV: Slip Power Recovery Scheme
Torque equation - Torque-Slip characteristics - Power Factor considerations, Sub-synchronous and Super-synchronous operation - Closed loop control – Static Kramer and Scherbius Drive – Four-quadrant sub-synchronous cascade with DC dynamic braking.

Unit V: Synchronous Motor Drives
Need for leading pf operation - Open loop VSI fed drive and its characteristics – Load Commutated drive - Self control - Torque angle control - Power factor control - Brushless excitation systems - Starting methods - Principles of vector control – Introduction to PSIM.

Text Books
References
## ADDITIONAL NEW SUBJECTS

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<tr>
<td>EE356</td>
<td>Electric Drives and Control Laboratory</td>
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<tr>
<td>EE357</td>
<td>Power Systems and Power Electronics Simulation Lab</td>
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</table>
EE245 ELECTRIC CIRCUITS

Credits 3:1:0

Unit I: Introduction

Unit II Ac Circuits
Introduction to time varying and alternating quantities-Average and RMS (effective) values-Form Factor- Phasor Relationships for circuit elements-Steady state using Phasor algebra – Analysis using Kirchoff’s laws – Power triangle – Power factor.

Unit III Mesh and Nodal Analysis
Loop analysis – mesh equations for circuits with independent current sources-mesh equations for circuits with dependent sources –Nodal Analysis: Node equations for circuits with independent voltage sources-node equation for circuits with dependent sources.

Unit IV Network Theorems
Superposition theorem-Source transformation-Thevenin’s and Norton’s theorem – Maximum Power transfer theorem.

Unit V: Resonance

Text Books

References

EE246 NETWORK THEORY

Credits 3:1:0
Prerequisite: Electric Circuits

Unit I: Three Phase Circuits
Phase sequence-line and phase quantities-phasor diagram – Balanced and unbalanced Wye, Delta loads-Analysis of balanced load-Analysis of unbalanced load – Neutral shift

**Unit II: Magnetically Coupled Circuits**
Mutual inductance – Co-efficient of coupling – Dot convention-analysis of coupled circuits, Ideal transformer, Ideal auto transformer – Analysis of single tuned and double tuned circuits

**Unit III: Network Transients**

**Unit IV: Two Port Network, Filters and Attenuators**
Two port network parameters-interconnection of two port networks: series, parallel and cascade – T and π equivalent networks - Low pass filter, Band pass filter, Band stop filter – Constant K and m-derived filter – attenuators - T and π type, lattice attenuator

**Unit V: Network Synthesis**
Reliability concept – Hurwitz property – positive realness – properties of positive real functions- Synthesis of RL, RC and LC driving point impedance functions using simple canonical networks – Foster and Cauer forms.

**Text Books**

**References**

**EE247 ELECTRON DEVICES**

**Credits 3:1:0**

**Unit I: P-N Junction Diode**
V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clamping, Diode
switching times, PN junction diode ratings. Breakdown phenomena in diodes - Zener diodes. Metal - semiconductor junction - Schottky barrier diodes.

**Unit II: Bipolar Junction Transistor (Bjt)**
Physical behaviour of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings. Introduction to photo transistors.

**Unit III: Junction Field Effect Transistor (Jfet)**
JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, Voltage variable resistor and an amplifier.

**Unit IV: Metal Oxide Semiconductor Field Effect Transistor (Mosfet)**
Constructional details - Operation of Enhancement and Depletion type MOSFETs , V-I characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier. Introduction to CMOS devices.

**Unit V: Integrated Circuit (Ic) Fabrication**
Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication - need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, CMOS technology. Monolithic IC Resistors: sheet resistance - Diffused, Ion implanted, Epitaxial, pinch, MOS and thin film resistors, Monolithic IC capacitors - Junction, MOS and thin film capacitors, IC packaging, Micro-electronic circuit layout.

**Text Books**

**References**
EE248 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Unit I: General Principles

Unit II: Electrostatic Fields

Unit III: Magnetostatic Fields

Unit IV: Electromagnetic fields

Unit V: Electromagnetic Waves
Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines – Skin effect.-Power and the Poynting Vector.

Text Books

References
EE249 ELECTRONIC CIRCUITS

Credits 3:1:0

Pre requisite: Electron Devices

Unit I: Power Supplies
Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor, Filters – Inductor, Capacitor, L type and \( \pi \) type, Ripple Factor and Regulation, Need for voltage regulators – Series and Shunt regulators, Comparison, Current limiting and protection circuits – Introduction to Switched Mode Power Supplies

Unit II Wave Shaping
Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping–Clipping and clamping circuits, clamping circuit theorem and applications, Attenuator and compensated attenuator. Introduction to pulse transformers and applications.

Unit III Voltage Amplifiers
BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, Analysis at low, medium and high frequencies BIFET amplifiers, DC amplifiers – Problems in DC Amplifiers, Differential and Common mode gain, CMRR, Cascade and Darlington Amplifiers. Chopper Amplifiers.

Unit IV Power Amplifiers and Feedback Amplifiers
Power amplifiers– Classification, Class A/B/C, Single ended and Push-pull Configuration, Power dissipation and output power, Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation. Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth, Voltage and current feedback circuits.

Unit V: Oscillators and Multivibrators

Textbooks

References

EE250 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Unit I: Dc Generators
Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit II: Dc Motors
Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne’s test – Separation of losses, Hopkinson’s test.

Unit III: Transformers
Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams - Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency

Unit IV Test on Transformer

Unit V: Three Phase Transformer

Textbooks

References
 EE251 INDUCTION AND SYNCHRONOUS MACHINES

Credits 3:1:0

Pre requisite: DC Machines and Transformers

Unit I: Three-Phase Induction Motors

Unit II Single-Phase Induction Motors

Unit III: Synchronous Generators

Unit IV: Synchronous Motors

Unit V: Two Reaction Theory

Textbooks

References
EE252 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Pre requisite: DC Machines and Transformers
Induction and Synchronous Machines

Unit I: General Aspects
Major considerations – Limitations - Main dimension- Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth -Total MMF calculation - Leakage reactance, Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension.

Unit II: Dc Machines
Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III: Transformers
Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers- Design of tanks and cooling tubes.

Unit IV: Three Phase Induction Machines
Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient. No-load current calculation - Stator and rotor resistance - Losses and efficiency

Unit V: Synchronous Machines

Text Books

References
EE253 GENERATION ,TRANSMISSION AND DISTRIBUTION

Credits 3:1:0

Unit I: Power Generation

Unit II: Power Transmission Systems

Unit III: Line Insulators
Types - Potential distribution over a string of suspension insulators - Methods of increasing string efficiency. Corona – Factors affecting corona - Stress and Sag Calculation – Effect of wind and ice - supports at different levels – Stringing chart.

Unit IV: Underground Cables
Types - Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle - Breakdown voltage - Optimum cable length -Comparison between Overhead lines and Underground cables.

Unit V: Distribution Systems
Feeders, Distributors and Service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, A.C. single phase and three phase distribution systems.

Text Books

References
EE254 POWER ELECTRONICS

Credits 3:0:0

Unit I: Power Semiconductor Devices
Introduction - Power Diodes - Power Transistors - Power MOSFETs - IGBTs - Thyristor family: SCRs, Triacs, GTOs and IGCT - Static and Dynamic characteristics - Protection circuits - Series and parallel connections, MCT.

Unit II: Ac to Dc Converters
Diode rectifiers: Single phase and Three phase diode bridge rectifiers with R, RL and RLE load - Estimation of average load voltage and average load current - Free wheeling diode, Controlled rectifiers: Single phase and three phase half wave Thyristor converters. Estimation of average load voltage and average load current - Single phase Half controlled and Fully Controlled Thyristor Bridge Converters - Estimation of average load voltage and load current for continuous current operation - Input power factor estimation for ripple free load current - Three phase Half and Fully Controlled Thyristor Converters (no analysis) - Dual Converters.

Unit III: Ac to Ac and Dc to Dc Converters

Unit IV: Dc to Ac Converters

Unit V: Control Circuits & Applications
Functional requirements of the switching control circuits - Generation of control signals for single phase AC to DC converters - Cosine wave crossing control, Ramp comparator approach. Generation of timing pulses for DC choppers - PWM techniques for DC to AC converters - Introduction to power converter control using Microprocessors, Microcontrollers and DSP-Applications: Motor drive applications: DC Motor Drives using Phase Controlled Thyristor Converters and DC Choppers - AC voltage controller and inverter fed induction motor drives - UPS - HVDC systems - Tap changing of Transformers.

Text Books
References

EE255 POWER SYSTEM ANALYSIS

Credits 3:1:0

Pre requisite: Generation, Transmission and Distribution

Unit I: Introduction
Need for System analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - Short circuits analysis for fault on machine terminals.

Unit II: Network Formulation & Modelling, Short Circuit Studies

Unit III: Load Flow Studies
Formulation of load flow problem - bus classification – Solution by Gauss - Seidal, Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow.

Unit IV: Economical Operation of Generating Stations
Optimal operation of generators – Economical scheduling of thermal plant with and without transmission losses – Loss formula derivation- Unit commitment - Elementary idea of optimal load scheduling of Hydro - Thermal plants.

Unit V: Stability Studies
Steady state and Transient stability - Swing equation and its solution by Modified Euler and Runge-Kutta methods - Equal area criterion - Factors affecting stability and methods of improving stability- Causes of voltage instability – voltage stability proximity indices for two-bus system

Text Books

References

EE256 POWER SYSTEM PROTECTION AND SWITCHGEARS

Credits 3:0:0

Pre requisite: Power System Analysis

Unit I: Introduction
Principles and need for protective schemes – Nature and cause of faults – types of fault – per unit representation - Analysis of Symmetrical fault – Current limiting reactors. CTs and PTs and their applications in their protection schemes.

Unit II: Protective Relays & Apparatus & Line Protection
Definition - Requirement of relays - Universal torque equation - Non directional and directional over current relays – Earth fault relays - Distance relays - Impedance, Mho and Reactance relays - Differential relays - Negative sequence relays - Pilot (Translay) relay - Carrier and Microwave pilot relays – Under frequency relays - Introduction to static relays - Microprocessor and computer based protective relaying.

Unit III: Circuit Breakers
Functions of switchgear - Elementary principles of arc extinction - Arc control devices - Recovery voltage and reststriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers.

Unit IV: Surge and Surge Protection
Switching surges - Lightning phenomenon – Traveling waves on transmission lines - Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers.

Unit V: Earthing and Insulation Co-Ordination
Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers – Earth wires - Earthing of appliances- Insulation co-ordination: Definition - Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules.

Text Books
References

EE257 DIGITAL ELECTRONICS

Credits 3:1:0

Unit I: Number Systems, Boolean Algebra

Unit II: Digital Logic Families
Characteristics of Digital ICs – Voltage and current ratings, Noise margin, Propagation delay, Power dissipation. TTL logic family – Totem pole, Open collector and tri-state outputs, Wired output operations, LS, ALS and Fast sub families. MOS transistor switches – NMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. Multiplexers – High speed CMOS (74HC, 74HCT, 74AHC, 74AHCT logic sub-families) and ECL logic families – Comparison of performance of various logic families. Interfacing TTL and CMOS devices.

Unit III: Combinational Logic Design

Unit IV: Sequential Devices & Design of Sequential Circuit

Unit V: Programmable Logic Devices & Vhdl
instantiation – Concurrent statements-Sequentail statements- Behavioral, Dataflow and Structural modeling-Simple VHDL codes.

Text Books

References

EE258 LINEAR INTEGRATED CIRCUITS
Credits 3:1:0
Pre requisite: EE247 Electron Devices

Unit I: Operational Amplifier Characteristics
Functional Block Diagram – Symbol, Characteristics of an Ideal Operational Amplifier, Circuit schematic of μA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response characteristics – stability, limitations, frequency compensation, slew rate. Transfer characteristics.

Unit II: Linear Applications of Operational Amplifiers

Unit III: Non Linear Applications of Operational Amplifiers:

Unit IV: IC Voltage Regulators & Special Function ICS:
Block diagram of 723 General purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting , Fixed and adjustable three terminal regulators, Switching regulators- SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs, PLL Functional Block
diagram – Principle of operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications: Frequency synthesis, AM and FM detection, FSK demodulator, Motor speed control.

Unit V: A-D and D-A Converters
Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Parallel types – DAC/ADC performance characteristics.

Text Books

References

EE259 CONTROL SYSTEMS

Credits 3:1:0

Unit I: Introduction
Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Transfer function of DC Generator, DC servomotor, AC servomotor and Synchros , Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs – Mason’ gain formula.

Unit II: Time Response Analysis

Unit III: Frequency Response Analysis
Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.

Unit IV: Stability of Systems
Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient

**Unit V: State Variable Analysis**
Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms. Transfer function from state space representation.

**Text Books**

**References**

### EE260 DIGITAL SIGNAL PROCESSING

**Credits 3:1:0**

**Pre requisite: Signals and Systems**

**Unit I: Discrete-Time Signals and Systems**

**Unit II: Discrete Transforms**

**Unit III: Design of Digital Filters**

**Unit IV: Finite Word Length Effects**
Finite word length effects in IIR and FIR filters – A/D quantization noise – Co-efficient quantization – overflow errors – Product round off errors-limit cycle due to product round off errors – Finite word length effects in FFT implementation.

**Unit V: General-Purpose Digital Signal Processors**

**Text Books**

**References**

**EE261 C++ AND DATA STRUCTURES**

**Credits 3:0:0**

**Unit I: Introduction to Data Structures**
Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue, Trees

**Unit II: Sorting and Searching Techniques**
Sorting, Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort. Searching, Binary Tree Search, Linear Search, Binary Search.

**Unit III: Objects and Classes**
A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

**Unit IV: Operator Overloading**
Overloading Unary and Binary Operator, data conversion, and Pitfalls, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, new and delete operator, pointers to pointer.

**Unit V: Virtual Functions**
Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

**Text Books**

**References**

**EE262 MEASUREMENTS AND INSTRUMENTATION**

**Credits 3:0:0**

**Unit I: Standards and Indicating Instruments**

**Unit II: Measurement of Power and Energy**

**Unit III: Measurement of R-L-C**

**Unit IV: Measurement of Non-Electrical Quantities**

**Unit V: Electronic Laboratory Instruments**
signal and function generators. Harmonic distortion analyzer. Strip chart and X-Y
recorders, Field Bus Instrumentation.

Text Book
1. Sawhney A.K., “A Course in Electrical & Electronic Measurement and
   Instrumentation”, Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition,
   2007.

References
   Hall India Private Limited, New Delhi, 2007.

EE263 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Unit I: Architecture & Programming of 8085 Microprocessor:
Functional Block Diagram – Registers, ALU, Bus systems – Timing and control signals-
Programming of 8085: Instruction formats – Addressing modes – Instruction set – Need
for Assembly language – Development of Assembly language programs – Machine
cycles and Timing diagrams

Unit II: Memory & I/O Interfacing
Interface requirements – Address space partitioning – Buffering of Buses – Timing
constraints – Memory control signals – Read and write cycles – Typical EPROM and
RAM Interfacing- I/O Interfacing: Memory mapped I/O scheme – I/O mapped I/O
scheme – Input and Output cycles – Simple I/O ports – Programmable peripheral
interface (8255). Data transfer schemes – Interfacing simple keyboards and LED displays.

Unit III: Interrupts and Dma
Interrupt feature – Need for interrupts - Characteristics of Interrupts – Types of Interrupts
– Interrupt structure – Methods of servicing interrupts - Development of Interrupt
service subroutines – Multiple interrupt requests and their handling – Need for Direct
Memory Access – Devices for handling DMA – Typical DMA Controller features.

Unit IV: Applications
Multiplexed seven segment LED Display systems – Stepper motor control –
Measurement of frequency, phase angle and power factor – Interfacing ADC0801 A/D

Unit V: Intel 8051 Microcontroller
Architecture – Memory Organization – Addressing modes – Instruction set – Boolean
processing – Simple programs - 8051 Peripherals : Interrupt structure – Timer, Serial

Text Books

References
2. The MCS – 80 / 85 Family User’s Manual, INTEL Corporation, USA.

EE264 MOBILE COMMUNICATION

Credits 4:0:0

Unit I: Wireless Transmission

Unit II: Telecommunication Systems

Unit III: Broadcast Systems

Unit IV: Wireless Atm
Motivation, Working group, WATM services, reference model, functions, radio access layer, handover, location management, addressing, quality of service, access point control protocol - Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, AD-HOC networks

Unit V: Mobile Transport Layer
Traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast retransmission/ fast recovery, selective retransmission, transaction oriented TCP - Support for Mobility: File systems, World Wide Web, Wireless application protocol

Text Books
References


EE265 BIOMEDICAL INSTRUMENTATION

Credits 4:0:0

Unit I: Electrophysiology and Biopotential Recorders

Unit II: Measurement and Physiological Parameters

Unit III: Therapeutic and Surgical Equipments

Unit IV: Biomedical Equipments and Patient Safety

Unit V: Imaging Systems and Telemetry

Text Books

References
EE266 VLSI DESIGN

Credits 4:0:0

Unit I: Introduction to Mos Technology

Unit II: Layout Design

Unit III: Design of System

Unit IV: Tools for Design

Unit V: Cmos Design Projects & Fast Vlsi Circuits
Incremental/Decremental – Left/Right – Serial/Parallel shift register – Comparator – GaAs device – Layout design for GaAs devices.

Text Books

References

EE267 EMBEDDED SYSTEM

Credits 4:0:0

Unit I: Introduction to Embedded Systems

Unit II: Real Time Systems

Unit III: Real Time Operating Systems

Unit IV: Programming Languages and Tools

Unit V: Programming Concepts and Embedded Programming In C And C++
Software programming in Assembly Language and in High level language – C Program Elements – Queues – Stacks – lists and ordered lists – Embedded programming in C++.

Text Books

References

EE268 OPERATING SYSTEMS

Credits 3:0:0

Unit I: Introduction
Advanced OS - Distributed OS – Multiprocessor OS – Database operating system – Real time OS.

Unit II: Memory Management

Unit III: Process Management

Unit IV: Device and File Management

Unit V: Case Studies:

Text Books

References

EE269 COMPUTER COMMUNICATION

Unit I: Introduction
Unit II: Local Area Networks

Unit III: Data Communication Techniques
Asynchronous and synchronous communication – BISYNC, SDLC, HDLC – X.2.5 protocols – Error control coding.

Unit IV: Inter – Networking

Unit V: Broadband Networks

Text Books

References

EE270 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Unit I: Review of Virtual Instrumentation
Historical perspective, advantages, Block diagram and Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II: Vi Programming Techniques
VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit III: Data Acquisition Basics
ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts, DMA, software and hardware installation.

Unit IV: Common Instrument Interfaces
Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., Networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing. Motion control.

Unit V: Use of Analysis Tools
Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields.

Textbooks

Reference

EE271 HIGH VOLTAGE ENGINEERING

Credits 3:0:0

Unit I: Ionization and Decay Process
Introduction- Ionization process- Types of ionization - Electron collision - Photo ionization - Thermal ionization - Electron detachment and recombination - Mobility of gaseous ions and Decay by diffusion - Cathode process.

Unit II: Electric Breakdown in Gases, Solids and Liquids

Unit III: Generation of High Voltage and High Currents
Generation of high DC voltages - Cockroft - Walton voltage multiplier circuit - Electrostatic generator - Vande groaf generator - Generation of high AC voltages, Transformers in cascade - Construction of Impulse generator - Generation of Impulse voltages and currents - Tripping and control of Impulse generators.

Unit IV: Measurement of High Voltages and Currents & Non Destructive Testing of Materials and Electrical Apparatus
Measurement of high DC voltages - Measurement of High AC voltages - Electrostatic voltmeters - Impulse voltage measurements using voltage dividers - Measurement of High DC, AC and Impulse currents - Surge test oscilloscope-Destructive Testing Of
Materials And Electrical Apparatus: Measurement of resistivity - High voltage dielectric loss measurement - Schering bridge - Measurement of large capacitance - Inductively coupled ratio - Arm bridge- Loss measurement on complete equipment - Discharge measurement - Recurrent surge generator.

Unit V: High Voltage Testing

Text Books

Reference Books
Asynchronous Data transfer – Modes of transfer – Direct memory access – I/O processor.

**Unit V: Introduction to Parallel Processing**
Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.

**Textbooks**

**References**

EE273 ELECTRIC DRIVES AND CONTROL
Credit 3: 0: 0
Pre requisite: EE245 Power Electronics, EE250 DC Machines and Transformers, EE251 Induction and Synchronous Machines

**Unit I: Introduction to Electric Drives**
History and development of Electric Drives, Classification of Electric Drives, Basic elements & advantages of variable speed drives- Joint Speed-Torque characteristics of various types of loads and drive motors- Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation-Load Equalization.

**Unit II: Dc Drives**

**Unit III: Three Phase Induction Motor Drives**
Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives.

**Unit IV: Drives for Special Machines**
Speed control of 3 phase Synchronous Motors - True synchronous and self controlled modes of operations - DC servo drives principle of operation AC servo drives principle
of operation - Principle and control of Stepper motor and Switched Reluctance Motor drives.

Unit V: Digital Control and Drive Applications

Text Books

References

EE274 POWER SYSTEM STABILITY

Credits 3:1:0

Unit I: Introduction to Stability
Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II: Steady State Stability

Unit III: Transient Stability

Unit IV: Improving Transient Stability

Unit V: Computer Applications
EE275 POWER SYSTEM CONTROL

Credits 4:0:0

Unit I: Introduction
Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops -Real power and Reactive Power improvement methods.

Unit II: Real Power and Frequency Control
Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – Steady state instabilities.

Unit III: Reactive Power and Voltage Control
Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

Unit IV: Computer Control of Power System

Unit V: Economic Dispatch Control
Incremental cost curve – co-ordination equations with loss and without losses - Solution by iteration method. (No derivation of loss coefficients). Base point and participation factors - Economic controller added to LFC control.

Text Books


References

References

EE276 MATERIAL SCIENCE

Credits 3:0:0

Unit I: Crystallography, Metals and Alloys
Crystallography: Crystal systems, Lattice parameters, Bravais lattice, packing factors of cubic and HCP crystal systems, Miller indices. Linear and planar density of atoms, Debye – Scherrer method of crystal structure. Crystal imperfections-points, line and surface defects and their role in electrical, mechanical and optical properties of materials.


Unit II: Semi-Conducting Materials and Devices
Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors-Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski’s technique and zone refining technique, Hall effect – Hall coefficient in extrinsic semiconductors, experimental determination of hall coefficient, Application of hall effect, Semiconductor devices – LDR, LED, photodiode, Solar cells and LCD.

Unit III: Dielectric Materials and Devices
Qualitative study of various polarization, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – BaTiO3 and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism, Classification of insulating materials on temperature basis.

Unit IV: Magnetic Materials and Devices
Ferro and Ferri magnetic materials – properties, Helesenberg and domain theory of ferromagnetism, Hysteresis ferrite- structure and properties, Applications – floppy disks, CD ROM, Magnetic optical recording.
Unit V: Advanced Materials
Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys-Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors, Metallic glasses – preparation, properties, applications.

Textbooks

References

EE277 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY
Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time

EE278 C++ AND DATA STRUCTURES LABORATORY
Credits 0:0:2

12 Experiments will be notified by the HOD from time to time

EE279 ELECTRONIC CIRCUITS LABORATORY
Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time.

EE280 LINEAR AND DIGITAL IC LABORATORY
Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time.

EE 281 DC MACHINES AND TRANSFORMERS LABORATORY
Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.
EE282 AC MACHINES AND CONTROLS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 283 POWER ELECTRONICS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 284 COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 285 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 286 CIRCUITS AND DEVICES LAB

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 287 LINEAR ICS AND MEASUREMENTS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 288 ELECTRICAL WORKSHOP PRACTICE

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 289 ELECTRONIC CIRCUITS AND DIGITAL LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.
EE 290 DESIGN LABORATORY
Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE 291 DIGITAL SIGNAL PROCESSING LABORATORY
Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE 292 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY
Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE 293 ILLUMINATION ENGINEERING
Credits 4:0:0

Pre requisite: Basic Electrical Engineering

Unit I: Language of Light & Lighting
Eye & vision, Light & Lighting, Light & Vision, Light & Color, Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

Unit II: Accessories

Unit III: Calculation and Measurement
Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro -photometry, photocells.

Unit IV: Interior Lighting
Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theaters and Hospitals.

Unit V: Exterior Lighting
Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

Text Books
References

EE294 AUTOMOTIVE ELECTRONICS

Credits 4:0:0

Pre Requisites: Basic Electrical Engineering
Basic Electronics

Unit I: Sensors and Actuators
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System

Unit III: Electronic Fuel Injection and Ignition Systems
Introduction. Feed back carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories

Unit V: Digital Control Systems
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Exhaust emission control engineering. Advanced suspension, electronically controlled electric power steering, 4-wheel steering and electronically controlled electric brakes.

Text Books

References
2. James D. Halderman and Chase D. Mitchell “Diagnosis and Troubleshooting of Automotive
EE 295 NETWORK ANALYSIS AND SYNTHESIS

Credits 3:1:0

Unit I: S-Domain Analysis
S-domain network -driving point and transfer impedances and their properties -transform network analysis -poles and zeros of network functions -time response from pole-zero plots.

Unit II: Frequency Domain Analysis
Amplitude and Phase Characteristics from pole zero plot - Responses due to exponential and sinusoidal sources - Magnitude and phase plots for RL & RC networks - Complex Loci for RL & RC and RLC networks - Plots based on s-plane phasors.

Unit III: Network Topology
Network graph, Tree, incidence matrix – fundamental cut-sets and fundamental loops -tie set and cut-set schedules -v-shift and I-shift - Formulation of equilibrium equation on loop basis and node basis, Formulation of equilibrium equation in matrix form - Duality, Construction of a dual of a network.

Unit IV: Two-Port Networks & Filters
Characterization of two-port networks in terms of z, y, h and T, g and inverse T -parameters -Relations between network parameters - Network Equivalents -Analysis of T, π, ladder, bridged- T and lattice networks -Transfer function of terminated two-port networks.
Filters and attenuators -Design of constant -k, m-derived and composite filters
Design of symmetrical and asymmetrical attenuators (T and π)

Unit V: Elements of Network Synthesis

Text Book

References

EE296 ELECTRICAL ENGINEERING

Credit: 3:1:0

Unit I: Electric Circuits

Unit II: Circuit Theorems and Resonance

Unit III: Electrical Machines

Unit IV: Light & Lighting
Eye & Vision, Light & Lighting, Light & Vision, Light & Color, Basic Concepts and Units, Quantity and Quality of Lighting- Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps, lasers, neon signs, LED-LCD displays, Luminaries, wiring, switching & control circuits.

Unit V: Wiring Circuits, Instruments and Power Conditioning Equipments

References
EE328 POWER SEMICONDUCTOR DEVICES
Credit :4:0:0

Unit I: Introduction
Status of Development of power semiconductor Devices - Types of static switches -
Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance -
Use of heat sinks - Switching losses. Power Diodes: Types - Electrical rating - Switching
and steady state characteristics - switching aid circuits - Series and parallel operation -
Schotky diodes - Fast recovery diodes.

Unit II: Thyristors
Physics of device operation - Electrical rating - Switching and steady state characteristics
- Gate circuit requirements - Protection - Series and parallel operation - Driver circuit
- Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - light fired
Thyristor - switching losses.

Unit III: Special Types of Thyristors
TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics -
Protection - Gate circuit requirements - Turn ON and Turn OFF methods – Series, Parallel
operation of GTO Thyristors.

Unit IV: Power Transistors & Power Mosfets
Types - Ratings - Static and switching characteristics - Driver circuit - Switching aid
Circuit - Power Darlington. Power MOSFETS: Types - Comparison with BJTs - Structure
- Principle of operation - Switching losses - Driver circuit - Switching aid circuit.

Unit V: Igbts & Emerging Devices
Comparison with power BJT and MOSFET - Structure, Principle of working - Switching
characteristics - Gate drive requirements. Emerging Devices: SITs-characteristics - Power
Integrated circuit - Characteristics - Field Controlled Thyristors - New semiconductor
materials for devices - Intelligent power modules.

References
Components”, ELBS Oxford University Press, London, 1992
4. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”,

EE329 POWER ELECTRONICS – I
Credit :3:1:0

Unit I : Single Phase Controlled Rectifiers
Half controlled and Fully controlled thyristor bridge converters -R, RL and RLE loads -
Continuous and discontinuous current operations- Evaluation of performance
parameters-Harmonics, ripple and input power factor.
Unit II: Three Phase Controlled Rectifiers
Half controlled and Fully controlled thyristor bridge converters - R, RL and RLE loads - Continuous and discontinuous current operations - Evaluation of performance parameters - Harmonics, ripple and input power factor.

Unit III: Performance
Effects of source inductance - Power factor improvement techniques - twelve pulse converters - Dual converters - Design of converter circuits.

Unit IV: Inverters
Single phase and three phase bridge inverters with R, RL and RLE loads - Voltage control - Harmonic reduction - Rectifier mode of operation - Current source inverters - Inverter Circuit Design.

Unit V: Resonant Pulse Converters
Series and parallel resonant inverters - Zero current and Zero voltage switching resonant converters - Two quadrant zero voltage switching resonant converters - Resonant dc link inverters

References:

EE330 POWER ELECTRONICS – II

Credit: 3:1:0

Unit I: Dc Choppers
Step down DC Chopper with R, RL and RLE loads - Control strategies - Continuous and discontinuous current operations.

Unit II: Dc Choppers
Two quadrant and Four-quadrant DC Chopper - Multiphase DC Chopper - Switching Mode Regulators: Buck, Boost, Buck-Boost and Cuk regulators - Chopper circuit design.

Unit III: Ac Voltage Controllers
Principles of on-off control and phase control - Single-phase half and full wave controller with R, RL and RLE loads - Three phase half wave and full wave controllers.

Unit IV: Ac Voltage Controllers
Single-phase transformer tap changers - AC voltage controllers with PWM control (AC chopper) - Design of ac voltage controller circuits - Effects of source inductance.
Unit V: Cyclo Converters
Principle of operation - Envelope and phase controlled Cyclo converters - Single phase and three phase versions - Circulating current and circulating current free mode of operation - Effect of source inductance - Advantages and disadvantages of Cyclo converters.

References

EE331 LINEAR SYSTEMS

Credit :3:1:0

Unit I: State Space Analysis
Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.

Unit II: Decomposition Methods
Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III: State Space Representation for Discrete System
State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations. Eigen Values And Eigen Vectors: Characteristic equation, Eigen values, Eigen vectors - Invariance of Eigen values - Diagonalization - Jordan canonical form.

Unit IV: Concepts of Controllability and Observability
Kalman’s and Gilbert's - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability. State Estimators: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators

Unit V: Liapunov Stability Analysis

References

EE332 SOLID STATE DC DRIVES

Credit :3:1:0

Unit I: Review of Conventional Dc Drives

Unit II: Converter Control of Dc Motors

Unit III: Chopper Control of Dc Motors
Analysis of series and separately excited DC motors fed from Single Quadrant Choppers – Evaluation of Performance Parameters – Two Quadrant and Four Quadrant Chopper controlled Drives.

Unit IV: Design of Converter Fed Dc Drives

Unit V: Intelligent Controllers for Dc Drive

References

EE333 SOLID STATE AC DRIVES

Credit :3:1:0

Unit I: Induction Motor: Stator Voltage Control
Adjustable speed drives – Torque-Slip characteristics - Operation with different types of loads – Performance – Equivalent circuit of IM, Closed loop speed control & Speed
reversal – NEMA classification & Design of SQIM – Load characteristics – Transient Stability – Choice of drives - Comparison of different AC power controllers – Production of Stator Flux (RMF).

Unit II: Induction Motor: Stator Frequency Control
Operation of Induction Motor with non- sinusoidal supply waveforms – Air gap MMF harmonics – Harmonic behavior of IM – Constant volt and variable frequency operation of 3-phase Induction Motors - Constant flux operation - Current fed operations – Constant torque, constant power, high speed motoring – Stator current control - Dynamic and regenerative braking of CSI and VSI fed drives - Principle of vector control.

Unit III: Induction Motor: Rotor Resistance Control & Slip Power Recovery Schemes

Unit IV: Synchronous Motor Drives
Introduction – Control of Synchronous Motors on Fixed Frequency and Variable Frequency Supply – Voltage Source Inverter (VSI) fed Drive – Cycloconverter fed Drive – Load Commutated Thyristor Inverter fed Drive – Current Source Inverter (CSI) fed Drive.

Unit V: Permanent Magnet Ac Motor Drives (Pmac) & Applications Of Ac Drives

References
EE334 ADVANCED DIGITAL SIGNAL PROCESSING

Credit :4:0:0

Unit I: Review of Discrete Time Systems

Unit II: Discrete Fourier Transform

Unit III: Digital Filter Design Techniques

Unit IV: Finite Register Length Effects
Introduction - Effects of coefficient on Quantization –Quantization in Sampling - Analog Signals - Finite Register Length effects in realizations of Digital Filters - discrete Fourier Transform Computations.

Unit V: Introduction to Digital Signal Processors
Commercial DSP devices – TMS C240 processor and ADSP 2181 processor – Architecture – Addressing modes – Program control – Instruction and programming – Simple programs.

References
EE335 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credit :3:1:0

Unit I: Introduction
Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSpice, MATLAB and SIMULINK. Mathematical Modelling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of Power Electronic systems.

Unit II: PSpice
File formats - Description of circuit elements - Circuit description - Output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT and Power S-Functions - Converting S-Functions to blocks.

Unit III: Matlab and Simulink

Unit IV: Introduction to Psim

Unit V: Simulation Using Pspice, Psim, Matlab and Simulink
Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

References
EE336 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credit :3:1:0

Unit I: Introduction
High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II: Converter Control
Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III: Wind Energy Conversion System
Basic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV: Hvdc Systems
Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: Facts
Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.

References

EE337 NEURO-FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credit :4:0:0

Unit I: Introduction to Neural Network
Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks- Single layer, multiple layer-Feed forward, feedback networks; Back propagation -Learning and training -Hopfield network.
Unit II: Neuro Controller
Neural network for non-linear systems - Schemes of Neuro control - System identification forward model and inverse model - Indirect learning neural network control applications.

Unit III: Introduction to Fuzzy Logic
Fuzzy sets - Fuzzy operation - Fuzzy arithmetic - Fuzzy relations - Fuzzy relational equations - Fuzzy measure - Fuzzy functions - Approximate reasoning - Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV: Fuzzy Controller

Unit V: Applications to Electric Drives

References

EE38 GENERALISED THEORY OF ELECTRICAL MACHINES

Credit : 3:1:0

Unit I: Generalised Theory
Conversions - Basic two pole machines - Transformer with movable secondary - Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II: Linear Transformations
Invariance of Power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes - Transformed impedance matrix - Torque calculations.

Unit III: Dc Machines
Generalized Representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.

**Unit IV: Ac Machines**

**Unit V: Special Machines**

**References**

EE340 ADVANCED ELECTRIC DRIVES AND CONTROLS

Credit : 3:1:0

Unit I: Introduction
Need for advanced controls - Principle factor affecting the choice of drive – Parameter identification techniques for electric motors – Electromagnetic compatibility of electric drives – Different options for an adjustable speed electric drive – Simulation of electrical drives – Advanced control strategies for electrical drives – DSP based control of electric drives.

Unit II: Dsp Controllers and Instruction Set

Unit III: Pwm Inverter Control

Unit IV: Space Vector Modulation

Unit V: Neural Network and Fuzzy Controllers

References

EE341 SPECIAL MACHINES AND CONTROLLERS

Credit : 4:0:0

Unit I: Stepper Motors
Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.

Unit II: Switched Reluctance Motors
Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive Concept.

Unit III: Permanent Magnet Brushless Dc Motors
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV: Permanent Magnet Synchronous Motors
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Unit V: Servomotors & Linear Motors

References

EE342 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credit :4:0:0

Unit I: Introduction
Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

Unit II: Photovoltaic Energy Conversion
Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking, DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem – Applications

Unit III: Wind Energy Conversion (Wec)

Unit IV: Self-Excited & Grid Connected Wecs

Unit V: Stand Alone Power Supply Systems
Wind/solar PV integrated systems - Optimization of system components - storage - Reliability evolution.

References
EE33 EMBEDDED CONTROLLER APPLICATIONS IN POWER ELECTRONICS

Credit: 3:1:0

Unit I: Review of Microprocessors
Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other interfacing ICs.

Unit II: Microprocessor Based Firing Scheme for Converters
Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable voltage and frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, PWM Techniques.

Unit III: Applications in Drives
Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various types of controllers using microprocessors.

Unit IV: Applications of Power Electronics
Static excitation of synchronous generators, Solid State tap-changers for transformers, UPS systems, Induction furnace control.

Unit V: Arm Processor

References

EE344 HVDC TRANSMISSION

Credit: 4:0:0

Unit I: Dc Power Transmission Technology
Unit II: Analysis of Hvdc Converters
Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60 degree – With overlap greater than 60 degree – Complete characteristics of rectifier and Operation of Inverter.

Unit III: Converter and Hvdc System Control
Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV: Misoperation of Converters & Protection

Unit V: Harmonics and Filters

References

EE345 ADVANCED TOPICS IN POWER ELECTRONICS

Credit :4:0:0

Unit I: Resonant Converters
Zero voltage and Zero current switching- Classification of Resonant converters- Basic Resonant circuit concepts-Load resonant converters-Resonant switch converters- Zero voltage switching, clamped voltage topologies- Resonant DC link inverters and Zero voltage switching- High frequency link integral half cycle converters- Application in SMPS and lighting.

Unit II: Improved Utility Interface
Generation of current harmonics- Current harmonics and power factor- Harmonics standards and recommended practices- Need for improved utility interface- Improved single phase utility interface-Improved three phase utility interface- Electromagnetic interference.

Unit III: Facts and Custom Power
Introduction-principles of reactive power control in load and transmission line compensation-Series and shunt reactive power compensation- Concepts of flexible AC
transmission system (FACTS)- Static Var Compensator (SVC)- Thyristor Controlled Reactor-Thyristor Switched Capacitor. Solid state power control- Static condensers- Controllable series compensation- Thyristor controlled phase angle regulator and unified power flow control

**Unit IV: Facts – Analysis & Protection**
Modelling and methods of analysis of SVC and FACTS controllers- System control and protection- Harmonics and filters- Simulation and study of SVC and FACTS under dynamic conditions.

**Unit V: Emerging Devices and Circuits**
Power Junction Field Effect Transistors- Field Controlled Thyristors- JFET based devices VS other power devices- MOS controlled Thyristors-Power Integrated Circuits-New semiconductor materials for power devices.

**References**

**EE346 OPTIMIZATION TECHNIQUES**

**Unit I: Introduction to Optimization**

**Unit II: Linear Programming**
Linear programming definition – Pivotal reduction of general system of equation – Simplex algorithms – Two phases of the simplex method – Revised simplex method – Duality in linear programming.

**Unit III: Nonlinear Programming (One Dimensional)**

**Unit IV: Nonlinear Programming (Unconstrained Optimization)**

Unit V: Special Techniques

References

EE347 VIRTUAL INSTRUMENTATION SYSTEMS
Credit :3:1:0

Unit I: Introduction

Unit II: Software Overview

Unit III: Programming Structure
FOR loops, WHILE loop, CASE structure, formula node, Sequence structures – Array and Clusters – Array operations – Bundle – Bundle/Unbundle by name, graphs and charts – String and file I/O – High level and Low level file I/Os – Attribute modes Local and Global variables.

Unit IV: Hardware Aspects
Installing hardware, installing drivers – Configuring the hardware – Addressing the hardware in LabVIEW – Digital and Analog I/O function – Data Acquisition – Buffered I/O – Real time Data Acquisition.

Unit V: Labview Applications
Motion Control: General Applications – Feedback devices, Motor Drives – Machine vision – LabVIEW IMAQ vision – Machine vision Techniques – Configuration of IMAQ.
References
   Delhi, 2000.

EE348 ROBOTICS AND FACTORY AUTOMATION

Credit : 4:0:0

Unit I: Fundamentals Concepts of Robotics
History, Present status and future trends in Robotics and automation – Laws of Robotics –
resolution, repeatability and accuracy of a manipulator – Robotics applications.

Unit II: Robot Drives and Power Transmission Systems
Robot drive mechanisms, hydraulic – electric – servomotor – stepper motor – pneumatic
drives, Mechanical transmission method – Gear transmission, belt drives, cables, Roller
chains, Link – Rod systems – Rotary –to-Rotary motion conversion, Rotary-to-Linear
conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors –
Types.

Unit III: Sensors
Sensor characteristics, Position sensors – Potentiometers – Encoders – Resolvers –
LVDT, Velocity sensors – Tacho generators – Encoders – Proximity sensors, Limit
for Robotics: Robot vision systems, image capture – cameras – vidicon and solid state,
Image representation – Gray scale and colour images, image sampling and quantization –
Image processing and analysis – Image data reduction – Segmentation – Feature
extraction – Object Recognition – Image capturing and communication – JPEG, MPEGs
and H.26x standards, packet video, error concealment – Image texture analysis.

Unit IV: Transformations and Kinematics
Homogeneous coordinates – Coordinate reference frames – Homogeneous
transformations for the manipulator – The forward and inverse problem of manipulator
kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D-H
matrices – Controller architecture.

Unit V: Plc & Factory Automation
Building blocks of automation, Controllers – PLC –Role of PLC in FA – Architecture of
PLC – Advantages – Types of PLC – Types of Programming – Simple process control
programs using Relay Ladder Logic and Boolean logic methods – PLC arithmetic
functions. Factory Automation: Flexible Manufacturing Systems concept – Automatic

References

EE349 MICROCONTROLLERS AND APPLICATIONS

Credit :4:0:0

Unit I: Intel 8051
Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area- Addressing modes- Instruction set- Programming examples. Interrupt structure- Timer modules- Serial features- Port structure- Power saving modes- MCS51 family features:8031/8051/8751.

Unit II: Motorola 68hc11
Controller features – Different modes of operation and memory map – Functions of I/O Ports in single chip and expanded multiplex model – Timer System. Input Capture, Output compare and pulsed accumulator features of 68HC11 – Serial peripheral and serial communications interface – Analog to digital conversion features – Watchdog feature.

Unit III: Pic Microcontrollers

Unit IV: Features Of Pic

Unit V: Typical Applications

References

EE350 COMPUTER NUMERICAL CONTROL

Credit :4:0:0

Unit I: Numerical Control

Unit II: Types of Cnc Machines

Unit III: Input Output Units
Keyboard, Tape reader, Hand held terminals, PC interfacing, Display devices and Ethernet communication. Drive Units: Axis drive arrangements, ball screw, timing belts and couplings, AC & DC servomotors, Stepper motors, Hydraulic Servo, AC permanent magnet synchronous motor for spindle drives Characteristics and drive schemes for these motors.

Unit IV: Feedback Elements
Absolute and incremental encoders, Resolvers, linear optical encoders, Proximity switches, limit switches – Transducer placement measuring schemes using these feedback devices. Control Units: Functions of CNC, system hardware, Contouring control – Digital differential analyzer, Linear and circular interpolation, software development process, Open architecture systems.

Unit V: Programmable Logic Controllers
Hardware, programming techniques, Ladder logic programming of PLCs using basic functions – Timers and counters – Advanced programming with control and arithmetic instructions. Role of PLC in CNC machines. Microprocessor in CNC machines, Sensors for Adaptive Control of CNC machine tools. New developments in CNC technology.

References
EE31 EMBEDDED SYSTEMS

Credit :4:0:0

Unit I: Introduction
Introduction to embedded systems – hardware and software components – Types – Examples – Characteristics – Challenges in Embedded computing system design – Embedded system design processes.

Unit II: Architecture of Embedded System

Unit III: Os for Embedded Systems

Unit IV: Performances Issues of an Embedded System
CPU performance – CPU Power Consumption – Analysis and Optimization of CPU Power Consumption program execution time – Analysis and optimization of energy and power – Analysis of program size – Hardware accelerators.

Unit V: Design Examples
Personal Digital Assistants – Set Top Boxes – Ink Jet Printers – Telephone PBX.

References

EE32 SCADA AND DCS

Credit :4:0:0

Unit I: Introduction
Unit II: Supervisory Control and Data Acquisition

Unit III: Communication Protocols of Scada

Unit IV: Distributed Control Systems

Unit V: Applications of Scada & Dcs
Applications of SCADA & DCS – Case studies of Process plants using SCADA & DCS – Advanced features / options in SCADA & DCS – Role of PLC in DCS and SCADA – Comparison – field devices (Transducers, drives etc) in DCS/SCADA.

References

EE353 POWER QUALITY MANAGEMENT
Credit :3:1:0

Unit I: Introduction

Unit II: Short & Long Interruptions

Unit III: Voltage Sag & Transients

Unit IV: Waveform Distortion, Wiring & Grounding

Unit V: Power Quality Solutions
Introduction – Power quality monitoring: Evolution, Deregulation effect – Brief introduction to power quality measurement equipment and power conditioning equipments – Planning, Conducting and Analyzing power quality survey.

References

EE354 FLEXIBLE AC TRANSMISSION SYSTEMS
Credit :4:0:0

Unit I : Introduction
FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

Unit II : Series Compensation Schemes
Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional ASC, NGH damping schemes, Modelling and control of Thyristor controlled series compensators.

Unit III: Unified Power Flow Control (Upfc)
Unit IV: Design Of Facts Controllers
Introduction to VSC, Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, variable structure resistor control.

Unit V: Modern Facts Devices
Basic concepts, Centre Node Unified Power Flow Controller (C-UPFC), Fault Current Controller (FCC), Interlined Power Flow Controller (IPFC), location of FACTS.

References

EE355 POWER ELECTRONICS LABORATORY
Credit :0:0:2
12 Experiments will be notified by the HOD from time to time.

EE356 ELECTRIC DRIVES AND CONTROL LABORATORY
Credit :0:0:2
12 Experiments will be notified by the HOD from time to time.

EE357 POWER SYSTEMS AND POWER ELECTRONICS SIMULATION LABORATORY
Credit :0:0:2
12 Experiments will be notified by the HOD from time to time.
## ADDITIONAL SUBJECTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject Name</th>
<th>Credit</th>
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<tbody>
<tr>
<td>09EE101</td>
<td>Basic Electrical Engineering</td>
<td>3:0:0</td>
</tr>
<tr>
<td>09EE201</td>
<td>Electronic Circuits</td>
<td>3:1:0</td>
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<tr>
<td>09EE202</td>
<td>Digital Electronics</td>
<td>3:1:0</td>
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<tr>
<td>09EE203</td>
<td>Communication Engineering</td>
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<td>09EE204</td>
<td>Special Electrical Machines</td>
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<td>Energy Systems</td>
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<td>Measurements and Computer Aided Electrical Machine Design Lab</td>
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<td>Computer Aided Power Systems Analysis Laboratory</td>
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<td>09EE301</td>
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<td>09EE302</td>
<td>Microprocessor Applications in Power Electronics</td>
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<td>PLC and Automation</td>
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### 09EE101 BASIC ELECTRICAL ENGINEERING

**Credits 3:0:0**

**COURSE OBJECTIVE**
- To impart the basic knowledge about the Electric and Magnetic circuits.
- To inculcate the understanding about the AC fundamentals.
- To understand the working of various Electrical Machines.
- To know about various measuring instruments and house wiring.

**UNIT I: DC CIRCUITS**

UNIT II: MAGNETIC CIRCUITS
Magnetic flux– flux density – reluctance – permeance-magnetic effect of electric circuit-Law of
Electromagnetic induction – induced emf – self and mutual inductance – coupling co-efficient –
inductance in series and parallel, Magnetic Materials.

UNIT III: AC FUNDAMENTALS
Sources of Electrical Energy – Thermal, Hydro and Nuclear power generating station –
Transmission of Electric Power – Introduction to Alternating Quantities – Average and RMS
values – Circuit Elements – Series and Parallel Combinations – Phasor representation –
Introduction to three phase system.

UNIT IV: ELECTRICAL MACHINES
Working principle, operation and application of DC Generator, DC Motor, Transformer, Three
Phase Induction motor ,Single phase Induction motor, Alternator. (Quantitative approach)

UNIT V: MEASURING INSTRUMENTS AND HOUSE WIRING
Wiring materials and accessories – Types of wiring – Fluorescent lamp wiring – stair case wiring – basic principles of earthing – layout for a residential building.

COURSE OUTCOME
After the completion of the course, the student should be able
- To predict the behavior of any electrical and magnetic circuits.
- To identify the type of electrical machine used for that particular application.
- To wire any circuit depending upon the requirement.

TEXT BOOK

REFERENCE BOOK
4. Openshaw Taylor .E, “Utilization of Electrical Energy in SI Units”, Orient Longman limited,
New Delhi, 2007.
Limited, Europe, 1993
09EE201 ELECTRONIC CIRCUITS

Credits 3:1:0
Pre requisite: EE 247 Electron Devices

COURSE OBJECTIVE

• The course is aimed to impart in-depth knowledge of Electronic circuits and its Characteristics
• Introduce about the different types of amplifiers.
• Gives the knowledge about the different wave shaping circuits.

UNIT I: POWER SUPPLIES


UNIT II: WAVE SHAPING

Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping– Clipping and clamping circuits, clamping circuit theorem and applications, Attenuator and compensated attenuator. Introduction to Pulse Transformers and applications.

UNIT III: VOLTAGE AMPLIFIERS


UNIT IV: POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS

Power Amplifiers– Classification, Class A/B/C, Single ended and Push-Pull configuration, Power dissipation and output power, Conversion efficiency, Complementary Symmetry Power Amplifiers, Class AB operation. Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth. Voltage and Current feedback circuits.

UNIT V: OSCILLATORS AND MULTIVIBRATORS


COURSE OUTCOME

On completion of course the students will be able to:
• Design and analyze the various amplifiers characteristics.
• Design the Oscillator circuits for various applications.
• Design the wave shaping circuits required for specific use.
TEXTBOOKS

REFERENCE BOOKS

09EE202 DIGITAL ELECTRONICS
Credits 3:1:0
Pre requisite: EE 247 Electron Devices

COURSE OBJECTIVE
• To introduce the concepts of Boolean algebra,
• To make them familiar with the implementation of combinational logic functions.
• To make them understand about the working of counters and flip flops

UNIT I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA

UNIT II: COMBINATIONAL LOGIC DESIGN

UNIT III: COUNTERS AND REGISTERS

UNIT IV: SEQUENTIAL LOGIC DESIGN
Basic models of sequential machines – concept of state table – state diagram – state reduction through partitioning & implementation of synchronous sequential circuits – Introduction to asynchronous sequential logic design.

UNIT V: PROGRAMMABLE LOGIC DEVICES
LOGIC FAMILIES: RTL, DTL, TTL families, Schottky – clamped TTL, Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL), MOS inverters, CMOS inverters, Comparison of performance of various logic families.

COURSE OUTCOME
On completion of the course, the students will be able to
- Apply Boolean algebra & K –map to digital circuits
- Design combinational and Sequential circuits
- Design the logic families to specific applications.

TEXT BOOKS

REFERENCE BOOKS

09EE203 COMMUNICATION ENGINEERING
Credits 4:0:0
Prerequisite: 09EE202 Electronic Circuits
COURSE OBJECTIVE
- To learn the basic principles, concepts and types of communication systems.
- To understand the various design issues in a communication systems.
- To gain knowledge about optical communication.
- To become familiar with the performance capabilities of present communication systems.

UNIT I: RADIO COMMUNICATION SYSTEMS

UNIT II: PULSE COMMUNICATION SYSTEMS

UNIT III: DATA TRANSMISSION
Base band signal receiver – error probability – optimum and matched filter techniques coherent reception – digital modulation systems – ASK, FSK, PSK – comparison of data transmission systems.

UNIT IV: TRANSMISSION MEDIUM

UNIT V: TELEVISION
Scanning methods – B/W and Colour television systems – Camera and Picture tubes – synchronization – transmitters and receivers.

COURSE OUTCOME
After the completion of the subject, the student will be able to
- Analyze and design basic communication systems, particularly with application to noise-free analog and digital communications,
- Apply concepts and techniques from circuit analysis to communication systems.
- Develop the ability to compare and contrast the strengths and weaknesses of various communication

TEXT BOOKS

REFERENCE BOOKS
09EE204 SPECIAL ELECTRICAL MACHINES

Credits 3:1:0
Pre requisite: EE 250 DC Machines and Transformers
EE 251 Induction and Synchronous Machines

COURSE OBJECTIVE
- Differentiate the constructional features and principle of operation, characteristics of various special machines.
- Devise suitable control techniques for the special machine considered.
- Control of special machines with microprocessor and microcontrollers.

UNIT I: STEPPER MOTOR

UNIT II: SWITCHED RELUCTANCE MOTOR

UNIT III: PERMANENT MAGNET MOTORS

UNIT IV: AC COMMUTATOR MOTORS

UNIT V: LINEAR MOTORS

COURSE OUTCOME
At the completion of the course, the student should be able to
- Select a energy efficient linear or rotary motor based on the characteristics of the load & application
- Incorporate the correct control technique to the machine for efficient operation
- Improve the performance of the motor by enhancing the motor suitably.

TEXT BOOK

REFERENCE BOOKS

**09EE205 ENERGY SYSTEMS**

**Credits 4:0:0**

**COURSE OBJECTIVE**

- To impart knowledge about the various non-conventional energy sources
- To understand about the theory of illumination
- To know the various ways of generating high voltage
- To know about the traction

**UNIT I: SOLAR AND WIND ENERGY SOURCE**

Solar Thermal Systems: Principle of solar thermal power generation

**UNIT II: MISCELLANEOUS ENERGY SOURCE**

Energy From Oceans: Ocean thermal energy conversion systems - Energy from tides
Ocean Waves - MHD Energy Conversions: Magneto Hydro Dynamic (MHD) power generation - Types - Fuel cells - Types - Energy from fusion
Hybrid Systems: Range and type of Hybrid systems - Case studies of Diesel-PV and Wind-PV systems.

**UNIT III: ILLUMINATION, ELECTRIC HEATING & WELDING**


**UNIT IV: ELECTRIC TRACTION**


**UNIT V: GENERATION OF HIGH VOLTAGES AND CURRENTS AND ITS MEASUREMENTS**

Generation of high DC voltage using voltage multiplier circuits – Van de Graff generator – generation of high alternating voltages using cascade transformers – High DC voltage measurement techniques – methods of measurement for power frequency AC voltage – sphere gap measurement technique – use of CRO for impulse voltage and current measurements.
COURSE OUTCOME
After the completion of the subject, the student will be able to
- Identify and develop the best non-conventional energy system for a firm depending upon the needs and availability.
- Develop a better illumination system
- Know the appropriate method of controls of electric traction.

TEXT BOOKS

REFERENCE BOOKS

09EE206 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits 3:1:0

COURSE OBJECTIVE
- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic.

UNIT I: INTRODUCTION TO NEURAL NETWORK

UNIT II: BACK PROPOGATION NETWORKS

UNIT III: HOPFIELD NETWORK
Hopfield nets – Associative memory – Bi-directional associative memories – BAM structure – continuous BAM-adaptive and competitive BAM – applications.
UNIT IV: INTRODUCTION TO FUZZY SYSTEMS

UNIT V: FUZZY LOGIC CONTROL

COURSE OUTCOME
After the completion of the subject, the student will be able to
- Apply the concept of neural network for optimization of any system performance.
- Use an appropriate network for fault diagnosis and pattern recognition
- Apply the concepts of fuzzy logic for parameter identification

TEXT BOOKS

REFERENCE BOOKS

09EE207 ILLUMINATION ENGINEERING
Credits 3:0:0
Pre requisite: EE101/09EE101 Basic Electrical Engineering
COURSE OBJECTIVE
- To understand the illumination in electrical system.
- To discuss various measurements and accessories with illumination.
- To study about interior and exterior lighting.

UNIT I: LANGUAGE OF LIGHT & LIGHTING
Eye & vision, Light & Lighting, Light & Vision, Light & Color, Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

UNIT II: ACCESSORIES
UNIT III: CALCULATION AND MEASUREMENT
Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro-photometry, photocells.

UNIT IV: INTERIOR LIGHTING
Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theatres and Hospitals.

UNIT V: EXTERIOR LIGHTING
Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

COURSE OUTCOME
- Can develop a High Performance Electronics Ballast for Energy Efficient Illumination.
- It also helps to design and develop various overload trip circuit renewable energy sources.
- Select and design an illumination system for a given environment.

TEXT BOOKS

REFERENCE BOOKS

09EE208 AUTOMOTIVE ELECTRONICS
Credits 3:0:0
Pre requisites: EE 101 / 09EE101 Basic Electrical Engineering
EC 104 / 09EC218 Basic Electronics

COURSE OBJECTIVE
- To study the concepts of sensors, actuators, drives.
- To study Electronics Fuel Injection System.
- To study the Lighting system and accessories.
- To study the digital control of starting and braking methods in the automobile system.

UNIT I: SENSORS AND ACTUATORS
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.
UNIT II: STARTING SYSTEM

UNIT III: ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS
Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

UNIT IV: LIGHTING SYSTEM & ACCESSORIES

UNIT V: DIGITAL CONTROL SYSTEMS
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Advanced suspension, electronically controlled electric power steering, electronically controlled electric brakes.

COURSE OUTCOME
During the end of this course, the student would be able,
- To design the digital control of drives using sensors and Digital Control Systems.
- To design the starting and braking system for the automobiles.
- To do research in field of automotive electrical applications.

TEXT BOOK

REFERENCE BOOKS

09EE209 DIGITAL SYSTEM DESIGN
Credits 3:0:0
COURSE OBJECTIVE
- To have a wide knowledge on the programmable logic devices and its programming abilities.
- To be aware of Xilinx and Altera Programming techniques.
• Also to have a clear idea to write the codings for the above mentioned softwares.

UNIT I: PROGRAMMABLE LOGIC DEVICES & FPGA
Basic concepts - Programming techniques - Programmable Logic Element (PLE) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Structure of Standard PLD’s - Design of combination and sequential circuits using PLD’s. Type of FPGA – Xilinx XC3000 Series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) Input/Output Blocks (I/OB) – Programmable Interconnects - CPLD-AlteraMax 7000 Series – Introduction to Actel Act-1 Logic Module – Xilinx XC4000 Series.

UNIT II: SEQUENTIAL LOGIC CIRCUITS
Mealy machine - Moore machine - State diagrams - State table minimization – Incompletely specified sequential machines - State assignments - Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode.

UNIT III: SYMMETRIC FUNCTIONS
Elementary symmetric functions - Partially symmetric and totally symmetric functions – Mc Cluskey de-composition method - Synthesis of symmetric function by contact networks.

UNIT IV: INTRODUCTION TO VHDL

UNIT V: INTRODUCTION TO VERILOG

COURSE OUTCOME
On completion of the course the graduates will be able to:
• Have an understanding on the FPGA and its programming coding such as VERILOG or VHDL
• Know about the sequential logic circuits and the other symmetric functions.
• Knowledge on the programmable logic devices and its programming abilities.

TEXT BOOK

REFERENCE BOOKS
09EE210 GRID COMPUTING

Credits 4:0:0

COURSE OBJECTIVE

- To introduce about the grid computing techniques
- To explain and describe the structure of Grid Computing in Business.
- To make a complete case study of enterprise grid, engine and grid cyper-infrastructure.

UNIT I: INTRODUCTION

A vision of the grid and its promises-Scientific Roots- Business Perspective-WS-Resource Frame Format and its meaning-Virtual Organizations and its security-Open Grid Service Architecture(OGSA) and its overview-Grid Versus Distributed Computing-Grid Versus Web Services-Grid Versus Peer to Peer(P2P)

UNIT II: GRID COMPUTING IN BUSINESS

Grid Taxonomy- Departmental Grids – Enterprise Grids- Open Grids and the Grid Joining the Grid- Strategies for Participation- Building an Enterprise Grid- example-Software Release Engineering on the Grid-Grid Enabling a Solution-Grid Infrastructure Provider-Service Provider on the Grid-example-Grid for Equipment Health Monitoring

UNIT III: TECHNICAL ISSUES


UNIT IV: MANAGEMENT ISSUES


UNIT V: CASE STUDIES:

The MCNC enterprise grid-SUN N1 grid engine-LSF suite-the NEES grid cyper-infrastructure-the globus toolkit 4 service container.

COURSE OUTCOME

On completion of the course the graduates will be able to:

- Acquire knowledge about open grid service architecture.
- Understand about the grid taxonomy , grid infrastructure provider
- Know about the security in grid computing

TEXT BOOK

REFERENCE BOOK

09EE211 NANO COMPUTING

Credits 4:0:0

COURSE OBJECTIVE
- To make the students know about the introduction to nanoelectronics.
- To be aware of the different architecture.
- To be aware of the different Nanosystems.

UNIT I: INTRODUCTION TO NANO ELECTRONICS

UNIT II: BIOCHEMICAL AND QUANTUM-MECHANICAL COMPUTERS

UNIT III: PARALLEL ARCHITECTURES FOR NANOSYSTEMS

UNIT IV: SOFT COMPUTING AND NANAEOELECTRONICS

UNIT V: NANOSYSTEMS AS INFORMATION PROCESSING MACHINES:
Nanosystems as functional machines-information processing as information modifications-system design and its interfaces-requirements of nanosystems. Uncertainties: Removal of Uncertainties by nano machines- Uncertainties in nano systems – Uncertainties in the development of nano electronics.

COURSE OUTCOME
At the end of the course the student will have
- Good knowledge in the basis of Nanotechnology
- Good knowledge on soft computing
- Aware of the development of Nanoelectronics

TEXT BOOK

09EE212 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2

1. Study of Lighting Schemes
2. Study of accessories used in wiring and types of wiring.
3. Exercises in house wiring and power wiring
5. Experiment on the various types of Electrical Machines.
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.
11. Characteristics of PN junction diode and Zener diode.
12. Transducers

09EE213 CIRCUITS AND DEVICES LAB

Credits 0:0:2

1. Verification of Ohms and Kirchhoff’s law.
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

09EE214 DC MACHINES AND TRANSFORMERS LABORATORY

Credits 0:0:2

1. Load characteristics of a separately excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series Motor
6. Speed control of DC Shunt Motor
7. Electric Braking of DC Shunt Motor
8. Swinburne’s Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner’s Test on a Single Phase Transformer.
12. Three Phase Transformer Connections

**09EE215 AC MACHINES AND CONTROLS LABORATORY**

**Credits 0:0:2**

1. Load test on Three Phase Induction Motor
2. No load and blocked rotor tests on Three Phase Induction Motor
3. Speed control of Three Phase Induction Motor
4. Load test on Single Phase Induction Motor
5. Regulation of Alternator by EMF/MMF methods
6. Operation of alternator on Infinite bus bar
7. V and Inverted V curve for Synchronous Motor
9. Transfer function of Separately Excited DC Generator.
10. Transfer function of a) Field controlled DC Motor b) Armature controlled DC Motor.
11. Time & Frequency Response of the System using MATLAB
12. Measurement of Physical Variable with the help of LABVIEW

**09EE216 ELECTRONIC CIRCUITS LABORATORY**

**Credits 0:0:2**

1. BJT Amplifier (CE)
2. JFET Amplifier (CS)
3. Differential Amplifier using BJT
4. Study of Half-Wave & Full-Wave Rectifiers (with and without Filter)
5. Integrator and Differentiator using R and C
6. Voltage Regulator (Series Type)
7. Emitter Follower
8. RC Phase-Shift Oscillator
9. Colpitts Oscillator
10. Astable Multivibrator
11. Bistable Multivibrator
12. Schmitt Trigger Circuit

**09EE217 LINEAR AND DIGITAL IC LABORATORY**

**Credits 0:0:2**

1. Performance characteristics of Op-amp IC
2. Instrumentation amplifier using Op-amp ICs.
3. Maximally flat active filter using Op-amp IC.
4. Precision full wave and half wave rectifier, using Op-amp IC.
5. Wien’s bridge oscillator using Op-amp IC.
6. Astable multivibrator and Schmitt trigger, using Op-amp IC
7. Realization of different flip-flops, using logic gates.
8. Realization of simple switching functions, using NAND or NOR gates.
10. Shift register and Ring counter
11. Multiplexer and Demultiplexer
12. Digital to Analog converter

**09EE218 POWER ELECTRONICS LABORATORY**

Credits: 0:0:2
1. Characteristics of MOSFET, IGBT, SCR and TRIAC
2. Single Phase and Three Phase Diode Bridge Rectifier with R & R – L Load
3. Single Phase Half and Fully Controlled Thyristor Converter with R & R – L Load
4. D.C. Chopper with R & R – L Load
5. Three Phase PWM Inverter with R & R – L Load
7. Three Phase A.C. Voltage Controller with R & R – L Load
8. Single Phase Cycloconverter with R & R – L Load
9. Single Phase Series Inverter with R & R – L Load
10. Simulation of Power Electronic Circuits using MATLAB Simulink
11. Simulation of Power Electronic Circuits using PSPICE
12. Simulation of Power Electronic Circuits using PSIM

**09EE219 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB**

Credits: 0:0:2
1. Measurement of Resistance using Wheatstone and Kelvin’s bridge
2. Measurement of Inductance using Hays and Anderson bridge
3. Measurement of Capacitance using Schering and Maxwell bridge
4. Calibration of voltmeter, Ammeter and Wattmeter
5. Study of Resistive, Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine using AutoCAD
8. Design of Single and Three Phase Transformer using AutoCAD
9. Design of Three phase Induction Motor using AutoCAD
10. Design of Single Phase Induction Motor using AutoCAD
11. Design of Synchronous Machine using AutoCAD
12. Effect of air gap variation on induction machines performance

**09EE220 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY**

Credits: 0:0:2
1. Formation of $Y_{bus}$ Matrix using Direct Inspection Method
2. Formation of $Y_{bus}$ Matrix using Singular Transformation Method
3. Load Flow Analysis by Gauss-Seidel Method
4. Load Flow Analysis by Newton-Raphson Method
5. Automatic Load Frequency Control
6. Simulation of AVR(Automatic Voltage Regulator) using MATLAB-SIMULINK
7. $Z_{bus}$ Formation using building algorithm
8. Analysis of Symmetrical Faults
9. Perform Economic Load Dispatch using MATLAB programming
10. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
11. Harmonic Analysis of simple electrical circuit using MATLAB-SIMULINK
12. Speed Control of DC motor using MATLAB-SIMULINK

09EE301 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION
Credit :4:0:0
COURSE OBJECTIVE
- To understand the concepts of Conventional and Digital Transducers
- To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
- To study the Microprocessor based instrumentation

UNIT I : REVIEW OF CONVENTIONAL TRANSDUCERS

UNIT II : DIGITAL TRANSDUCERS
Direct digital transducers – absolute and incremental displacement transducers – Moiré Fringe transducers – transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

UNIT III : INDUSTRIAL HEATING & PHOTOELECTRIC DEVICES
Industrial Heating using high frequency dielectric heating infrared and ultra violet heating – laser heating. Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

UNIT IV : MICROPROCESSOR BASED INSTRUMENTATION
Detection of zero crossing of an alternating waveform – Microprocessor based triggering of a Thyristor – Microprocessor based AC voltmeter – Microprocessor based AC Ammeter – Microprocessor based Speed monitoring unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring unit – Microprocessor based over and under voltage and over current protection.

UNIT V : SMART TRANSDUCERS

COURSE OUTCOME
During the end of the course the student would be able to
- Select the type of transducer for the Industrial application.
- Help the students to do case studies and mini projects in industries.
- Design the Microprocessor based Controllers.

REFERENCES

09EE302 MICROPROCESSOR APPLICATIONS IN POWER ELECTRONICS

Credit :3:1:0

COURSE OBJECTIVE
For the students to
- Increase the understanding of Microprocessors and the interfacing of various peripherals
- Understand the flexibility of Embedded system in Power Electronic controls,
- Understand the fundamentals of ARM Processor, its internal architecture and features

UNIT I: REVIEW OF MICROPROCESSORS
Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other interfacing ICs.

UNIT II: MICROPROCESSOR BASED FIRING SCHEME FOR CONVERTERS
Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable voltage and frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, PWM Techniques.

UNIT III: MICROPROCESSORS IN CLOSED LOOP CONTROL SCHEMES
Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various types of controllers using microprocessors.

UNIT IV: SPECIAL APPLICATIONS OF POWER ELECTRONICS
Static excitation of synchronous generators, Solid state tap-changers for transformers, UPS systems, Induction furnace control.

UNIT V: ARM PROCESSOR

COURSE OUTCOME
Students will be able to
• Understand the role that power electronics play in the improvement of energy usage efficiency.
• Gain in-depth technical competence in selection of appropriate Microcontrollers and interfaces for solving a particular technical problem
• Design embedded controlled Power electronic converters and drives.

REFERENCES

09EE303 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS
Credits 4:0:0
COURSE OBJECTIVE
For the student to
• Understand the basic architecture, memory and the features of Microprocessors and Microcontrollers
• Understand the concepts of modular programming.
• Understand the detailed architecture and features of Pentium processors,
• Understand the detailed architectures and features of popular RISC and ARM processors.

UNIT I: ADVANCED MICROPROCESSOR ARCHITECTURE
Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addresses –Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions - Arithmetic and Logic Instructions.

UNIT II : MODULAR PROGRAMMING AND ITS CONCEPTS
Modular programming –Using keyboard and Video display –Data Conversions- Disk files- Interrupt hooks - using assembly languages with C/ C++.

UNIT III: PENTIUM PROCESSORS

UNIT IV: 16-BIT MICRO CONTROLLER
interfacing.

UNIT V: RISC PROCESSORS AND ARM

COURSE OUTCOME
Students will able to
- Explore the peripheral features, processing speeds and limitations of popular microcontrollers.
- Handle the design and develop of small scale embedded projects
- Perform programming in both assembly and high-level languages.

REFERENCES

09EE304 PLC AND AUTOMATION
Credit :4:0:0
COURSE OBJECTIVE
- To learn the basics of PLC.
- To study the programming of PLC and HMI systems.
- To study about the DCS.
- To understand the concept of Automation.

UNIT I: PROGRAMMABLE LOGIC CONTROLLERS

UNIT II: PROGRAMMING OF PLC & HMI SYSTEMS
PROGRAMMING OF PLC:
Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - Introduction to advanced programming methods.
HMI systems: Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI)

UNIT III: DISTRIBUTED CONTROL SYSTEMS (DCS)

UNIT IV: APPLICATIONS OF PLC & DCS
Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS

UNIT V: AUTOMATION

COURSE OUTCOME
During the end of the course the student would be able
- To understand the concepts of PLC
- To design controllers for industrial automation systems

REFERENCES
ADDITIONAL SUBJECTS

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10EE201 ELECTRIC CIRCUITS AND NETWORKS

Credit: 3:1:0
Course Objective:

This Course will provide the students to
1. Develop an understanding of the fundamental elements of electric circuits.
2. Develop the ability to apply the basic theorems to analyze a DC and AC electric circuit.
3. Use mathematical methods such as Laplace and Fourier transforms and some linear algebra techniques and differential equations to solve circuits problems
4. Synthesize a network with stable condition.

Course Outcome:
At the end of this course, the student should be able to
1. Analyze simple circuits applying Ohm’s and Kirchhoff’s laws
3. Demonstrate the network parameters of a transmission cable.
4. Design any non linear network, filters and attenuators for an application

Unit I: Circuit Analysis

Unit II: Network Theorems
Superposition, Reciprocity, Substitution, Thevenin, Norton, and Maximum Power Transfer Theorems - Problems

Unit III: Transient Response of Electric Circuits
Unit IV: Coupled Circuits and Three Phase Circuits

Unit V: Two Port Networks and Filters
Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent π and T networks – passive filters as a two port network – characteristics of ideal filter – low pass and high pass filters.

Text Books:

Reference Books

10EE202 DIGITAL SIGNAL PROCESSING

Credits 3:1:0
Course Objective:
This Course will provide the students
1. To have an overview of signals and systems.
2. To study DFT & FFT Transforms.
3. To study the design of IIR filters.
4. To study the design of FIR filters.
5. To study the applications of DSP techniques in processors.

Course Outcomes:
At the end of the course the students will have an understanding on the
1. Different types of digital signals and systems.
2. Different Transforms and its application to signals and systems.
3. Design of IIR & FIR filters.
4. Different DSP processors.

Unit I: Discrete Time Signals and Systems
Need and benefits of Digital Signal Processing – Signal Classification and basic operations on them – Properties of DT system: Linear, Time Invariance, Causal, Stable, Passive and Lossless – LTI system: Convolution Sum- Interconnection Schemes- I/O relationship determination of
impulse response and step response - Anti Aliasing and Anti Imaging Filtering - Typical DSP system: ADC/DAC – sampling, quantization, and encoding.

**Unit II: Discrete Transforms**

**Unit III: Infinite Impulse Response Digital Filters**

**Unit IV: Finite Impulse Response Digital Filters**

**Unit V: General Purpose Signal Processors**

**Text Books:**

**Reference Books:**

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**10EE203 RENEWABLE ENERGY SOURCES**

**Credits: 3:0: 0**

**Course Objectives:**

1. To explain concept of various forms of renewable energy
2. To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
3. To analyse the environmental and cost economics of using renewable energy sources compared to fossil fuels.
Course Outcome:
At the end of the semester the student will

1. Have knowledge about various renewable energy sources
2. Be able to choose the appropriate renewable energy as an alternate for conventional power in any application.
3. Be able to analyze the cost effect of renewable energy sources.

Unit I: Solar Energy
Solar radiation its measurements and prediction - solar thermal flat plate collectors, concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes.

Unit II: Wind Energy

Unit III: Bio-Energy
Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of Biogas Plants- applications

Unit IV: Hydrogen and Fuel Cells
Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types - construction and applications.

Unit V: Other Types of Energy
Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection, and geothermal power plants.

Text Book:

Reference Books:

10EE204 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 4:0:0

Course Objective:
1. To introduce the concept of Micro Electro Mechanical Systems
2. To outline different methods of micromachining, microstructures, micro sensors, and micro actuators
3. To cover various applications of MEMS

Course Outcomes
At the end of the semester the students will be able to
1. Have knowledge about various Micro Electro Mechanical Systems
2. Understand Material Processing and Device Fabrication using which can do Microsystems Design for various applications.
3. Understand the Applications of MEMS in various fields.

Unit I: Introduction To MEMS:
Historical background of Micro Electro Mechanical Systems, role of MEMS in improved efficiency, Smart materials and structures, materials-processing, synthesis, Multifunctional polymers.

Unit II: Material Processing and Device Fabrication:
Lithography, Ion Implantation, Etching, Wafer bonding, Integrated processes, Bulk silicon micro machining, surface micro machining, CVD oxide process.

Unit III: Micro Sensors and Micro actuators:
Micromechanical components – springs, bearings, gears and connectors, High temperature sensors, Capacitive pressure sensor, bulk micro-machined accelerometer, Surface micro machined micro spectrometer.

UNIT IV : Microsystems Design and Packaging
Design considerations, Mechanical Design, Process design, Realization of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

Unit V: Applications of MEMS:

**Text book:**

**Reference Books:**
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

NEW SUBJECTS
### 10EE301 OPTIMIZATION TECHNIQUES

**Credit: 3:1:0**

**Course Objectives:**
- To insist the importance of optimization problems and their applications
- To instruct the steps for formulating optimization problems
- To impart the knowledge of traditional and modern optimization techniques

**Course Outcomes:**
- Students will be able to state the different types of optimization problems, their formulation and solution techniques.
- Students will be able to understand the mechanisms of various traditional and modern optimization techniques
- Students will be able to apply the optimization techniques for practical applications

**Unit I: Introduction to Optimization**

**Unit II: Linear Programming**
Linear programming definition – Pivotal reduction of general system of equations – Simplex algorithms – Two phases of the simplex method – Revised simplex method – Duality in linear programming

**Unit III: Nonlinear Programming (Unconstrained Optimization)**
One dimensional problems-Dichotomous search, Fibonacci method– Multidimensional problems- Univariate method- Simplex method –Steepest descent method – Conjugate gradient method- Quasi Newton methods

**Unit IV: Nonlinear Programming (Constrained Optimization)**

**Unit V: Modern Optimization Techniques**

References

10EE302 POWER CONVERTERS AND ANALYSIS
Credits: 3:1:0

Course Objective:
1. To give in depth knowledge of the various power electronics circuits,
2. Analyze the behavior of the Power Electronic circuits along with their design.

Course Outcome:
After completing the course, the student should be able to:
1. Analyze the circuits and select them for the suitable applications.
2. Understand the problems associated with the Power Electronic circuits.

Unit I: AC to DC Converters

Unit II: DC to DC Converters
DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper – Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit III: AC Phase Converter

Unit IV: DC to AC Converters

**Unit V: Resonant and Soft-Switching Converters**

**References:**

10EE303 SOLID STATE DRIVES AND CONTROL

**Course Objective:**
1. To understand the basic concept of DC and AC Drives.
2. To understand the various control techniques involved with both DC and AC Drives.
3. To brief about the working principle of Special Electrical Drives.

**Course Outcome:**
After taking this course, the student will be able to:
1. Design and Analyze different control techniques of DC Drive
2. Design and Analyze different control techniques of AC Drive
3. Select suitable Special Electrical Drive and apply appropriate control method for the application.

**Unit I: Converter Fed DC Drives**

**Unit II: Chopper Fed DC Drives**

**Unit III: Induction Motor Drives**

**Unit IV: Vector Control, Sensor less and Direct Torque Control of Induction Motors**

**Unit V: Special Drives**

**References:**

**10EE304 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY**

**Credits**: 4:0:0

**Course Objective:**
1. To understand different Electro Magnetic Interference problems and various mitigation techniques.
2. To understand EMI Sources, EMI problems and their solution methods in PCB level / Subsystem and system level design.
3. To understand EMC Design and Standards.

**Course Outcome:**
After completing the course, the student should be able to:
1. Design a compatible system with less interference.
2. Provide solution methods in PCB level / Subsystem and system level design.

**Unit I: EMI Environment**
Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters.

**Unit II: EMI Coupling Principles & EMI Specification / Standards / Limits**
Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field
Cable to Cable Coupling, Power Mains and Power Supply Coupling - Units of specifications, Civilian standards Military standards.

**Unit III: EMI Measurements**

**Unit IV: EMI Control Techniques**
Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

**Unit V: EMC Design of PCBs**

**References:**

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**10EE305 ELECTRIC AND HYBRID VEHICLES**

**Credits:** 3:1:0

**Course Objective:**
1. To understand the concept of Electric Vehicle Technology.
2. To understand various architectures of Hybrid Electric Vehicle (HEV) technology.

**Course Outcomes:**
1. The students will be able to understand the need of Hybrid Vehicles and Electric vehicles.
2. The students will be able to design different types of Architectures in Electric & Hybrid Vehicles.

**Unit I: Electric Vehicles**
Layout of an Electric Vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

**Unit II: Hybrid Vehicles**
Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

**Unit III: Electric Propulsion System and Motor Control system**
DC Motors, AC Motors, Permanent Magnet Motors, Brushless DC and Reluctance Motors, Characteristics, Regenerative Braking, Control System Principles, speed and torque control – DC motors and AC Motors

**Unit IV: Energy Storages & Generators**
Electromechanical batteries – types of batteries – lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra capacitors – DC Generators, AC Generators, Voltage and Frequency regulations.

**Unit V: Fuel Cells & Solar Cars**
Fuel Cell, Construction, Working, Equations, possible fuel sources, fuel reformer, design, solar cars, photovoltaic cells, tracking, efficiency and cost comparison.

**References:**
## ADDITIONAL SUBJECTS

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11EE101 BASIC ELECTRICAL ENGINEERING

Credits 3:0:0

Course Objective:
   i.  To impart the basic knowledge about the Electric and Magnetic circuits.
   ii. To inculcate the understanding about the AC fundamentals.
   iii. To understand the working of various Electrical Machines.
   iv.  To know about various measuring instruments and house wiring.

Unit I: DC Circuits

Unit II: Magnetic Circuits

Unit III: AC Fundamentals

Unit IV: Electrical Machines
Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor, single phase Induction motor, Alternator. (Quantitative approach)

Unit V: Measuring Instruments and House Wiring
Fluorescent lamp wiring – stair case wiring – basic principles of earthing – layout for a residential building.

Course Outcome:
At the end of the course, student would be able to:
   i. Predict the behavior of any electrical and magnetic circuits.
   ii. Identify the type of electrical machine used for that particular application.
   iii. Wire any circuit depending upon the requirement.

Text Book

Reference Books

11EE201 ELECTRIC CIRCUITS

Credits 3:1:0
Course Objective:
   i. To understand the concepts and investigate the behavior of electric circuits by analytical techniques.
   ii. To learn the basic concepts of single phase DC and AC electrical circuits.
   iii. To imbibe the methods of circuit analysis using network theorems.
   iv. To introduce the concepts of AC resonance circuits.

Unit I: Introduction
System of Units-Electrical Quantities-Circuit elements-Independent and Dependent sources-Ohm’s Law-Kirchoff’s Laws-Analysis of circuits using Kirchoff’s law-Circuits with dependent sources –Network reduction, Star-Delta transformation – Introduction to PSPICE.

Unit II: AC Circuits
Introduction to time varying and alternating quantities-Average and RMS (effective) values-Form Factor- Phasor Relationships for circuit elements-Steady state using Phasor algebra – Analysis using Kirchoff’s laws – Power triangle – Power factor.

Unit III: Mesh and Nodal Analysis
Loop analysis – mesh equations for circuits with independent current sources-mesh equations for circuits with dependent sources –Nodal Analysis: Node equations for circuits with independent voltage sources-node equation for circuits with dependent sources.
Unit IV: Network Theorems
Superposition theorem, Source transformation, Thevenin’s theorem, Norton’s theorem, Maximum Power transfer theorem, Reciprocity theorem, Tellegen’s theorem.

Unit V: Resonance

Course Outcome:
At the end of the course, student would be able to:

i. Apply the elementary concept of electric sources, elements and their properties in the circuits.
ii. Calculate the current and voltage in any practical circuits.
iii. Analyze DC and AC circuits using mathematical tools.

Text Books

Reference Books

11EE202 NETWORK THEORY

Credits 3:1:0
Course Objective:

i. To understand the basic concepts of three phase AC electrical circuits.
ii. To examine the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
iii. To know and analyze the concepts of coupled circuits.
iv. To understand the concepts of two port networks and passive filters.

Unit I: Three Phase Circuits

Unit II: Magnetically Coupled Circuits
Mutual inductance – Co-efficient of coupling – Dot convention-analysis of coupled circuits, Ideal transformer, Ideal auto transformer – Analysis of single tuned and double tuned circuits

**Unit III: Network Transients**
Transient Concepts – Singularity functions-Unit step, Unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of complex frequency – Driving point and transfer impedances – Poles and zeros of network function.

**Unit IV: Two Port Network, Filters and Attenuators**
Two port network parameters-interconnection of two port networks: series, parallel and cascade – T and π equivalent networks - Low pass filter, Band pass filter, Band stop filter – Constant K and m-derived filter – attenuators - T and π type, lattice attenuator

**Unit V: Network Synthesis**
Reliability concept – Hurwitz property – positive realness – properties of positive real functions- Synthesis of RL, RC and LC driving point impedance functions using simple canonical networks – Foster and Cauer forms.

**Course Outcome:**
At the end of the course, student would be able to:
- Investigate the behavior of electric networks by analytical techniques.
- Synthesize the networks by different analytical methods.
- Analyze the two port networks, coupled circuits and three phase circuits.

**Text Books**

**Reference Books**

**11EE203 ELECTRONIC DEVICES**

**Credits 3:1:0**

**Course Objective:**
- To study the operation and characteristics of different semiconductor devices.
- To know different methods of fabrication of semiconductor devices in an IC.
- To familiarize the student with the principle of operation, capabilities and
limitation of various electron devices and their applications.

Unit I: P-N Junction diode
V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clamps, Diode Switching times, PN junction diode ratings. Breakdown phenomena in diodes - Zener diodes - Metal semiconductor junction - Schottky barrier diodes.

Unit II: Bipolar Junction Transistor (BJT)
Physical behaviour of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings. Introduction to photo transistors.

Unit III: Junction Field Effect Transistor (JFET)
JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, Voltage variable resistor and an amplifier.

Unit IV: Metal Oxide Semiconductor Field Effect Transistor (MOSFET)
Constructional details - Operation of Enhancement and Depletion type MOSFETs, V-I characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and an amplifier, Introduction to CMOS devices.

Unit V: Integrated Circuit (IC) Fabrication
Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication - need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, CMOS technology. Monolithic IC Resistors: sheet resistance - Diffused, Ion implanted, Epitaxial, pinch, MOS and thin film resistors, Monolithic IC capacitors - Junction, MOS and thin film capacitors, IC packaging, Micro-electronic circuit layout.

Course Outcome:
At the end of the course, the student will be able to
i. Understand the concepts of semiconductor devices
ii. Understand their application in rectifiers, inverters, choppers etc.
iii. Understand the concepts of IC fabrication.

Text Books

Reference Books

11EE204 CIRCUITS AND DEVICES LAB

Credits 0:0:2
1. Verification of Ohms and Kirchhoff’s law.
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

11EE205 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2
1. Study of Lighting Schemes
2. Study of electrical wiring and accessories
3. Exercises in house wiring and power wiring
5. Study of step down transformer
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.
11. Characteristics of PN junction diode and Zener diode.
12. Transducers

11EE206 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Course Objective:
   i. To understand the concepts of coordinate systems.
   ii. To realize the electromagnetic fields, charges and currents.
   iii. To calculate electromagnetic field distribution.
   iv. To impart knowledge on vector fields - electrostatic and magneto static fields, electrodynamics and electromagnetic waves.

Unit I: General Principles

Unit II: Electrostatic Fields

Unit III: Magneto Static Fields

Unit IV: Electromagnetic fields

Unit V: Electromagnetic Waves
Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines –Skin effect-Power and the Poynting Vector.

Course Outcome:
At the end of the course, student would be able to:

i. Develop analog and digital electronic system that takes into account propagation and radiation effects.

ii. Analyze and understand advanced electromagnetic field problems that arise in various branches of engineering.

iii. Design various electromagnetic based equipments.

Text Books


Reference Books


11EE207 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Course Objective:

i. To understand the basic concepts about the DC machines and transformers

ii. To conduct various tests for studying the performance of the machines

iii. To learn about the instrument transformers and power transformers

Unit I: DC Generators

Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit II: DC Motors

Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne’s test – Separation of losses, Hopkinson’s test.

Unit III: Transformers

Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams - Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency.

Unit IV Test on Transformer

**Unit V: Three Phase Transformer**

**Course Outcome:**
At the end of the course, student would be able to:

i. Choose the machines for the specific application based on their characteristics.
ii. Use the instrument transformers efficiently for measurements.
iii. Estimate the various losses taking place in D.C. machines.

**Textbooks**

**Reference Books**

**11EE208 DC MACHINES AND TRANSFORMERS LABORATORY**

**Credits 0:0:2**
1. Load characteristics of a Separately Excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series and compound motor.
6. Speed control of DC Shunt Motor
7. Electric Braking of DC series Motor
8. Swinburne’s Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner’s Test on a Single Phase Transformer.
12. Three Phase Transformer Connections

**11EE209 INDUCTION AND SYNCHRONOUS MACHINES**

**Credits 3:1:0**
Course Objective:
   i. To learn the basic concepts about the different types of induction and synchronous machines
   ii. To understand the speed control and the starter operations
   iii. To acquire knowledge on two reaction theory

Unit I: Three-Phase Induction Motors

Unit II: Single-Phase Induction Motors

Unit III: Synchronous Generators

Unit IV: Synchronous Motors

Unit V: Two Reaction Theory

Course Outcome:
At the end of the course, student would be able to:
   i. Familiarizes with working and characteristics of different machines.
   ii. Implement speed control methods in industry sectors.
   iii. Operate the machines in parallel.

Textbooks

Reference Books

11EE210 AC MACHINES AND CONTROL SYSTEMS LABORATORY

Credits 0:0:2
1. Load test on Three Phase Induction Motor
2. No load and blocked rotor tests on Three Phase Induction Motor
3. Speed control of Three Phase Induction Motor
4. Load test on Single Phase Induction Motor
5. Regulation of Alternator by EMF/ MMF methods
6. Operation of alternator on Infinite bus bar
7. V and Inverted V curve for Synchronous Motor
9. Transfer function of Separately Excited DC Generator.
10. Transfer function of DC Motor.
11. Time & Frequency Response of the System using MATLAB
12. Measurement of Physical Variable with the help of LABVIEW

11EE211 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Course Objective:
  i. To gain the knowledge about the calculation of total MMF in the machine.
  ii. To find out the dimension of various parts of the machine.
  iii. To examine various losses in the machines.
  iv. To understand the usage of auxiliary windings.

Unit I: General Aspects
Major considerations – Limitations - Main dimension- Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth –Total MMF calculation - Leakage reactance, Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension.
Unit II: DC Machines
Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III: Transformers
Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers - Design of tanks and cooling tubes.

Unit IV: Three Phase Induction Machines
Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient. No-load current calculation - Stator and rotor resistance - Losses and efficiency.

Unit V: Synchronous Machines

Course Outcome:
At the end of the course, student would be able to:
  i. Design DC machines
  ii. Design transformers with reduced loss
  iii. Calculate the losses and efficiency in the machines

Text Books

Reference Books

11EE212 POWER ELECTRONICS

Credits: 3:1:0
Course Objective:
  i. To Learn the Static and Dynamic characteristics of Power Semiconductor Devices
  ii. To understand the principles of operation of power electronic converters
  iii. To study the various control strategies of various power converters
  iv. To study the design parameters for control circuitry requirement of various converters.

Unit I: Power Semiconductor Devices
Introduction – Power Diodes – Power Transistors – Power MOSFETs – IGBTs – Thyristor family: SCRs, Triacs, GTOs and IGCT – Static and Dynamic characteristics – Protection circuits – Series and parallel connections, MCT.

Unit II: AC to DC Converters

Unit III: AC to AC and DC to DC Converters

Unit IV: DC to AC Converters

Unit V: Control Circuits & Applications

Course Outcome:
At the end of the Course the student would be able to:
- use electronics and solid-state power devices for the control, conversion, and protection of electrical energy
- design switching using power semiconductor devices
- apply control techniques to meet desired switching objectives
- Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
- Select components, interpret terminal characteristics of the components for designing the circuitry for power converters.
Text Books:

Reference Books:

11EE213 POWER ELECTRONICS & DRIVES LABORATORY

Credits: 0:0:2
2. Single Phase Semi & Full Converter Bridge on R & R – L Load
3. MOSFET based DC Chopper on R & R – L Load
4. Single Phase AC Voltage Controller with R & R – L Load
5. Three Phase AC Voltage Controller with R & R – L Load
6. Single Phase Inverter with R & R – L Load
7. Single Phase Cyclo-converter with R & R – L Load
8. Simulation of Power Converters using PSIM
9. Simulation of Power Converters using MATLAB
10. Single Phase Rectifier fed DC Drive
11. Three Phase Inverter fed Induction Motor Drive
12. Testing of UPS and SMPS

11EE214 ELECTRIC DRIVES AND CONTROL

Credits: 3:0:0
Pre requisites: 11EE212 Power Electronics
11EE207 DC Machines and Transformers
11EE209 Induction and Synchronous Machines

Course Objective:
1. To understand the classification and characteristics of Drives
2. To analyze the various types and operations of DC Drives
3. To analyze the various types and operations of Induction Motor Drives
4. To study the operations of Synchronous Motor Drives, Servo Motor, Stepper Motor and Switched Reluctance Motor.

Unit I: Introduction to Electric Drives
History and development of Electric Drives, Classification of Electric Drives, Basic elements & advantages of variable speed drives- Joint Speed-Torque characteristics of various types of loads and drive motors- Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation-Load Equalization.

Unit II: DC Drives

Unit III: Three Phase Induction Motor Drives
Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives.

Unit IV: Drives for Special Machines
Speed control of 3 phase Synchronous Motors - True synchronous and self controlled modes of operations - DC servo drives principle of operation - AC servo drives principle of operation - Principle and control of Stepper motor and Switched Reluctance Motor drives.

Unit V: Digital Control and Drive Applications

Course Outcome:
At the end of the Course the student would be able to:
  i. Understand the dynamics of electrical drive systems.
  ii. Select suitable converters and their controls for drive applications.
  iii. Use MATLAB/SIMULINK in simulating and designing of controllers for electrical drive systems.

Text Books:

Reference Books
11EE215 GENERATION, TRANSMISSION AND DISTRIBUTION

Credits: 3:1:0

Course Objective:
   i. To understand the concepts of various methods of Electrical Energy Generation.
   ii. To learn the usage of passive elements in various Power Transmission Systems.
   iii. To understand the factors affecting Insulators and also in Underground cables.
   iv. To calculate the various parameters in Distribution System.

Unit I: Power Generation

Unit II: Power Transmission Systems

Unit III: Line Insulators
Types - Potential distribution over a string of suspension insulators – Methods of increasing string efficiency: Corona – Factors affecting corona – Stress and Sag Calculation – Effect of wind and ice – supports at different levels – Stringing chart.

Unit IV: Underground Cables

Unit V: Distribution Systems
Feeders, Distributors and Service mains – Radial and ring main systems – Calculation of voltage in distributors with concentrated and distributed loads – A.C. single phase and three phase distribution systems.

Course Outcome:
At the end of the Course the student would be able to:

i. Analyze the performance of various Units involved in the power plants.

ii. Apply power system fundamentals to the design of a system that meet specific needs.

iii. Design a power system solution based on the problem requirements and realistic Constraints.

iv. Develop a major design experience in power a system that prepares them for engineering practice.

Text Books:

References Books:

11EE216 POWER SYSTEM ANALYSIS

Credits: 3:1:0

Course Objectives:

i. To learn the fundamentals of power system for designing a system that meets specific need.

ii. To analyze the phasor techniques in the analysis of power systems.

iii. To know the necessity of load flow in a regulated system.

iv. To examine the need of various analysis like fault analysis, short circuit analysis stability analysis, steady state and transient analysis.

Unit I: Introduction
Need for System analysis in planning and operation of power system – One line diagram – Per Unit representation – Symmetrical components – Short circuits analysis for fault on machine terminals.

Unit II: Network Formulation & Modeling, Short Circuit Studies

Unit III: Load Flow Studies

**Unit IV: Economical Operation of Generating Stations**

**Unit V: Stability Studies**

**Course Outcome:**
At the end of the Course the student would be able to:

i. apply the load flow application to various power system problems like minimization of transmission line losses, minimization of the total fuel cost etc.,

ii. analyze the economic dispatch problem in thermal power plant

iii. design a power system solution based on the problem requirements and realistic constraint

**Text Books:**

**Reference Books**
Credits: 0:0:2
1. Formation of $Y_{bus}$ Matrix using Direct Inspection Method
2. Formation of $Y_{bus}$ Matrix using Singular Transformation Method
3. Load Flow Analysis by Gauss-Seidel Method
4. Load Flow Analysis by Newton-Raphson Method
5. Load Flow Analysis by FDLF Method
6. Automatic Load Frequency Control
7. Simulation of AVR(Automatic Voltage Regulator) using MATLAB-SIMULINK
8. $Z_{bus}$ Formation using building algorithm
9. Analysis of Symmetrical Faults
10. Perform Economic Load Dispatch using MATLAB programming
11. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
12. Harmonic Analysis of simple electrical circuit using MATLAB - SIMULINK

11EE218 POWER SYSTEM PROTECTION AND SWITCHGEARS
Credits: 4:0:0
Course Objective:
- To understand the principle of protective schemes and various faults in the Power System Scenario.
- To examine protection of power system with various protection relays.
- To study the various types of the circuit breakers, the arc quenching phenomena and the protection against over voltages.

Unit I: Introduction

Unit II: Protective Relays, Apparatus & Line Protection

Unit III: Circuit Breakers
Functions of switchgear - Elementary principles of arc extinction - Arc control devices - Recovery voltage and restriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers.

Unit IV: Surge and Surge Protection
Switching surges - Lightning phenomenon – Traveling waves on transmission lines - Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers.

**Unit V: Earthing and Insulation Co-Ordination**
Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers – Earth wires - Earthing of appliances- Insulation co-ordination: Definition - Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules.

**Course Outcome:**
At the end of the Course the student would be able to:

i. Design the relevant protection systems for the main elements of a power system.

ii. Analyze with over current, differential, and ratio protection devices and their application in a coordinated protection scheme.

iii. Do the stability problems and clearing of faults to mitigate these problems.

**Text Books:**

**Reference Books**

**11EE219 CONTROL SYSTEMS**

**Credits 3:1:0**

**Course Objective**

i. To understand the methods of representation of systems and getting their transfer function models.

ii. To impart adequate knowledge in the time response of systems and steady state error analysis.

iii. To give basic knowledge is obtaining the open loop and closed–loop frequency responses of systems.

iv. To understand the concept of stability of control system and methods of stability analysis.

**Unit I: Introduction**
Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical
network, Thermal and hydraulic systems. Transfer function of DC Generator, DC servomotor, AC servomotor and Synchros, Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs –Mason’ gain formula.

**Unit II: Time Response Analysis**

**Unit III: Frequency Response Analysis**
Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.

**Unit IV: Stability of Systems**

**Unit V: State Variable Analysis**
Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms. Transfer function from state space representation.

**Course Outcome:**
At the end of the course, student would be able to:
- Have a sound knowledge in the basic concepts of control theory
- Design closed loop system projects.
- Work out the practical problems by using state variable analysis.

**Text Books**

**Reference Books**
11EE220 LINEAR INTEGRATED CIRCUITS

Credits 3:1:0

Course Objective:
   i. To obtain knowledge on Op-Amp characteristics
   ii. To study linear and non-linear applications as an amplifier
   iii. To study various IC voltage regulators.

Unit I: Operational Amplifier Characteristics
Functional Block Diagram – Symbol, Characteristics of an Ideal Operational Amplifier, Circuit schematic of µA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques, Frequency response characteristics – stability, limitations, frequency compensation, slew rate, Transfer characteristics.

Unit II: Linear Applications of Operational Amplifiers

Unit III: Non Linear Applications of Operational Amplifiers

Unit IV: IC Voltage Regulators & Special Function ICS:
Block diagram of 723 General purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting , Fixed and adjustable three terminal regulators, Switching regulators- SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs.

Unit V: A-D and D-A Converters & PLL
Course Outcome:
At the end of the course, the student will be able to:
   i. Understand the concepts of operational amplifiers.
   ii. Design various converters using Op-Amp.
   iii. Fundamentals of analysis and design of analog integrated circuits.

Text Books

Reference Books

11EE221 MICROPROCESSORS AND MICROCONTROLLERS

Credits: 3:1:0
Course Objective:
   i. To study the basics microprocessors and microcontrollers
   ii. To know the various applications
   iii. To analyze the interfacing with the external device using 8051

Unit I: Microprocessor and Applications

Unit II: Architecture Of 8051

Unit III: Instruction Set and Programming
Assembling and running an 8051 program – Instruction set of 8051 – Data transfer instructions – Different addressing modes – Arithmetic Instructions – Signed number concepts and arithmetic operations – Logic and Compare instructions – Rotate instruction and data serialization – BCD,
ASCII – Loop and jump instructions – Call instructions – Time delay routines – Program control – Assembler directives – Sample programs.

Unit IV: I/O, Timer, Interrupt and Serial Programming

Unit V: Interfacing External Device With 8051
8051 interfacing to external memory – 8051 interfacing with the 8255 – (Programs are to be written in Assembly for the following interfacing applications) Relays and opto isolators – Sensors interfacing and signal conditioning – Parallel ADC and Serial ADC interfacing – DAC interfacing - Keyboard interfacing – Seven segment and LCD display interfacing – Stepper Motor interfacing – DC motor interfacing and PWM - RTC Interfacing.

Course Outcome:
At the end of the course, the student will be able to:
  i. Implement of projects applying various processors.
  ii. To write coding using any of these microcontrollers.
  iii. Interface the processor to external devices.

Text Books:

Reference Books

11EE222 MICROPROCESSOR AND MICROCONTROLLER LABORATORY
Credits: 0:0:2
1. Programs for 8/16 Bit Arithmetic Operations using 8085.
2. Programs for Sorting and Searching using 8085.
5. Microprocessor based Stepper Motor control.
7. Programming using Arithmetic, Logical and Bit Manipulation Instructions of 8051 Microcontroller.
8. Interfacing ADC with Microcontroller.
10. LCD Display interface with 8051.

11EE223  C++ AND DATA STRUCTURES

Credits 4:0:0

Course Objective:
   i. To study the basics of C++ programming
   ii. To know various programming methods in C++
   iii. To know the various applications using programming language

Unit I: Objects and Classes
A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

Unit II: Operator Overloading
Overloading Unary and Binary Operator, data conversion, and Pitfalls, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, new and delete operator, pointers to pointer.

Unit III: Virtual Functions
Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

Unit IV: Introduction to Data Structures
Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue, Trees

Unit V: Sorting and Searching Techniques
Sorting, Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort. Searching, Binary Tree Search, Linear Search, Binary Search.

Course Outcome:
At the end of the course, the student will be able to:
   i. Understand the fundamental concepts of C++ programming
   ii. Apply programming skills for various applications including electrical applications.
   iii. To have analytical ability by quick programming.
Text Books

Reference Books

11EE224 C++ AND DATA STRUCTURES LABORATORY
Credits: 0:0:2
1. Basics of C++ Programming
2. Implementation of Classes and Objects
3. Implementation of Constructor and Destructor
4. Implementation of Overloading
5. Implementation of Inheritance
6. Illustration on Pointers
7. Implementation of Abstract Class and Virtual Functions
8. Implementation of Class Template
9. Implementation of Stack and Queue
10. Implementation of Linked List
11. Implementation of Searching Techniques
12. Implementation of Sorting Techniques

11EE225 MEASUREMENTS AND INSTRUMENTATION
Credits 4:0:0
Course Objective:
1. To develop an understanding of the characteristics of experimental measurements. These include concepts such as uncertainty, the dynamic limitations of physical instruments.
2. To become familiar with the operation and characteristics of several experimental tools including oscilloscope, data acquisition systems and spectrum analyzers.
3. To gain knowledge of some of basic measuring measurements including temperature, pressure, energy and power.

Unit I: Standards and Indicating Instruments
moving coil Instruments, Torque equations and errors. Extension of ranges, use of shunts and Instrument Transformers.

**Unit II: Measurement of Power and Energy**

**Unit III: Measurement of R-L-C**

**Unit IV: Measurement of Non-Electrical Quantities**

**Unit V: Electronic Laboratory Instruments**

**Course Outcome:**
At the end of the course, student would be able to:

i. Know which instrument is to be used to measure one particular quantity.

ii. Calculate various errors that will occur while using an instrument to measure a quantity and they know how to see to that error.

iii. Operate electronic instruments for parameter measurement.

**Text Book**

**Reference Books**

11EE226 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credits 0:0:2
1. Measurement of Resistance using Wheatstone and Kelvin’s bridge
2. Measurement of Inductance using Hays and Anderson Bridge
3. Measurement of Capacitance using Schering and Maxwell Bridge
4. Calibration of Measuring Instruments
5. Study of Resistive, Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine using AutoCAD
8. Design of Single and Three Phase Transformer using AutoCAD
9. Design of Single Phase & Three phase Induction Motor using AutoCAD
10. Magnetic analysis of Electrical machines
11. Design of Synchronous Machine using AutoCAD
12. Effect of air gap variation on induction machines performance

11EE227 MATERIAL SCIENCE

Credits 3:0:0
Course Objectives:
   i. To gain knowledge on the microstructure, properties, processing and performance of engineering materials and the interrelationships among these qualities.
   ii. To imbibe knowledge on material behavior and properties.
   iii. To understand the mechanical, physical and chemical properties of materials.

Unit I: Crystallography, Metals and Alloys

Unit II: Semi-Conducting Materials and Devices
Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors- Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski’s technique and zone refining technique, Hall effect – Hall coefficient in extrinsic semiconductors, experimental determination of hall
coefficient, Application of hall effect, Semiconductor devices – LDR, LED, photodiode, Solar cells and LCD.

**Unit III: Dielectric Materials and Devices**
Qualitative study of various polarization, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – BaTiO₃ and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism, Classification of insulating materials on temperature basis.

**Unit IV: Magnetic Materials and Devices**
Ferro and Ferri magnetic materials – properties, Helesenberg and domain theory of ferromagnetism, Hysteresis ferrite- structure and properties, Applications – floppy disks, CD ROM, Magnetic optical recording.

**Unit V: Advanced Materials**
Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys- Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors, Metallic glasses – preparation, properties, and applications.

**Course Outcome:**
At the end of the course, student would be able to:
1. Design and conduct experiments to study the microstructure and properties of materials.
2. Identify materials-related problems and formulate plans to solve such problems.
3. Determine failure of materials, and select appropriate material for a given application.

**Textbooks**

**Reference Books**
ii. To give comprehensive introduction of concepts of cellular systems and trunking theory etc
iii. To impart knowledge about different radio propagation models.

Unit I: Wireless Transmission

Unit II: Telecommunication Systems

Unit III: Broadcast Systems

Unit IV: Wireless ATM
Motivation, Working group, WATM services, reference model, functions, radio access layer, handover, location management, addressing, quality of service, access point control protocol - Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, ADHOC networks.

Unit V: Mobile Transport Layer

Course Outcome
At the end of the course, the student will be able to:
   i. Understand the Concepts of Mobile Communication Networks
   ii. Design simple communication network in mobile environment
   iii. Understand fading and multipath channel problems and their solutions.

Text Books

Reference Books

11EE230 BIOMEDICAL INSTRUMENTATION

Credits: 4:0:0

Course Objective
i. To Study various bio potential recorders
ii. To know about the measurement of physiological parameters
iii. To know about various therapeutic and surgical instruments
iv. To know about various Imaging Systems and Telemetry techniques.

Unit I: Electrophysiology and Bio-potential Recorders

Unit II: Measurement and Physiological Parameters

Unit III: Therapeutic and Surgical Equipments

Unit IV: Biomedical Equipments and Patient Safety

Unit V: Imaging Systems and Telemetry

Course Outcome:
At the end of the course, the student will be able to understand:
   i. The concepts of biomedical instrumentation.
   ii. The concepts of therapeutic and surgical instruments
   iii. The concepts of Imaging Systems and Telemetry techniques.

Text Books

Reference Books

11EE230 VLSI DESIGN

Credits 4:0:0
Course Objectives
i. To introduce the concepts of VLSI technology.
ii. To expose the students of design of various VLSI based systems
iii. To give an exposure to the standard algorithms for VLSI Physical design Automation.

Unit I: Introduction to MOS Technology

Unit II: Layout Design

Unit III: Design of System

Unit IV: Tools for Design

Unit V: CMOS Design Projects & Fast VLSI Circuits
Incremental/Decremental – Left/Right – Serial/Parallel shift register – Comparator – GaAs device – Layout design for GaAs devices.

Course Outcome
At the end of the course, the student will be able to:
   i. Understand the concepts of VLSI Design Automation Tools
ii. Understand Placement and Routing Algorithms & Floor Planning Algorithms
iii. Understand Simulation and Logic Synthesis Concepts

Text Books

Reference Books

11EE231 EMBEDDED SYSTEM

Credits 4:0:0
Course Objectives:
   i. To make students aware of Embedded systems
   ii. To learn and understand concepts of RTOS.
   iii. To learn and understand concepts of Embedded Programming.

Unit I: Introduction to Embedded Systems

Unit II: Real Time Systems

Unit III: Real Time Operating Systems
Task and Task States, Tasks and Data, Semaphores and Shared Data Operating System Services Application of Semaphores-Message Queues-Timer Function-Events-Memory Management-Real time Embedded System Operating Systems-Interrupt Routines in RTOS environment.

Unit IV: Embedded Software Development Process, Tools and Testing
Introduction to Embedded Software Development Process and Tools-Host and Target Machines-Linking and Locating Software-Getting Embedded Software into the Target System-Issues in

**Unit V: Design Examples and Case Studies**

**Course Outcome:**
At the end of the course, the student will be able to understand:
  i. Design simple embedded systems.
  ii. Choose effective communication for embedded systems.
  iii. Analyze real-time scheduling algorithms & Identify design flows.

**Text Books**

**Reference Books**

**11EE232 VIRTUAL INSTRUMENTATION**

**Credits 4:0:0**

**Course Objective:**
  i. It provides new concepts towards measurement and automation.
  ii. It imbibes knowledge about how to control an external measuring device by interfacing a computer.
  iii. To become competent in data acquisition and instrument control.

**Unit I: Review of Virtual Instrumentation**
Historical perspective, advantages, Block diagram, Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

**Unit II: VI Programming Techniques**
VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence
structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web

**Unit III: Data Acquisition Basics**
Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses, ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts DMA, software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

**Unit IV: Common Instrument Interfaces**
VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing. Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

**Unit V: Use of Analysis Tools**
Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management, Biomedical, remote testing of instruments, optical engineering, aerospace.

**Course Outcome:**
At the end of the course, the student will be able to
i. Acquire knowledge on how virtual instrumentation can be applied for data-acquisition and instrument control.
ii. Identify salient traits of a virtual instrument and incorporate these traits in their projects.
iii. Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

**Text Books**

**Reference Books**

**11EE233 OPERATING SYSTEMS**
Credits 3:0:0
Course Objective

i. To study the evolution of Operating Systems.
ii. To analyze the concepts of memory management and process management systems.
iii. To understand the procedure of each and every management system and do case study.

Unit I: Introduction

Unit II: Memory Management

Unit III: Process Management
Introduction to processes –Scheduling objectives- Scheduling Criteria- Types of scheduling algorithms – Performance comparison – Inter process communications- Synchronization – Semaphores – Deadlock-Prevention, Recovery, Detection – Avoidance.

Unit IV: Device and File Management

Unit V: Case Studies:

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

i. Understand the concepts of operating systems.
ii. Gain understanding of memory and process management.
iii. To have a better knowledge on different windows versions and its development.

Text Books


Reference Books

11EE234 COMPUTER COMMUNICATION

Credits 3:0:0

Course Objectives:

i. To study the communication networks in computer

ii. To know various data communication techniques.

iii. To know the various applications using network protocols

Unit I: Introduction


Unit II: Local Area Networks


Unit III: Data Communication Techniques

Asynchronous and synchronous communication – BISYNC, SDLC, HDLC – X.2.5 protocols – Error control coding.

Unit IV: Inter – Networking


Unit V: Broadband Networks


Course Outcome:

At the end of the course, the student will be able to:

i. Understand the concepts of Computer Communication

ii. Understand the peripheral connections in a computer.

iii. It also gives broad idea on networking which are available for daily use.
Text Books

References

11EE235 COMPUTER ARCHITECTURE

Credits 3:0:0

Course Objective:
  i. To familiarize students about hardware design and behavior of the various functional modules of the computer
  ii. To understand and evaluate constraints and tradeoffs in microprocessor design
  iii. To highlight the important issues in computer architecture, organization, its performance, design and relation to the system software.

Unit I: Introduction

Unit II: Central Processor Organization
General register organization – Stack organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline.

Unit III: Arithmetic Processing
Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations.

Unit IV: Memory and Input/output Organization
Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache and Virtual memory concepts – Input – Output interface – Asynchronous Data transfer – Modes of transfer – Direct memory access – I/O processor.

Unit V: Introduction to Parallel Processing
Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.
Course Outcome:
At the end of the course, the student will be able to
i. Recognize different types of architectures and the difference between computer architecture and organization.
ii. Know how to design a computer system.
iii. Bridge the software, hardware, and firmware gaps.

Text Books

Reference Books

11EE236 HIGH VOLTAGE ENGINEERING

Credits: 3:0:0
Course Objective:
i. To understand the design principles and critical elements of a high voltage system.
ii. To know about Ionization and Decay Process.
iii. To learn about the electric breakdown in gases, solids and liquids.
iv. To study the generation of high voltage and high current.

Unit I: Ionization and Decay Process
Introduction- Ionization process- Types of ionization - Electron collision - Photo ionization - Thermal ionization - Electron detachment and recombination - Mobility of gaseous ions and Decay by diffusion - Cathode process.

Unit II: Electric Breakdown in Gases, Solids and Liquids
Unit III: Generation of High Voltage and High Currents
Generation of high DC voltages - Cockcroft - Walton voltage multiplier circuit - Electrostatic generator - Vande groaf generator - Generation of high AC voltages, Transformers in cascade - Construction of Impulse generator - Generation of Impulse voltages and currents - Tripping and control of Impulse generators.

Unit IV: Measurement of High Voltages and Currents & Non Destructive Testing of Materials and Electrical Apparatus

Unit V: High Voltage Testing

Course Outcome:
At the end of the Course the student would be able to:
 i. Understand the causes of unnecessary electric breakdown.
 ii. review the breakdown mechanisms in solid, liquid, gaseous and composite dielectrics
 iii. Choose the right surge device to eliminate over voltages for high voltage apparatus.
 iv. Select the right technique to measure different types of high voltages.

Text Books:

References:

11EE236 POWER SYSTEM STABILITY
Credits: 3:1:0
Course Objective:
i. To investigate and understand the stability of power system, with the main focus on stability theories and power system modeling.

ii. To study the steady and transient stability problems.

iii. To examine the power system modeling using simulation tools.

Unit I: Introduction to Stability
Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II: Steady State Stability

Unit III: Transient Stability

Unit IV: Improving Transient Stability

Unit V: Computer Applications

Course Outcome:
At the end of the Course the student would be able to:

i. Analyze the stability problems and clearing of faults by calculating critical clearing times.

ii. Understand the basics of interconnected operations of control areas in a deregulated environment.

iii. Design and calculate the power flow for an N-bus power system using the various simulation methods.

Text Book:

References:

### 11EE238 POWER SYSTEM CONTROL

**Credits: 4:0:0**

**Course Objective:**

i. To explain the performance of supervision and control systems of electric power and describe their main functions.

ii. To acquaint students with the principles of state estimation.

iii. To acquaint students with the problem of system control centre and automatic control.

iv. To acquaint students with the performance of electronic systems of control and equipments of electrical networks

**Unit I: Introduction**

Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops - Real power and Reactive Power improvement methods.

**Unit II: Real Power and Frequency Control**

Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – Steady state instabilities.

**Unit III: Reactive Power and Voltage Control**

Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

**Unit IV: Computer Control of Power System**


**Unit V: Economic Dispatch Control**

Incremental cost curve – co-ordination equations with loss and without losses - Solution by iteration method. (No derivation of loss coefficients). Base point and participation factors - Economic controller added to LFC control.

**Course Outcome:**

At the end of the Course the student would be able to:

i. understand with power system operation, including economic dispatch of generation, frequency and voltage control

ii. analyze the economic dispatch problem in various power plant

iii. Design and introduce new control techniques for power system.
Text Books:

References:

11EE239 ILLUMINATION ENGINEERING

Credits: 4:0:0

Course Objective:
- To design a electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
- To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
- To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Unit I: Language of Light & Lighting
Eye & vision, Light & Lighting, Light & Vision, Light & Color, Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

Unit II: Accessories

Unit III: Calculation and Measurement
Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro -photometry, photocells.

Unit IV: Interior Lighting
Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theaters and Hospitals.

Unit V: Exterior Lighting
Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

Course Outcome:
At the end of the Course the student would be able to:

i. Perform indoor & outdoor lighting design calculations.
ii. Determine appropriate lighting control techniques and equipment to a sample project.
iii. Perform basic lighting energy audit to a sample project.

Text Books:


Reference Books


11EE240 AUTOMOTIVE ELECTRONICS

Credits: 4:0:0

Course Objective:

i. To study the concepts of sensors, actuators, drives.
ii. To study Electronics Fuel Injection System.
iii. To study the Lighting system and accessories.
iv. To study the digital control of starting and braking methods in the automobile system.

Unit I: Sensors and Actuators
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System

Unit III: Electronic Fuel Injection and Ignition Systems
Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories
Unit V: Digital Control Systems
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Exhaust emission control engineering. Advanced suspension, electronically controlled electric power steering, 4-wheel steering and electronically controlled electric brakes.

Course Outcome:
At the end of the Course the student will be able to:
   i. Design the digital control of drives using sensors and Digital Control Systems.
   ii. Design the starting and braking system for the automobiles.
   iii. Understand electronic engine control required for the reduction of emissions.
   iv. Familiarize with hybrid electric vehicle systems and components.

Text Books:

Reference Books:

11EE241 NETWORK ANALYSIS AND SYNTHESIS

Credits 3:1:0
Course Objectives:
   i. To know the concepts and investigate the behavior of electric networks by analytical techniques.
   ii. To learn the network topology of DC circuits.
   iii. To examine the concepts of network synthesis.
   iv. To analyze the concepts of two port networks and passive filters.

Unit I: S-Domain Analysis
S-domain network - driving point and transfer impedances and their properties – transform network analysis - poles and zeros of network functions - time response from pole-zero plots.

Unit II: Frequency Domain Analysis
Amplitude and Phase Characteristics from pole zero plot- Responses due to exponential and sinusoidal sources- Magnitude and phase plots for RL & RC networks- Complex Loci for RL & RC and RLC networks- Plots based on s-plane phasors.

Unit III: Network Topology
Network graph, Tree, incidence matrix – fundamental cut-sets and fundamental loops –tie set and cut-set schedules -v-shift and I-shift - Formulation of equilibrium equation on loop basis and node basis, Formulation of equilibrium equation in matrix form- Duality, Construction of a dual of a network.

Unit IV: Two-Port Networks & Filters
Characterization of two-port networks in terms of z, -y, h-and T, g and inverse T - parameters - Relations between network parameters- Network Equivalents -Analysis of T, π , ladder, bridged-T and lattice networks -Transfer function of terminated two-port networks. Filters and attenuators -Design of constant -k, m-derived and composite filters Design of symmetrical and asymmetrical attenuators (T and π)

Unit V: Elements of Network Synthesis

Course Outcome:
At the end of the course, student would be able to:
  i. Synthesis the networks by different methods.
  ii. Analyze the networks by s-domain and frequency domain.
  iii. Analyze the two port networks.
  iv. Evaluate DC and AC circuits using mathematical tools.

Text Book

Reference Books

11EE242 ENERGY SYSTEMS

Credits: 4:0:0
Course Objectives:
  i. To provide a broad introduction to the area of electric energy systems
  ii. To impart knowledge about the various non conventional energy sources.
iii. To understand concept of illumination systems, heating and welding systems.
iv. To learn the requirements of traction systems.

Unit I: Solar and Wind Energy Source

Unit II: Miscellaneous Energy Source

Unit III: Illumination, Electric Heating & Welding

Unit IV: Electric Traction

Unit V: Generation of High Voltages and Currents and Its Measurements
Generation of high DC voltage uses voltage multiplier circuits – Van de Graff generator – generation of high alternating voltages using cascade transformers – High DC voltage measurement techniques – methods of measurement for power frequency AC voltage – sphere gap measurement technique – use of CRO for impulse voltage and current measurements.

Course Outcome:
At the end of the Course the student would be able to:
   i. Explain the technological basis for harnessing these renewable energy sources including their possibilities and limitations.
   ii. Recognize the effects that current energy systems based on fossil fuels have over the environment and the society.
   iii. Overcome climate change and other sustainable development goals and an insight into the possible solutions to sustainable energy usage.

Text Books:

Reference Books:

11EE243 MICRO ELECTRO MECHANICAL SYSTEMS
Credits: 4:0:0

Course Objectives:
1. To know the concepts in micro electro mechanical systems and understand the various sensors.
2. To gain knowledge on different mechanics of MEMS design
3. To learn about electrostatic actuators.
4. To understand the RF and optical MEMs equipments.

Unit I: Introduction to MEMS
MEMS and Microsystems, miniaturization, Typical products, Micro sensors, micro actuation, MEMS with micro actuators, micro accelerometers, and Micro fluidics, MEMS materials, Micro fabrication.

Unit II: Mechanics for MEMS Design
Elasticity, Stress, strain and material properties, Bending of thin plates, spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics- actuators, force and response time, Fracture and thin film mechanics, material, physical vapour deposition(PVD), chemical mechanical polishing(CMP)

Unit III: Electrostatic Design
Electro statistics-basic theory, electrostatic instability, surface tension, gap and finger pull up, Electrostatic actuators, Comb generators, gap closers, rotary motors, bistable actuators.

Unit IV: Circuit and System Issues
Electronic interfaces, Feedback systems, Noise, Circuit and System issues, Case studies- Capacitive accelerometer, Piezo electric pressure sensor, Thermal sensors, Radiation sensors, mechanical sensors, bio-chemical sensors, Modeling of MEMS systems, CAD for MEMS.

Unit V: Introduction to Optical and RF MEMS
Optical MEMS, system design basics- Gaussian Optics, matrix operations, Resolution, Case
Electrical and Electronics Engineering  

Course Outcome:  
At the end of the course, student would be able to:  
  i. Design micro electro mechanical systems process modules. 
  ii. Model the micro electro mechanical systems. 
  iii. Implement the micro electro mechanical systems and use the various sensors.

Text Book  

References  

11EE244 ADVANCED CONTROL SYSTEMS  
Credit: 3:1:0  
Course Objectives:  
  i. To incite a wide knowledge on the description and stability of non-linear system. 
  ii. To examine the conventional technique of non-linear system analysis. 
  iii. To solve the analysis discrete time systems using conventional techniques. 
  iv. To understand the analysis of digital control system using state-space formulation. 
  v. To look at the formulation and analysis of multi input multi output (MIMO) system. 

Unit I: State Space Analysis Of Continuous Time Systems  
State variable representation – Conversion of state variable form to transfer function and vice versa – Eigen values and Eigenvectors – Solution of State Equation – Controllability and observability – Pole placement design – Design of State observer 

Unit II: Z Transform and Sampled Data Systems  

Unit III: State Space Analysis of Discrete Time Systems  
State variables – Canonical forms – Digitization – Solution of state equations – Controllability and Observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems
Unit IV: Non-Linear Systems


Unit V: MIMO Systems

Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control

Course Outcome:
At the end of the course, student would be able to:
   i. Gain knowledge in analysis of non-linear system and digital control of linear system.
   ii. Implement the concept of MIMO system.
   iii. Find non-linear system stability using the trajectory methods.

Text Book:

Reference Books:

11EE245 PLC AND AUTOMATION

Credits: 4:0:0

Course Objectives:
   i. To learn the basics of PLC.
   ii. To study the programming of PLC and HMI systems.
   iii. To examine the difference between SCADA and DCS.
   iv. To understand the basic concepts of Intelligent Automation.

Unit I: Programmable Logic Controllers

Unit II: Programming of PLC & HMI Systems Programming of PLC
Types of Programming – Simple process control programs using Relay Ladder Logic and Boolean logic methods – PLC arithmetic functions. **HMI systems:** Necessity and Role in Industrial Automation – Text display – Operator panels & Touch panels – Panel PCs – Integrated displays (PLC & HMI)

**Unit III: Distributed Control Systems (DCS)**

**Unit IV: Applications of PLC & DCS**
Case studies of Machine automation – Process automation – Introduction to SCADA – Comparison between SCADA and DCS.

**Unit V: Automation**

**Course Outcome:**
At the end of the Course the student would be able to:
1. Identify, formulate, and solve problems related to PLC.
2. Design a system, component, or process to meet desired needs of the industrial requirement.
3. Implement a complete SCADA project relating to an industrial process or operation.

**Text Books:**

**Reference Books:**

Credits: 4:0:0

**Course Objectives**
1. To understand the basic industrial communication protocols.
2. To know the industrial application of PLC, SCADA, and open systems.
3. To impart knowledge about PLC and the programming.
4. To give adequate information in the interfaces used in DCS.

**Unit I: Introduction to Automation**

**Unit II: Programmable Logic Controller (PLC)**
Basics of PLC – Architecture of PLC – Advantages – Types of PLC-Applications of PLC’s- Specifications of advanced PLC’s. PLC Programming – Simple process control programs are using Relay Ladder Logic and Boolean logic methods – Structured text, Sequential flow chart, State diagrams. System configuration hardware, system sizing and selection, wiring diagram, PLC installation, interfacing to PC.

**Unit III: Introduction to DCS**
DCS- Basic Packages Introduction, analog control, direct digital control, distributed process Control, DCS configuration with associated accessories, control console equipment, control Unit (Relay Rack mounted equipments), local control units and attributes of DCS & DCS Flow Sheet symbols. DCS System Integration I/O hardware stations, Set-point station control, Supervisory Computer Tasks & configurations, system integration with PLCs and computers.

**Unit IV: Industrial Protocol**
Instrumentation Standard Protocols, HART Protocol, frame structure, programming, implementation examples, Benefits, Introduction, Advantages and Limitations of Field bus, FDS configuration, Comparison with other field bus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet, MAP and TOP.

**Unit V: Applications**
Industrial applications of PLC, SCADA, DCS and open systems for following plants; Cement plant, Thermal power plant, Steel Plant, Glass manufacturing plant, Paper and Pulp plant.

**Course Outcome**
At the end of the course, student would be able to:
- Apply the various automation techniques involved in process industries
- Select suitable automation techniques for industrial application
- Control remote sites equipped with PLC to measure various parameters.

**Text Books:**

**Reference Books:**

11EE247 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Course Objectives:

i. It provides new concepts towards measurement and automation.
ii. It imbibes knowledge about how to control an external measuring device by interfacing a computer.
iii. To become competent in data acquisition and instrument control.

Unit I: Review of Virtual Instrumentation

Historical perspective, advantages, Block diagram, Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II: VI Programming Techniques

VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit III: Data Acquisition Basics

ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts DMA, software and hardware installation.

Unit IV: Common Instrument Interfaces

Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing, Motion control.

Unit V: Use of Analysis Tools

Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields –Biomedical engineering, optical engineering, remote testing of instruments, aerospace engineering.

Course Outcome:

At the end of the course, the student will be able to

i. Acquire knowledge on how virtual instrumentation can be applied for data-acquisition and instrument control.
ii. Identify salient traits of a virtual instrument and incorporate these traits in their projects.
iii. Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

Text Books

1. Jerome, Jovitha, “Virtual Instrumentation and LABVIEW”, PHI Learning, New Delhi, 1st
Reference Books:

11EE248 ILLUMINATION ENGINEERING

Credits: 3:0:0

Course Objectives:
1. To design a electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
2. To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
3. To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Unit I: Language of Light & Lighting

Unit II: Accessories

Unit III: Calculation and Measurement

Unit IV: Interior Lighting

Unit V: Exterior Lighting

Course Outcome:
At the end of the Course the student would be able to:
1. Perform indoor & outdoor lighting design calculations.
2. Determine appropriate lighting control techniques and equipment to a sample project.
iii. Perform basic lighting energy audit to a sample project.

Text Books:

Reference Books:

11EE249 AUTOMOTIVE ELECTRONICS

Credits 3:0:0
Course Objectives
i. To study the concepts of sensors, actuators, drives.
ii. To study Electronics Fuel Injection System.
iii. To study the Lighting system and accessories.
iv. To study the digital control of starting and braking methods in the automobile system.

Unit I: Sensors and Actuators
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System

Unit III: Electronic Fuel Injection and Ignition Systems
Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories

Unit V: Digital Control Systems
Current trends in modern Automobiles- Open loop and closed loop control systems – Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Advanced suspension, electronically controlled electric power steering, electronically controlled electric brakes.

**Course Outcome**
During the end of this course, the student will be able to,

i. Design the digital control of drives using sensors and Digital Control Systems.

ii. Design the starting and braking system for the automobiles.

iii. Do research in field of automotive electrical applications.

**Text Book**

**Reference Books:**


**11EE250 BASICS OF ELECTRIC AND HYBRID VEHICLE**

**Credits: 3:0:0**

**Course Objectives:**

i. To understand the concepts of electric and hybrid vehicle

ii. To analysis various battery Module by performing Power, Energy, and temperature testing

iii. To know the necessity of alternative and novel energy sources

iv. To study the various machines and controller used in electric and hybrid vehicle.

**Unit I: Introduction**
Electrical Vehicle History- Battery electric vehicles- Hybrid vehicle- Fuelled electric vehicles- Solar powered vehicles-Electric vehicles which use flywheels or super capacitors.

**Unit II: Batteries**
Introduction- Battery Parameter-Self-discharge rates-Battery temperature, heating and cooling needs -Battery life- Introduction to Lead Acid Batteries, Nickel-based Batteries, Lithium Batteries. Use of Batteries in Hybrid Vehicles.

**Unit III: Alternative Energy Sources and Storage Devices**
Introduction -Solar Photovoltaic -Wind Power- Flywheels- Super Capacitors-Supply Rails-

**Unit IV: Electric Machines and Their Controllers**

**Unit V: Design of Ancillary Systems**

**Course Outcome:**
At the end of the Course the student would be able to:

i. Develop a hybrid vehicle with existing renewable system.
ii. design a new controller for hybrid electric vehicle.
iii. apply control techniques to store the energy.
iv. analyze the performance ancillary systems.

**Text Books:**

**Reference Books:**

**11EE251 BUILDING AUTOMATION**

**Credits: 3:0:0**

**Course Objectives:**

i. To understand about the building automation and its management system.
ii. To study about the security and safety systems in smart building.
iii. To suggest suitable possibilities to integrate system and its managements for intelligent building.

**Unit I: Introduction to Building Automation System**

Unit II: Energy Management System

Unit III: Safety Systems

Unit IV: Security Systems & Video Management

Unit V: Integrated Systems

Course Outcome:
At the end of the Course the student would be able to:
   i. Construct and design structured building system by enabling integrated system connections.
   ii. Apply the building automation system and telecommunication facilities in modern intelligent buildings; and apply networking technologies in building automation.
   iii. Evaluate the comprehensive specifications of an importance of energy conservation components for a modern commercial building.

Text Books:

References:

11EE252 FUNDAMENTALS OF ELECTRICAL SAFETY

Credits: 3:0:0

Course Objectives
i. To exhibit knowledge of safety rules and regulations, and demonstrate awareness of hazards in the workplace.
ii. To explain the use of personal protective equipment.
iii. To understand the various reasons for electrical accidents
iv. To learn various method to calculate electric bill.

Unit I: Introduction to Electrical Safety

Unit II: Study of Electrical Safety Components
Introduction to conductors and insulators- Wire Characteristics- Ampacity, Insulation Type, Wire Size, Cables & Cords – Electrical Standards- Safety against Over voltages- Safety Against Static Electricity.

Unit III: Indoor and Outdoor Safety Precautions

Unit IV: Electrical Hazards
Main Factors in Electrical Accidents-Electrical Shock- Definition- Arc Flash-Arc Flash Burn Injuries -Arc Blast Pressure - Inhalation Injuries- Determining Safe Approach Distance Determining Arc Hazard Category.

Unit V: Calculating Electric Bills

Course Outcome
At the end of the course the students will be able to
i. Describe hazards and prevention practices.
ii. Demonstrate proper safety procedures.
iii. Demonstrate proper use of hand and power tools.
iv. Identify various trades used in the construction industry.
v. Select and use the power tools and hand tools

Text Books:

Reference Books

11EE301 POWER SEMICONDUCTOR DEVICES

Credits: 4:0:0

Course Objectives:
i. To understand various static and dynamic performances of static switches.
ii. To familiarize the student on switching and steady state characteristics power electronic devices.
iii. To analyze the control circuits and switching losses in power devices.

Unit I: Introduction

Unit II: Thyristors
Physics of device operation - Electrical rating - Switching and steady state characteristics - Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - Light fired Thyristor - switching losses.

Unit III: Special Types of Thyristors
TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods – Series, Parallel operation of GTO Thyristors.
Unit IV: Power Transistors & Power MOSFETs

Unit V: IGBTs & Emerging Devices
Comparison with power BJT and MOSFET - Structure, Principle of working - Switching characteristics - Gate drive requirements. Emerging Devices: SITs-characteristics - Power Integrated circuit - Characteristics - Field Controlled Thyristors - New semiconductor materials for devices - Intelligent power modules.

Course Outcome:
At the end of the Course the student would be able to:
   i. Design switching using power semiconductor devices.
   ii. Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
   iii. Select components, interpret terminal characteristics of the components, model components, design circuit, and understanding operation of power electronics circuits.

Reference Books:

11EE302 LINEAR SYSTEMS

Credits: 3:1:0
Course Objectives
   i. To understand the state model of LTI (Linear time invariant) system.
   ii. To give basic knowledge in obtaining decomposition of transfer function from state model.
   iii. To understand the concepts of controllability and Observability
   iv. To provide adequate knowledge in the Liapunov stability analysis.

Unit I: State Space Analysis
Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.
Unit II: Decomposition Methods
Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III: State Space Representation for Discrete System
State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations. Eigen Values And Eigen Vectors: Characteristic equation, Eigen values, Eigen vectors - Invariance of Eigen values - Diagonalization - Jordan canonical form.

Unit IV: Concepts of Controllability and Observability
Kalman’s and Gilbert's - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability. State Estimators: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators.

Unit V: Liapunov Stability Analysis

Course Outcome:
At the completion of the subject, the Student has
i. Very good knowledge in the basic concepts of linear control theory and design of control system.
ii. Gained the knowledge about the controllability & Observability.
iii. Solved the stability analysis problems.

Reference Books:

11EE303 ADVANCED DIGITAL SIGNAL PROCESSING

Credits :4:0:0

Course Objectives:
i. To have an overview of signals and systems and DFT & FFT Transforms.
ii. To study the design of IIR & FIR filters.
iii. To study the applications of DSP techniques in processors.

Unit I: Review of Discrete Time Systems

Unit II: Discrete Fourier Transform

Unit III: Digital Filter Design Techniques

Unit IV: Finite Register Length Effects

Unit V: Advanced DSP Processors

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

i. Understand types of digital signals and Transforms and its application to signals and systems.

ii. Design of IIR & FIR filters.

iii. Understand different DSP processors and basic programming skills.

Reference Books:
Course Objectives:
   i. To study the basics of static and dynamic models of power electronic switches.
   ii. To learn usage of the software tools like MATLAB, PSpICE & PSIM for various power electronic devices
   iii. To understand the different types of power electronic converters using the above mentioned tools in real time applications.

Unit I: Introduction
Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSpice, MATLAB and SIMULINK. Mathematical Modelling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of Power Electronic systems.

Unit II: PSpice
File formats - Description of circuit elements - Circuit description - Output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT and Power S-Functions - Converting S-Functions to blocks.

Unit III: MATLAB and SIMULINK

Unit IV: Introduction to PSIM

Unit V: Simulation using PSpice, PSIM, MATLAB and Simulink
Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

Course Outcome:
At the end of the Course the student would be able to:
   i. use the various functional blocks available in the simulation packages for the problems specified.
   ii. design and simulate any power electronic circuits by comparing the performance with other simulation software’s.
   iii. to do the mathematical modeling of power devices by analyzing their steady state and dynamic performances.

Reference Books:

11EE305 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS
Credits: 3:1:0

Course Objectives:
  i. To understand the safe and secure operation of simple power system.
  ii. To suggest suitable possibilities to extend power system operation.
  iii. To understand the recent advancements in power systems using the power electronic systems.

Unit I: Introduction
High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II: Converter Control
Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III: Wind Energy Conversion System
Basic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV: HVDC Systems
Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: FACTS
Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.

Course Outcome:
At the end of the Course the student would be able to:
  i. Find the solutions for eliminating harmonics and EMI present in the output due to fast switching devices.
  ii. Apply power system fundamentals to the design of a system that meet specific needs
iii. Design necessary filter circuit required to the distributed network.
iv. Maintain the power system stable and secure by selecting proper FACTS devices.

Reference Books:

11EE306 NEURO FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credits: 4:0:0

Course Objectives:
To impart knowledge on
i. The fundamental concept of neurons and their artificial models,
ii. The Structure of fuzzy logic controller and its application to electric drives
iii. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic
iv. The various application of adaptive neuro controllers and hybrid neuro fuzzy controllers

Unit I: Introduction to Neural Network
Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks - Single layer, multiple layer - Feed forward, feedback networks; Back propagation - Learning and training – Hopfield network.

Unit II: Neuro Controller
Neural network. for non-linear systems - Schemes of Neuro control - System identification forward model and inverse model - Indirect learning neural network control applications.

Unit III: Introduction to Fuzzy Logic
Fuzzy sets - Fuzzy operation - Fuzzy arithmetic - Fuzzy relations - Fuzzy relational equations - Fuzzy measure - Fuzzy functions - Approximate reasoning - Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV: Fuzzy Controller
Structure of fuzzy logic controller - Fuzzification models - Data base - Rule base - Inference engine defuzzification module - Non-linear fuzzy control - PID like FLC - Sliding mode FLC - Sugeno FLC - Adaptive fuzzy control - Fuzzy control applications.

Unit V: Applications to Electric Drives
Course Outcome:
On completion of this course students will be able to
i. Explain the various learning algorithms derived from the biological neurons
ii. Apply the concept of neural network for optimisation of any system problem
iii. Use appropriate network for fault diagnosis and pattern recognition

Reference Books

11EE307 GENERALISED THEORY OF ELECTRICAL MACHINES

Credits:3:1:0
Course Objectives
To impart knowledge on
i. The key principles in Analysis of electrical machines
ii. The Generalized Representation and steady state analysis of Synchronous Machines
iii. The generator and motor operation in steady state and transient conditions
iv. The analysis of harmonics in Ac machines
v. The generalized representation of special machines

Unit I: Generalised Theory
Conversions - Basic two pole machines - Transformer with movable secondary -Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II: Linear Transformations
Invariance of Power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes-Transformed impedance matrix – Torque calculations.

Unit III: DC Machines
Generalized Representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.
**Unit IV: AC Machines**

**Unit V: Special Machines**

**Course Outcome**
Students will be able to describe
i. The Generalized Representation of machines and their analysis
ii. The steady state analysis and transient analysis of various machines
iii. The performance of special machines and their representation

**Reference Books:**

**11EE308 SPECIAL MACHINES AND CONTROLLERS**

**Credits: 4:0:0**

**Course Objectives**
To impart knowledge on
i. The construction, principle of operation and the control techniques of stepper motor
ii. The constructional features of Switched reluctance motors
iii. Characteristics of permanent magnet brushless Dc motor
iv. Control methods of permanent magnet synchronous motors
v. Control application of linear and servomotors

**Unit I: Stepper Motors**
Constructional features, Principle of operation, Modes of excitation torque production in Variable reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, Intelligent control techniques

**Unit II: Switched Reluctance Motors**
Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive Concept, Sensorless control

**Unit III: Permanent Magnet Brushless DC Motors**
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Sensorless control

**Unit IV: Permanent Magnet Synchronous Motors**
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

**Unit V: Servomotors & Linear Motors**

**Course Outcome**
On completion of this course the student will be able to
i. Differentiate the working of different drives and performance
ii. Select a suitable special machine drive based on the application.
iii. Incorporate an appropriate control scheme for the application specified

**Reference Books:**

**11EE309 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION**

**Credits:** 4:0:0

**Course Objectives:**
1. To study the basics of various photovoltaic energy conversion.
2. To analyze the performance of self-excited and grid related problems.
3. To learn the Wind energy system and stand alone power supply systems.

**Unit I: Introduction**
Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

**Unit II: Photovoltaic Energy Conversion**
Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with
batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking. DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem –Applications.

Unit III: Wind Energy Conversion (WEC)

Unit IV: Self-Excited & Grid Connected WECS

Unit V: Stand Alone Power Supply Systems
Wind/solar PV integrated systems - Optimization of system components - storage - Reliability evolution.

Course Outcome:
At the end of the Course the student would be able to:
  i. Understand various factors which affect the wind energy conversion system.
  ii. Design isolated power generators used in wind energy conversion system.
  iii. design PV cells to meet the requirement of battery operated vehicle and other related applications

Reference Books:

11EE310 HVDC TRANSMISSION

Credits: 4:0:0
Course Objectives:
  i. The course aims at use of high voltages as the key to efficient transmission and distribution of electrical power.
  ii. To have an overview about different forms of insulation and their behavior, over voltage conditions and protection of equipments.
  iii. To analyze the malfunctioning of converters and protection.
Unit I: DC Power Transmission Technology

Unit II: Analysis of HVDC Converters
Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60 degree – With overlap greater than 60º – Complete characteristics of rectifier and Operation of Inverter.

Unit III: Converter and HVDC System Control
Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV: Misoperation of Converters & Protection

Unit V: Harmonics and Filters

Course Outcome:
At the end of the Course the student would be able to:
   i. facilitate a basic understanding about high voltage insulators, cables, bushings, occurrence of over voltages and protection of HV equipments from failure due to over voltage
   ii. outline the benefits of using DC transmission, terminal converters its operation and control.
   iii. analyze the Challenges and its solutions available in High voltage engineering.

Reference Books:
11EE311 ADVANCED TOPICS IN POWER ELECTRONICS

Credits: 4:0:0

Course Objectives:
   i. To understand the concept of resonant switch converters.
   ii. To analyze the factors affecting harmonics and electromagnetic Interference.
   iii. To understand the concepts of FACTS and their usage in power systems.
   iv. To learn the advanced Power Electronic Devices and their applications.

Unit I: Resonant Converters

Unit II: Improved Utility Interface
Generation of current harmonics – Current harmonics and power factor – Harmonics standards and recommended practices – Need for improved utility interface – Improved single phase utility interface – Improved three phase utility interface – Electromagnetic interference.

Unit III: FACTS and Custom Power

Unit IV: FACTS Analysis & Protection
Modelling and methods of analysis of SVC and FACTS controllers – System control and protection – Harmonics and filters – Simulation and study of SVC and FACTS under dynamic conditions.

Unit V: Emerging Devices and Circuits

Course Outcome:
At the end of the Course the student would be able to:
   i. derive the mathematical models of resonant converters to reduce harmonics electromagnetic interference.
   ii. perform modelling and simulation of specific FACTS controllers.
   iii. analyze the impact of FACTS devices on power system stability.

References:

11EE312 ROBOTICS AND FACTORY AUTOMATION

Credits: 4:0:0

Course Objectives:
   i. To acquire knowledge regarding the various parts of robots and field of robotics.
   ii. To understand about the various sensors used in robotic design.
   iii. To get brief knowledge on the basic concept of PLC and uses of PLC in automation.

Unit I: Fundamentals Concepts of Robotics

Unit II: Robot Drives and Power Transmission Systems

Unit III: Sensors

Unit IV: Transformations and Kinematics

Unit V: PLC & Factory Automation

**Course Outcome:**
At the completion of the subject,

i. It provides Comprehensive knowledge of robotics in the design, analysis and control point of view.

ii. The course will support to development the concept of factory automation.

iii. It also helps to understand the robot motion analysis.

**Reference Books:**

**11EE313 MICROCONTROLLERS AND APPLICATIONS**

**Credits: 4:0:0**

**Course Objectives:**

i. To make students aware of various microcontrollers

ii. To learn and understand the architecture of 8051, 68HC11 and PIC microcontrollers.

iii. To understand the design and interfacing of microcontroller based embedded systems.

**Unit I: Intel 8051**
Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area- Addressing modes- Instruction set- Programming examples. Interrupt structure- Timer modules- Serial features- Port structure- Power saving modes- MCS51 family features:8031/8051/8751.

**Unit II: Motorola 68HC11**
Controller features – Different modes of operation and memory map – Functions of I/O Ports in single chip and expanded multiplex model – Timer System. Input Capture,Output compare and pulsed accumulator features of 68HC11 – Serial peripheral and serial communications interface – Analog to digital conversion features – Watchdog feature.

**Unit III: PIC Microcontrollers**

**Unit IV: Features of PIC**
Timers 0,1 and 2 features – Interrupt Logic – Serial Peripheral Interface – I2C Bus – ADC
Unit V: Typical Applications

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

i. Design simple Microcontroller based systems.
ii. Write simple program using various Microcontrollers
iii. Interface / Apply in standard applications.

Reference Books:

11EE314 COMPUTER NUMERICAL CONTROL

Credits: 4:0:0
Course Objectives
To study:

i. The principles, techniques and applications of computer numerically controlled machine tools.
ii. Concepts of Computer Aided Manufacturing(CAD)
iii. Basic types of CNC machine tools.
iv. About Programmable logic controllers and its role in CNC machines.

Unit I: Numerical Control

Unit II: Types of CNC Machines
Unit III: Input Output Units
Keyboard, Tape reader, Hand held terminals, PC interfacing, Display devices and Ethernet communication. Drive Units: Axis drive arrangements, ball screw, timing belts and couplings, AC & DC servomotors, Stepper motors, Hydraulic Servo, AC permanent magnet synchronous motor for spindle drives Characteristics and drive schemes for these motors.

Unit IV: Feedback Elements
Absolute and incremental encoders, Resolvers, linear optical encoders, Proximity switches, limit switches – Transducer placement measuring schemes using these feedback devices. Control Units: Functions of CNC, system hardware, Contouring control –Digital differential analyzer, Linear and circular interpolation, software development process, Open architecture systems.

Unit V: Programmable Logic Controllers
Hardware, programming techniques, Ladder logic programming of PLCs using basic functions – Timers and counters – Advanced programming with control and arithmetic instructions. Role of PLC in CNC machines. Microprocessor in CNC machines, Sensors for Adaptive Control of CNC machine tools. New developments in CNC technology.

Course Outcome
At the completion of the course, the student will be able to:
  i. Control machine using PLC.
  ii. Do projects on machine control using CAD/CAM systems.
  iii. Know types of CNC machine tools and there by knows which one is suited for a particular operation.

Reference Books

11EE315 EMBEDDED SYSTEMS

Credits: 4:0:0
Course Objectives:
  i. To make students aware of Embedded systems
  ii. To learn and understand concepts of RTOS.
  iii. To understand the Performance issues of an embedded system.

Unit I: Introduction
Introduction to embedded systems – hardware and software components – Types – Examples – Characteristics – Challenges in Embedded computing system design – Embedded system design processes.

Unit II: Architecture of Embedded System

Unit III: OS for Embedded Systems

Unit IV: Performances Issues of an Embedded System
CPU performance – CPU Power Consumption – Analysis and Optimization of CPU Power Consumption program execution time – Analysis and optimization of energy and power – Analysis of program size – Hardware accelerators.

Unit V: Design Examples
Personal Digital Assistants – Set Top Boxes – Ink Jet Printers – Telephone PBX.

Course Outcome:
At the end of the course, the student will be able to:
   i. Design simple embedded systems.
   ii. Choose effective communication for embedded systems.
   iii. Analyze real-time scheduling algorithms and identify design flaws.

Reference Books:

11EE316 SCADA AND DCS

Credits: 4:0:0
Course Objectives:
   i. To learn basics of SCADA
   ii. To develop skills to work on SCADA features
   iii. Aims to build good understanding about the basics of industrial automation using
Unit I: Introduction

Unit II: Supervisory Control and Data Acquisition

Unit III: Communication Protocols of SCADA

Unit IV: Distributed Control Systems

Unit V: Applications of SCADA & DCS
Applications of SCADA & DCS – Case studies of Process plants using SCADA & DCS – Advanced features / options in SCADA & DCS – Role of PLC in DCS and SCADA – Comparison – field devices (Transducers, drives etc) in DCS/SCADA.

Course Outcome:
Upon completion of this course students will:

i. Able to control remote sites equipped with RTU or PLC to measure various parameters.
ii. Develop skills to work on SCADA features and to enable them to work efficiently in the field of industrial automation.
iii. Know how to monitor and control distributed equipments using DCS

Reference Books:
11EE317 POWER QUALITY MANAGEMENT

Credits: 3:1:0

Course Objectives:

i. To describe various equipment used for power monitoring.
ii. To learn the effects of harmonics on various power system components.
iii. To examine the methods of reducing excessive harmonics using advanced modeling technique.

Unit I: Introduction

Unit II: Short & Long Interruptions

Unit III: Voltage Sag & Transients

Unit IV: Waveform Distortion, Wiring & Grounding

Unit V: Power Quality Solutions
Introduction – Power quality monitoring: Evolution, Deregulation effect – Brief introduction to power quality measurement equipment and power conditioning equipments – Planning, Conducting and Analyzing power quality survey.

Course Outcome:
At the end of the Course the student would be able to:

i. Recognize the cause and source of power system disturbances.
ii. Calculate harmonic voltages and currents by analyzing types of electrical systems loads and their power quality considerations.

iii. Mitigate any existing and potential problems, thereby minimizing equipment disoperation and process downtime.

Reference Books:

11EE318 FLEXIBLE AC TRANSMISSION SYSTEMS

Credits: 4:0:0

Course Objectives:
i. To learn about the basic concepts of FACTS devices and its Principle of operation.
ii. To understand the implementation of UPFC and also designing the FACTS controllers.
iii. Introduction to New FACTS devices.

Unit I: Introduction
FACTS-a toolkit, Basic concepts of Static VAR compensator – Resonance damper – Thyristor controlled series capacitor – Static condenser – Phase angle regulator – other controllers.

Unit II: Series Compensation Schemes
Sub-Synchronous resonance – Torsional interaction – torsional torque – Compensation of conventional ASC – NGH damping schemes – Modelling and control of Thyristor controlled series compensators.

Unit III: Unified Power Flow Control (UPFC)

Unit IV: Design of FACTS Controllers

Unit V: Modern FACTS Devices
Basic concepts – Centre Node Unified Power Flow Controller (C-UPFC) – Fault Current Controller (FCC) – Interlined Power Flow Controller (IPFC) – location of FACTS.

Course Outcome:
At the end of the Course the student would be able to:
i. identify, formalize, model and analyze problems in a power network
ii. Select the suitable FACTS devices to enhance the security, capacity and flexibility of power transmission systems.
iii. Increase existing transmission network capacity while maintaining or improving the operating margins necessary for grid stability.

Reference Books:

11EE319 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION
Credits: 4:0:0
Course Objectives
i. To understand the concepts of Conventional and Digital Transducers
ii. To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
iii. To study the Microprocessor based instrumentation

Unit I: Review Of Conventional Transducers

Unit II: Digital Transducers
Direct digital transducers – Absolute and incremental displacement transducers – Moiré Fringe transducers – Transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III: Industrial Heating & Photoelectric Devices
Industrial Heating using high frequency dielectric heating – Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV: Microprocessor Based Instrumentation
Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based Voltmeter and Ammeter – Microprocessor based Speed monitoring Unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring Unit – Microprocessor based over and under voltage and over current protection.
Unit V: Smart Transducers
Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – measurement of flow, pH with smart transducers.

Course Outcome:
At the end of the course, the student will be able to understand:
i. Select the type of transducer for the Industrial application.
ii. And apply in case studies and mini projects in industries.
iii. Design the Microprocessor based Controllers.

Reference Books

11EE320 RESTRUCTURED POWER SYSTEMS

Credits: 4:0:0

Course Objectives:
i. To provide in-depth understanding of operation of deregulated electricity market systems
ii. To examine topical issues in electricity markets and how these are handled world-wide in various markets
iii. To analyze various types of electricity market operational and control issues using new mathematical models

Unit I: Fundamentals of Electricity Markets And Energy Auctions

Unit II: Transmission Open Access
Unit III: Transmission Congestion Management and Transmission Rights

Unit IV: Ancillary Services and System Security in Deregulation

UNIT V: System Planning in Deregulation

Course Outcome:
At the end of the Course the student would be able to:
1. analyze the market strategy the power scenario
2. perform cost optimization in the distributed system
3. design as smart grid for the specified requirement of the electricity market

Reference Books:

11EE321 POWER ELECTRONICS LABORATORY

Credits: 0:0:2
2. Design, Testing of Single Phase Semi & Full Converter Bridge on R & R – L Load
3. Design, Testing of MOSFET based DC Chopper on R & R – L Load
5. Design, Testing of Three Phase AC Voltage Controller with R & R – L Load
7. Design, Testing of IPM based Three Phase Inverter with R & R – L Load
9. Simulation of Semi & Full Bridge Converter using PSIM
10. Simulation of Inverter using PSIM
11. Simulation of Four Quadrant Chopper using MATLAB
12. Simulation of AC Voltage Controller using MATLAB

11EE322 ELECTRIC DRIVES AND CONTROLS LABORATORY
Credits: 0:0:2
1. IGBT Based Inverter Fed Induction Motor Drive
2. Chopper Fed DC Motor Drive
3. Multilevel Inverter Fed Induction Motor Drive
4. DSP (TMS320F2812) Based Switched Reluctance Motor Drive
5. Simulation of Vector Control of Induction Motor Drive using MATLAB
6. Three Phase Rectifier Fed DC Motor Drive
7. Three Phase AC Voltage Controller Fed Induction Motor Drive
8. Matrix Converter Fed Induction Motor Drive
9. DSP (TMS320F2407) Based Permanent Magnet Synchronous Motor Drive
10. Control of DC Motor using dSPACE ACE 1103 Control Kit
11. BLDC Motor Drive
12. FPGA Based Motor Control

11EE323 POWER ENGINEERING SIMULATION LABORATORY
Credits: 0:0:2
1. Simulation of Buck-Boost Converter using PSIM
2. Simulation of Synchronous Rectifier using PSIM
3. Simulation of Three Phase SVPWM Inverter using PSIM
4. Simulation of Soft Switching Converters using PSIM
5. Simulation of Multilevel Inverter using MATLAB
6. Simulation of SRM Drive using MATLAB
7. Formation of BUS Admittance Matrix using Direct Inspection Method using MATLAB
8. Determination of BUS bar Voltages using FDLF Method using MATLAB
9. Automatic Load Frequency Control using MATLAB
10. Load Flow Studies using ETAP
11. Simulation of SMIB using ETAP
12. Fault Analysis of AC Power System using PSCAD / EMTDC

11EE324 PHOTOVOLTAIC SYSTEMS
Credits: 4:0:0
Course Objectives:
i. To provide necessary knowledge about the modeling, design and analysis of various PV systems
ii. To show that PV is an economically viable, environmentally sustainable alternative to the world's energy supplies.
iii. To understand the power conditioning of PV system’s power output.

Unit I: Introduction to Photovoltaic (PV) Systems
Historical development of PV systems- Overview of PV usage in the world-Overview of PV usage in India- Solar Map-Solar energy potential for PV- irradiance, solar radiation and spectrum of sun- geometric and atmospheric effects of sunlight-Photovoltaic effect-conversion of solar energy into electrical energy.

Unit II: Solar Cells and Arrays
Behavior of solar cells-basic structure and characteristics: types - equivalent circuit-modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current-Solar cell arrays- PV modules-PV generators-shadow effects and bypass diodes- hot spot problem in a PV module and safe operating area-Terrestrial PV module modeling- Interfacing PV modules with different loads.

Unit III: Energy Storage Alternatives for PV Systems
Storage batteries- lead-acid- nickel-cadmium- nickel-metal-hydride and lithium type batteries. Small storage systems employing ultra capacitors- properties- modeling of batteries.

Unit IV: Inverters for PV Systems
Inverter control topologies for stand-alone and grid-connected operation-Analysis of inverter at fundamental frequency and at switching frequency-Feasible operating region of inverter at different power factors for grid connected systems and stand-alone PV systems. Consumer applications-residential systems-PV water pumping-PV powered lighting-rural electrification.

Unit V: Power Conditioning of PV Systems
Power conditioning and maximum power point tracking (MPPT) -Maximum power point tracking (MPPT) algorithms-Grid connected PV systems-Active power filtering with real power injection-Modeling and simulation of complete stand-alone and grid-connected PV systems.

Course Outcome:
After studying this course the students will be able to
i. model, analyze and design various photovoltaic systems
ii. know the feasibility of PV systems as an alternative to the fossil fuels
iii. design efficient stand alone and grid connected PV power systems

References:
11EE325 POWER ELECTRONIC CIRCUITS

Credits: 3:1:0
Course Objectives:

i. To impart the knowledge of various conversion techniques of electrical energy using power electronic components.

ii. To establish the link between efficient usage of power and conservation of energy resources of the world.

iii. To provide the design details of various power electronic converters.

Unit I: Power Semiconductor Switches
Classification of power converters-Ideal switch and rectifier-Semiconductor power switching devices used in power electronic circuits: Diode, bipolar junction transistor (BJT), silicon controlled rectifier (thyristor), Gate turn-off thyristor (GTO), MOSFET, insulated gate bipolar transistor (IGBT), integrated gate commutated thyristor (IGCT)- I-V characteristics, operation principles, maximum voltage and current ratings. Gating circuits for controlled semiconductor switches- Series and parallel commutation circuits for turning-off of thyristors.

Unit II: AC to DC Converters

Unit III: DC to DC Converters
DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper – Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit IV: Inverters & Resonant Converters


Unit V: AC Phase Converter

Course Outcome:
At the end of the course, the students will be able to
i. understand the significance of the characteristics of various power semiconductor switches
ii. design of power electronic conversion systems
iii. understand various modulation (control) techniques such as pulse width modulation and selective harmonic elimination.

Reference Books:

11EE326 SOLAR THERMAL ENERGY CONVERSION

Credits: 4:0:0
Course Objectives:
   i. To provide a comprehensive engineering basics for solar thermal system and its design
   ii. Know about the different technologies of solar thermal systems.
   iii. Know about the different types of solar heating & coolings.

Unit I: Radiative Properties and Characteristics of Materials
Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials.

Unit II: Flat-plate Collectors
Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors- Thermal analysis; Evacuated tubular collectors.

Unit III: Solar Thermal Energy Storage
Types: Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage system.

Unit IV: Concentrating Collector
Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V: Solar Heating & Cooling System
Solar water heating systems, Liquid based systems for buildings, solar air heating systems, Methods of modeling and design of solar heating system, Cooling requirements of buildings,
Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; solar desiccant cooling.

**Course Outcome:**

At the end of the course, Students will be able to
i. calculate the Solar Radiation on Horizontal and Tilted Surfaces
ii. analyze the performance of Different Solar Collectors
iii. choose the right type of solar collector for an application.
iv. design Solar Heating and Cooling Systems.

**Reference Books:**


**11EE327 ADVANCED CONTROL TECHNIQUES FOR INDUCTION GENERATORS**

**Credits:** 3:1:0

**Course Objectives:**

i. To understand the transient and steady state modeling of induction generators.
ii. To give an in-depth knowledge about the different control techniques of induction generators.
iii. To enhance the students’ perspective on optimized control of induction generators which are widely used in renewable energy systems.

**Unit I: Modeling of Induction Generators**

**Unit II: Operation of Induction Generators**

**Unit III: Scalar Control of Induction Generators**
Scalar Control background – Scalar Control Schemes –Open control schemes – closed loop control schemes– Problems

**Unit IV: Vector Control of Induction Generators**
Vector Control – Axis Transformation – Space Vector Notation – Field Oriented Control – direct vector control- indirect vector control-Problems

Unit V: Optimized Control of Induction Generators
Optimization Principles – Application of Hill Climbing Control (HCC) for Induction Generators-HCC based Maximum Power Search – Fuzzy Logic Controller based Maximum Power Search - Problems

Course Outcome:
Students will be able to
- understand the complex control concepts
- model the induction generators
- design control strategies for Induction generators

Reference Books:

11EE328 ENERGY ENGINEERING

Credits: 4:0:0

Course Objectives:
i. To create environment-friendly energy systems.
ii. To deal with actively harnessing renewable natural resources like solar energy and utilizing materials that cause the least possible damage to the global commons – water, soil, forests and air.
iii. To deal with global and Indian energy scenario.

Unit I: Introduction to Energy
Definition and Units of energy, power, Forms of energy, Conservation of energy, Energy flow diagram to the earth. Conventional and nonconventional energy sources- Origin of fossil fuels, time scale of fossil fuels, Renewable Energy Resources, Role of energy in economic development and social transformation. Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time,

Unit II: National and Global Energy Scenario
Energy resources available in India, urban and rural energy consumption, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources. Energy consumption in various sectors, projected energy consumption for the future.
future, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

**Unit III: Various Renewable Energy Systems**

**Unit IV: Environmental Impact**
Kyoto protocol- Environmental degradation due to energy production and utilization. Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment.

**Unit V: Smart Grids**
Electric grid operation - evolution of Smart Grids, electric system design and operation, technical and tariff changes - integration between utilities and Regional Transmission Organizations. Smart Grid components- metering, demand response, virtual power plants, dynamic pricing, grid enhancement funding, demand analysis, promotion of “green” resources, governmental regulation, network standards, network integration, loan guarantees, consumer privacy - Risks to the Smart Grid - protective measures – Wireless Sensor Networks and its applications.

**Course Outcome:**
At the end of this course, the students will be able to

i. gain knowledge about the current energy scenario.
ii. gain the knowledge about smart grids
iii. understand the problems about the pollution, ozone layer and global warming.

**Reference Books:**

**11EE329 WIND ENERGY**

**Credits: 3:1:0**

**Course Objectives:**

i. To develop a detailed understanding of the issues associated with the development of wind energy for electrical energy supply.
ii. To know the current state of wind energy development domestically and internationally
iii. To understand the issues of location and grid connection of wind energy power plants

Unit I: Role of Wind Energy
World’s energy requirements- Role of wind energy in Electricity production Renewable energy policy – National and International; The role of wind energy in greenhouse gas abatement- Economics of Wind Energy- Commercial and regulatory issues - Energy trading, green credits and carbon taxes; Economic assessment of wind energy systems- Funding of wind energy projects

Unit II: Wind Energy Resources

Unit III: Analysis and Design of Wind Turbines – Mechanical Aspects
Classification of wind turbine Elements of a wind turbine system- Modelling of the ideal turbine rotor- Airfoil and aerodynamics- Blade shape-performance-Loads on wind turbines-Wind turbine topologies- Mechanical design and control – Shafts, gearing, brakes, etc- Rotor and blade design; Power curve of turbine- Requirements of control systems for wind turbines.

Unit IV: Electrical Aspects of Wind Turbines
Electrical machines as applied to wind turbines- Synchronous, induction and double-fed generators- Fixed speed and variable speed operation- Stand-alone configurations- Transmission and distribution network interfaces- Power converters- On-shore and off-shore wind farms-Ancillary electrical equipment – Cables, protection, circuit breakers, capacitors

Unit V: Siting of Wind Turbines and Integration into Supply Networks
Wind turbine site selection- Operational issues of wind turbines- Embedded generation and wind turbines- Impacts of wind turbines on electrical supply networks- Network issues – frequency control, voltage control, fault levels- Quality of supply issues associated with wind turbines- Control of network interface- Supervisory control- Backup supply- Energy storage- Integration with other energy sources – Hybrid systems

Course Outcome:
At the end of the course, the Students will be able to
i. understand the role which wind energy plays and can play in the electricity supply system and its role in meeting the country’s obligations in terms of greenhouse gas abatement
ii. gain knowledge regarding wind energy resources and the ability to assess that resource
iii. gain knowledge of construction, characteristics, control and performance of wind turbines

Reference Books:

**11EE330 HYDROGEN AND FUEL CELLS**

**Credits: 4:0:0**

**Course Objectives:**

i. To understand hydrogen energy technology
ii. To understand fuel cell technology
iii. To enlighten the student community on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

**Unit I: Hydrogen – Basics and Production Techniques**

Hydrogen – physical and chemical properties, salient characteristics- Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

**Unit II: Hydrogen Storage and Applications**


**Unit III: Fuel Cells**

History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery vs fuel cell

**Unit IV: Fuel Cell - Types**

Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

**Unit V: Application of Fuel Cell and Economics**

Fuel cell usage for domestic power systems- large scale power generation- Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell- Future trends in fuel cells.

**Course Outcome:**

At the end of the course, the students will be able to

i. know detail on the hydrogen production methodologies, possible applications and various storage options.
ii. know the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics
iii. analyze the cost effectiveness and eco-friendliness of Fuel Cells.

**Reference Books:**

*Electrical and Electronics Engineering*

11EE331 ENERGY MANAGEMENT AND AUDIT

Credits: 3:1:0

Course Objectives:
- To understand various energy management techniques
- To understand energy auditing techniques
- To understand the importance of energy conservation

Unit I: Energy Management

Unit II: Energy Audit
Definition-needs-types-approaches; energy costs, benchmarking, energy performance, matching energy supply to requirement, fuel and energy substitution, energy audit instruments, duties and responsibilities of energy auditors

Unit III: Planning
Key elements, force field analysis, energy policy- purpose, perspective, contents, formulation, ratification; location of energy management, top management support, managerial function, energy manager-accountability, motivation- information system-strategies- marketing and communicating- training and planning.

Unit IV: Monitoring and Targeting
Definition – elements, data and information analysis; techniques, energy consumption, production, cumulative sum of differences, energy service companies, energy management information systems, SCADA

Unit V: Electrical Energy Management
Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC and FACTS, Demand Side: conservation in motors, pumps and fan systems, energy efficient motors, lighting.

Course Outcome:
At the end of the course, the students will be able to
i. become efficient energy managers
ii. know different energy auditing methods and the implementation procedures
iii. plan for the energy requirement

Reference Books:

11EE332 BIO-MASS ENERGY

Credits: 4:0:0
Course Objectives:
   i. To deal about the thermal biomass conversion and biological pathways.
   ii. To provide an introduction about the power generation techniques, through Biomass
   iii. To deal with the Design, Selection, Construction and Operation of Biogas Plants.

Unit I: Introduction

Unit II: Thermal Biomass Conversion

Unit III: Power Generation Techniques

Unit IV: Economics and Environmental Aspects

Unit V: Design, Selection, Construction and Operation of Biogas Plants

Electrical and Electronics Engineering
Design of the digester – design based on end user requirements – scaling of biogas plants – digester sizing – optimal design – design of fixed dome digester – Electricity Production from biomass.

**Course Outcome:**
At the end of this course, the students will be able to
i. understand the thermal biomass conversion.
ii. understand about the Pyrolysis, Gasification and Liquefaction and fermentation process
iii. design the biogas plants by the students.

**Reference Books:**

**11EE333 ENERGY MODELLING, ECONOMICS AND PROJECT MANAGEMENT**

**Credits: 3:1:0**

**Course Objectives:**
i. To impart greater understanding of energy modeling in renewable energy technology.
ii. To throw light on the economic aspects involved in renewable energy technology.
iii. To enlighten the students on the various techniques involved in project management.

**Unit I: Models and Modeling Approaches**

**Unit II: Input-Output Analysis**

**Unit III: Energy Demand Analysis and Forecasting**
Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting - Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

**Unit IV: Economics of Stand-alone Power Systems**

Unit V: Project Management – Financial Accounting

Course Outcome:
At the end of this course, the students will be able to
i. Gain clear perspective on energy economy.
ii. Forecast the energy demand and plan wisely.
iii. Become excellent managers of the energy resources.

Reference Books:

11EE334 SOLAR ENERGY LAB

Credits: 0:0:2
Course Objectives
i. To understand the basics of solar energy measurements and forecasting practically
ii. To understand the various control and operating strategies for stand alone and grid connected PV systems.
iii. To understand Solar Thermal System.

Course Outcome
Students will be able to
i. use simulation tools effectively to study the Solar Energy System
ii. design and construct Solar Applications
iii. analyze the PV and solar thermal system for various external and internal distribution.

1. Solar Energy Measurement
2. Solar Energy Forecasting
4. Characteristics of PV Panel
5. Perturb and Observe MPPT Technique
6. Fuzzy Logic based DC-DC Converter for PV System
7. Neural Network based DC-DC Converter for PV System
8. Simulation of Stand-alone PV systems using Matlab -Simulink.
10. Study of the Effects of Partial Shading on PV Array Characteristics
11. Thermal Modeling and Simulation of a Building
12. Modeling and Simulation of Solar Water Heater

**11EE335 WIND ENERGY LAB**

**Credits: 0:0:2**

1. Wind Turbine Modeling and Simulation
2. Permanent-magnet Synchronous Generator Modeling and Simulation
3. Fuzzy Logic based Wind Energy Forecasting
4. ANN based Wind Energy Forecasting
5. Wind Power Curve Estimation
6. Maximum power tracking of a wind energy system
7. Fuzzy logic control based maximum power tracking of a wind energy system
9. Simulation of a phasor model of a squirrel-cage induction generator driven by a variable pitch wind turbine
10. Simulation of a phasor model of a variable speed doubly-fed induction generator driven by a wind turbine
11. Simulation of model of a variable pitch wind turbine
12. Reactive power control in wind power plants

**11EE336 SOLAR PASSIVE ARCHITECTURE**

**Credits: 4:0:0**

**Course Objectives:**
- to understand the Building Laws and architectural Design.
- to understand the designing of a building, with an emphasis on the climate and other environmental conditions.
- to understand the concepts of a comfortable thermal environment and how to apply passive solar design principles, passive ventilation and solar shading to create a comfortable thermal environment.

**Unit I: Introduction**
Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building.

**Unit II: Thermal Analysis and Design for Human Comfort**
Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation; Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems.

**Unit III: Passive Cooling and Heating Concepts**
Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces; Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

Unit IV: Heat Transmission in Buildings
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.: Central receiver systems, parabolic trough systems; Solar furnaces.

Unit V: Bioclimatic Classification
Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.

Course Outcome:
At the end of the course, the students should be able to:
   i. analyze the site and its context in preparation for designing a building, particularly with respect to climate and other environmental conditions.
   ii. Design and build environments that are both thermally comfortable and thermally delightful by utilizing passive solar design principles.
   iii. utilize the combined site-specific potentials of sun, light, wind and rain for creating a sustainable, comfortable and delightful built environment.

Reference Books:

11EE337 GREEN BUILDING

Credits: 4:0:0

Course Objectives
i. To learn green building concepts and ecological design concepts applicable to modern buildings
ii. Acquaint students with the principle theories of materials and construction techniques to create green buildings
iii. To provide exposure to various national and international rating systems as compliance requirements for green buildings

**Unit I: Green Building Process and Ecological Design**
Conventional versus green building delivery systems - Green building project execution - the integrated design process - green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

**Unit II: Green Building Systems**

**Unit III: Green Building Implementation**
Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

**Unit IV: Green Building Assessment**

**Unit V: Economics of Green Buildings**
Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits.

**Course Outcome**
At the end of the course, the student will be able to:
  i. understand and actively participate in the overall iterative and multidisciplinary process of conceptualizing and designing an environmentally friendly building
  ii. choose and size building components, as well as energy and environmental systems suitable for different categories of buildings, and different climate zones.
  iii. evaluate the economic performance of buildings as related to their resource-consumption and environmental performance.

**Reference Books:**

11EE338 DATA MINING FOR RENEWABLE ENERGY TECHNOLOGY

Credits: 3:1:0

Course Objectives:
- To enlighten the students on the basic concepts of data mining.
- To improve the students competence in the algorithms and learning schemes of data mining.
- To enable the students to exploit the data mining techniques for research in renewable energy.

Unit I: Introduction
Data Mining – Kinds of Data – Functionalities – Classification – Primitives – Major Issues – Data Preprocessing – Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation - Data Reduction

Unit II: Data Warehouse: An Overview
Data Warehouse – Multidimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – From Data Warehousing to Data Mining. Mining Frequent Patterns, Associations: Basic Concepts and a Road Map – Efficient and Scalable Frequent Item set -Mining Methods- Mining Multilevel Association Rules

Unit III: Classification and Prediction
Issues regarding classification and prediction - Decision tree Induction - Bayesian Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit IV: Cluster Analysis
Types of Data – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods. Mining Stream, Time-Series and Sequence Data Mining- Data Streams – Mining Time-series- Data- Mining Sequence Patterns in Transactional Databases

Unit V: Applications in Renewable Energy Technology

Course Outcome:

At the end of this course, the students will be able to

i. understand the importance of data-driven performance optimization of renewable energy technology.
ii. exploit the vast data base available in the renewable energy sector and devise ways to make renewable energy a competitive source of supply.
iii. explore new data mining techniques for renewable energy applications
Reference Books:

11EE339 SOFT COMPUTING TECHNIQUES

Credits: 3:1:0

Course Objectives:
1. To develop a detailed understanding of various soft computing techniques.
2. To analyze the mechanisms of different AI techniques and modern heuristics algorithms.
3. To develop skills to apply the soft computing techniques for various practical optimization problems.

Unit I: Introduction
Approaches to intelligent control-Architecture for intelligent control- Symbolic reasoning system, rule-based systems- AI approach- Knowledge representation-Expert systems.

Unit II: Artificial Neural Networks
Concept of Artificial Neural Networks and its basic mathematical model- McCulloch-Pitts neuron model-simple perceptron, Adaline, Madeline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network, recurrent network. Neural Network based controller

Unit III: Fuzzy Logic System
Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases- Fuzzy modeling and control schemes for nonlinear systems- Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time-delay system.

Unit IV: Modern Heuristic Algorithms
Basic concept of Genetic algorithm (GA) and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of tabu search (TS), evolutionary programming (EP) and ant-colony optimization (ACO) techniques for solving optimization problems.

Unit V: Applications
GA, TS, EP and ACO applications to power system and power electronics optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-

Course Outcome:
At the end of the course, the students will be able to
   i. state the mechanisms of various soft computing techniques.
   ii. understand the mechanisms of various modern heuristic optimization algorithms.
   iii. apply the soft computing techniques for practical applications.

Reference Books:
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<tr>
<th>Sub. Code</th>
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<td>12EE102</td>
<td>Basic Electrical and Electronics Engineering</td>
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<td>12EE226</td>
<td>Digital Signal Processing Laboratory</td>
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<td>12EE227</td>
<td>C++ and Data Structures</td>
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<td>12EE228</td>
<td>C++ and Data Structures Laboratory</td>
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<td>12EE229</td>
<td>Measurement and Instrumentation</td>
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<td>12EE230</td>
<td>Measurements and Computer Aided Electrical Machine Design Laboratory</td>
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<tr>
<td>12EE231</td>
<td>Material Science</td>
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<td>12EE232</td>
<td>Energy Systems</td>
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<td>12EE233</td>
<td>Communication Engineering</td>
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<td>Biomedical Instrumentation</td>
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<td>Embedded System</td>
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<td>Special Electrical Machines</td>
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<td>Virtual Instrumentation</td>
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<td>Illumination Engineering</td>
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<td>Automotive Electronics</td>
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<td>12EE240</td>
<td>Renewable Energy Sources</td>
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<td>12EE241</td>
<td>Digital System Design</td>
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<td>Power System Stability</td>
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<td>Power System Control</td>
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<td>12EE244</td>
<td>Neural Network and Fuzzy Systems</td>
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<td>Micro Electromechanical Systems</td>
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<td>Computer Architecture</td>
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<td>Operating System</td>
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<td>Computer Communication</td>
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<td>Grid Computing</td>
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<td>Nanocomputing</td>
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<td>12EE251</td>
<td>Basics of Medical Electronics</td>
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<td>12EE252</td>
<td>Basics of Electric And Hybrid Vehicle</td>
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<td>Building Automation</td>
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<td>Fundamentals of Electrical Safety</td>
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<td>Artificial Organs &amp; Rehabilitation Engineering</td>
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<td>Advanced Control System</td>
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<td>High Voltage Engineering</td>
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<td>Electrical and Electronics Workshop Practice</td>
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<td>12EE259</td>
<td>Design Laboratory</td>
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<td>12EE260</td>
<td>Power Engineering Simulation Laboratory</td>
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<td>12EE261</td>
<td>Control Systems Laboratory</td>
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<td>HVDC Transmission</td>
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<td>HVDC and FACTS</td>
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<td>Power Semiconductor Devices</td>
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<td>Power Converter Analysis – I</td>
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<td>12EE303</td>
<td>Power Converter Analysis – II</td>
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<td>Solid State DC Drives</td>
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<td>Solid State AC Drives</td>
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<td>12EE306</td>
<td>Generalized Theory of Electrical Machines</td>
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<td>12EE307</td>
<td>Special Machines and Controllers</td>
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<td>12EE308</td>
<td>Advanced Digital Signal Processing</td>
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<td>12EE309</td>
<td>DSP Based Control of Electric Drives</td>
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<td>12EE310</td>
<td>Advanced Topics in Power Electronics</td>
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<td>Power Electronics Laboratory</td>
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<td>Electric Drives And Control Laboratory</td>
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<td>Photovoltaic Systems</td>
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<td>Power Electronic Circuits</td>
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<td>Solar Thermal Energy Conversion</td>
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<td>Advanced Control Techniques for Induction Generators</td>
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<td>12EE317</td>
<td>Energy Engineering</td>
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<td>12EE318</td>
<td>Wind Energy</td>
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<td>12EE319</td>
<td>Hydrogen and Fuel Cells</td>
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<td>Energy Management and Audit</td>
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<td>Bio-Mass Energy</td>
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<td>Energy Modelling, Economics and Project Management</td>
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<td>12EE325</td>
<td>Simulation of Power Electronics Systems</td>
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<td>12EE326</td>
<td>Power Electronics Applications to Power Systems</td>
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<td>12EE327</td>
<td>Neuro – Fuzzy Controllers for Electric Drives</td>
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<td>12EE328</td>
<td>Power Electronics in Wind and Solar Power Conversion</td>
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<td>12EE329</td>
<td>HVDC Transmission</td>
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<td>12EE330</td>
<td>PLC and Automation</td>
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<td>12EE331</td>
<td>Electric and Hybrid Vehicles</td>
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<td>12EE332</td>
<td>Electromagnetic Interference and Compatibility</td>
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<td>12EE333</td>
<td>Optimization Techniques</td>
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<td>12EE334</td>
<td>Power Engineering Simulation Laboratory</td>
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<td>12EE335</td>
<td>Flexible AC Transmission Systems</td>
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<td>Industrial Electronics and Instrumentation</td>
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<td>Passive Solar Architecture</td>
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<td>Green Building</td>
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<td>Data Mining for Renewable Energy Technology</td>
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<td>Soft Computing Techniques</td>
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<td>Oceanic Energy</td>
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<td>12EE343</td>
<td>Geothermal Energy</td>
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<td>12EE344</td>
<td>Optimal Control of Wind Energy Systems</td>
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<td>12EE345</td>
<td>Wind Resource Assessment and Forecasting Methods</td>
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<td>12EE346</td>
<td>Design of Turbines for Renewable Energy System</td>
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<td>12EE347</td>
<td>Computer Networks and Protocols</td>
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<td>12EE348</td>
<td>Microcontrollers Application in Power Electronics</td>
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</table>
12EE101 BASIC ELECTRICAL ENGINEERING

Credits: 3:0:0

Course Objective
- To impart the basic knowledge about the Electric and Magnetic circuits.
- To understand the working of various Electrical Machines.
- To know about various measuring instruments and house wiring.

Course Outcome
- Predicting the behavior of any electrical and magnetic circuits.
- Identifying the type of electrical machine used for a particular application.
- Wiring any circuit depending upon the requirement.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Book
Reference Books

12EE102 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Credits: 4:0:0

Course Objective
• To impart the basic knowledge about the DC and AC circuits.
• To understand the working of various Electrical Machines.
• To inculcate the understanding about the fundamentals of semiconductor devices, Transducers and Measuring Instruments.

Course Outcome
• Predicting the behavior of any DC and AC circuits.
• Identifying the type of electrical machine used for that particular application.
• Knowing the different types of transducers depending upon the requirement.

Unit I

Unit II
BASICS OF AC CIRCUITS: Generation of Alternating EMF – Equation of alternating voltage – Introduction to Alternating Quantities - Average and RMS value – Form and Peak factor – Introduction to Two phase and Three Phase systems – Star and Delta Connection – Comparison.

Unit III
BASICS OF ELECTRICAL MACHINES: Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor, Single phase Induction motor, Alternator, Stepper Motor. (Quantitative approach)

Unit IV

Unit V

Text Book

Reference Books

12EE201 ELECTRIC CIRCUITS AND NETWORKS

Credits: 3:1:0

Course Objective
- To develop the ability to apply the basic laws and theorems to analyze a DC and AC electric circuit.
- To use mathematical methods such as Laplace and Fourier transforms and some linear algebra techniques and differential equations to solve circuits problems
- To synthesize a network with stable condition.

Course Outcome
- Ability to analyze simple circuits applying Ohm’s and Kirchhoff’s laws
- Ability to analyze first-order response of RL, RC and RLC circuits.
- Ability to design any non-linear network, filters and attenuators for an application

Unit I

Unit II
NETWORK THEOREMS: Thevenin, Norton, Superposition, Reciprocity, Substitution, and Maximum Power Transfer Theorems - Problems

Unit III
TRANSIENT RESPONSE OF ELECTRIC CIRCUITS: Transient Concepts – Singularity functions-unit step, unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of
complex frequency – Driving point and transfer impedances – Poles and zeros of network function.

Unit IV

Unit V
TWO PORT NETWORKS AND FILTERS: Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent π and T networks – passive filters as a two port network – characteristics of ideal filter – low pass and high pass filters.

Text Books

Reference Books

12EE202 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Course Objective
• To understand the concept of charge, current and fields.
• To calculate electromagnetic field distribution for various configurations.
• To impart knowledge on electrostatic, and magnetostatic fields, electromagnetic fields and electromagnetic waves.

Course Outcome
• Knowledge on vector fields will be gained.
• Ability to solve the advanced EMF problems.
• Knowledge of Electromagnetic waves and its travelling through various medium will be gained.

Unit I

Unit II

Unit III

Unit IV

Unit V
ELECTROMAGNETIC WAVES: Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines – Skin effect.-Power and the Poynting Vector – Applications of EMF waves.

Text Books

Reference Books

12EE203 ELECTRON DEVICES

Credits: 3:0:0
Course Objective
- To study the operation and characteristics of different semiconductor devices.
- To know different methods of fabrication of semiconductor devices in an IC.
- To familiarize the student with the principle of operation, capabilities and limitation of various electron devices and their applications.

Course Outcome
- The concepts of semiconductor devices will be known
- Application in rectifiers, inverters, choppers etc. will be known.
- The concepts of IC fabrication will be known.

Unit I
P-N JUNCTION DIODE: Diode operation-V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Diode Switching times, PN junction diode ratings. Breakdown phenomenon in diodes - LED, Photodiode, Zener diodes, Schottky barrier diodes.

Unit II
BIPOLAR JUNCTION TRANSISTOR (BJT): Physical behavior of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings

Unit III
JUNCTION FIELD EFFECT TRANSISTOR (JFET): JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal J F E T model, JFET as a switch, Voltage variable resistor and an amplifier.

Unit IV
METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (MOSFET): Constructional details - Operation of Enhancement and Depletion type MOSFETs, V-I Characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier.

Unit V
INTEGRATED CIRCUIT (IC) FABRICATION: Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication – need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, IC packaging.

Text Books

Reference Books

12EE204 CIRCUITS AND DEVICES LABORATORY

Credits 0:0:2
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

12EE205 ELECTRONIC CIRCUITS

Credits: 3:0:0

Course Objective
- To impart knowledge about the various methods of transistor biasing and design of simple amplifier circuits.
- To teach the methods of analysis of feedback amplifiers and analyze, design of oscillators, tuned amplifiers and multivibrators.
- To train the students to analyze, design of power supplies and wave shaping circuits.

Course Outcome
- Knowledge to identify, formulate, and solve engineering problems in the area circuits and systems will be gained.
- Ability to function on multi-disciplinary teams through the electronic circuits experiments and projects.
- Ability to design an electric system, components or process to meet desired needs within realistic constraints
Unit I
POWER SUPPLIES: Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor, Filters – Inductor, Capacitor, L type and π type, Ripple Factor and Regulation, Basic concept about voltage regulator, Introduction to Switched Mode Power Supplies.

Unit II
WAVE SHAPING: Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping–Clipping and clamping circuits, Attenuator, Introduction to pulse transformers.

Unit III
VOLTAGE AMPLIFIERS: BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, BIFET amplifiers, DC amplifiers, Differential and Common mode gain, CMRR, Cascade and Darlington Amplifiers. Chopper Amplifiers

Unit IV
POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS: Power amplifiers– Classification, Class A/B/C, Single ended and Push-pull Configuration, Power dissipation and output power, Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation, Basic concepts of feedback amplifiers, Voltage and current feedback circuits.

Unit V

Text Books

Reference Books
1. Common Emitter Amplifier
2. Common Source Amplifier
3. Differential Amplifier using BJT
4. Integrator and Differentiator using R and C
5. Series Voltage Regulator
6. Emitter Follower
7. UJT Relaxation Oscillator
8. RC Phase-Shift Oscillator
9. Colpitts Oscillator
10. Astable Multivibrator
11. Bistable Multivibrator
12. Schmitt Trigger Circuit

12EE207 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Course Objective
- To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
- To understand the generation of D.C. voltages by using different type of generators and study their performance.
- To study the working principles of D.C. motors and their load characteristics, starting and methods of speed control.

Course Outcome
- Knowledge of constructional details of different type of transformers, working principle and its performance will be gained.
- Skill to estimate the various losses taking place in D.C. machines and transformers.
- Skill to analyze the different testing method to arrive at its performance.

Unit I

Unit II
DC GENERATORS: Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit III
DC MOTORS: Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne’s test – Separation of losses, Hopkinson’s test.
Unit IV
TRANSFORMERS: Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams -Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency – Parallel operation.

Unit V

Text Books

Reference Books

12EE208 DC MACHINES AND TRANSFORMERS LABORATORY

Credits 0:0:2
1. Load characteristics of a Separately Excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series Motor
6. Speed control of DC Shunt Motor
7. Electric Braking of DC Shunt Motor
8. Swinburne’s Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner’s Test on a Single Phase Transformer.
12. Three Phase Transformer Connections.

12EE209 INDUCTION AND SYNCHRONOUS MACHINES
Credits 3:1:0

Course Objective
- To learn the basic concepts about the different types of induction and synchronous machines.
- To understand the speed control and the starter operations.
- To acquire knowledge on two reaction theory.

Course Outcome
- Knowledge of selecting the suitable motor for an application and implement suitable control techniques for the selected motor.
- Ability to identify the various operation conditions of Synchronous motor and its impact.
- Ability to understand the importance of various parameter while synchronization.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE210 AC MACHINES AND CONTROLS LABORATORY

Credits 0:0:2

1. Load test on Three Phase Squirrel Cage Induction Motor.
2. Load test on an Alternator.
3. No load and blocked rotor Test on Three Phase Squirrel Cage Induction Motor.
4. Speed control of Three Phase Wound Rotor Induction Motor.
5. Load test on Single Phase Induction Motor.
6. Voltage Regulation of Alternator by MMF method.
7. V and Inverted V Curves of Three-Phase Synchronous Motor.
8. Operation of Alternator on infinite bus bar.
10. Transfer function of Separately Excited DC Generator.
11. Transfer function & Frequency Response analysis of an Armature Controlled DC Motor.
12. Transfer function & Frequency Response analysis of a Field Controlled DC Motor.

12EE211 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Course Objective
- Knowledge on the design aspects of Electrical Machines.
- Have a good understanding on the design and application of DC and AC machine.
- Knowledge of basic design concepts and cooling arrangement of transformer.

Course Outcome
- To demonstrate the magnetic circuit and electric circuit’s aspects of any machine.
- To design the DC and AC machine for any specification given.
- To design the transformer and its cooling tubes for the speciation given.
Unit I

Unit II
DC MACHINES: Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III
TRANSFORMERS: Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers- Design of tanks and cooling tubes.

Unit IV
INDUCTION MACHINES: Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient - No-load current calculation - Stator and rotor resistance - Losses and efficiency.

Unit V

Text Book

Reference Books

12EE212 POWER ELECTRONICS

Credits: 3:0:0

Course Objective
• Study the Static and Dynamic characteristics of Power Semiconductor Devices.
• Understand the operation of power electronic converters and its control strategies of various power converters.
• Study the design parameters for control circuitry requirement of various converters.
Course Outcome

- Usage of electronics and solid-state power devices for the control, conversion, and protection of electrical energy.
- Ability to design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
- Ability to components; interpret terminal characteristics of the components for designing the circuitry for power converters.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

**Reference Books**

**12EE213 POWER ELECTRONICS LABORATORY**

Credits 0:0:2
1. Characteristics of MOSFET, IGBT, SCR and TRIAC
2. Single Phase Full Converter Bridge Rectifier with R & R – L Load
3. Single Phase Semi Converter Bridge Rectifier with R & R – L Load
4. Three Phase Half wave Converter with R & R – L Load
5. D.C. Chopper with Motor Load
7. Single Phase Cycloconverter with R & R – L Load
8. Single Phase Series Inverter with R & R – L Load
9. Switched Mode Power Supply
10. Static Inverter with Three Phase Induction Motor Load
11. Simulation of Power Electronic Circuits using MATLAB/Simulink
12. Simulation of Power Electronic Circuits using PSIM

**12EE214 ELECTRIC DRIVES AND CONTROL**

Credits: 3:0:0

**Course Objective**
- Understand the classification and characteristics of Drives.
- Analyze the various types and operations of DC & AC Drives.
- Analyze the operation of Special Machine Drives.

**Course Outcome**
- Understand the dynamics of Electrical drive systems.
- Select suitable motor depending upon the loading.
- Select suitable converters and their controls for drive applications.

**Unit I**

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE215 GENERATION, TRANSMISSION AND DISTRIBUTION

Credits 3:1:0
Course Objective

- Understand the concepts of various methods Electrical Energy Generation.
- Learn the usage of passive elements in various Power Transmission Systems.
- Understand the factors affecting Insulators and calculate the various parameters in Distribution System.

Course Outcome

- Ability to analyze the performance of various units involved in the power plants.
- Ability to design a power system solution based on the problem requirements and realistic Constraints.
- Ability to develop a major design experience in power a system that prepares them for engineering practice.

Unit I

Unit II

Unit III
LINE INSULATORS: Types – Potential distribution over a string of suspension insulators - Methods of increasing string efficiency - Corona – Factors affecting corona - Stress and Sag Calculation – Effect of wind and ice - supports at different levels – Stringing chart.

Unit IV
UNDERGROUND CABLES: Types - Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle - Breakdown voltage - Optimum cable length – location of faults in cables – Comparison between Overhead lines and Underground cables.

Unit V
DISTRIBUTION SYSTEMS: Feeders, Distributors and Service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, A.C. single phase and three phase distribution systems.

Text Books

References Books

12EE216 POWER SYSTEM ANALYSIS

Credits: 3:0:0

Course Objective
- Develop understanding of the basic concepts of load flow, economic dispatch, fault analysis, and transient stability.
- Apply this knowledge to model and predict system behavior.
- Apply this knowledge to design power transmission and distribution systems to meet needs.

Course Outcome
- Demonstrate the ability to model power systems.
- Analyze the impact of short-circuit faults on the power network and make design changes to the network to control the fault currents.
- Understand the dynamic principle of power systems and generators.

Unit I
INTRODUCTION: Need for System analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - Short circuits analysis for fault on machine terminals.

Unit II

Unit III

Unit IV
ECONOMICAL OPERATION OF GENERATING STATIONS: Optimal operation of generators – Economical scheduling of thermal plant with and without transmission losses –
Loss formula derivation - Unit commitment – Elementary idea of optimal load scheduling of Hydro - Thermal plants.

**Unit V**

**STABILITY STUDIES & POWER QUALITY ANALYSIS:** Steady state and Transient stability - Swing equation and its solution by Modified Euler and Runge- Kutta methods- Equal area criterion Power Quality Analysis: Sags and swells - voltage sag - voltage swell – voltage imbalance -voltage fluctuation - power frequency variations. International standards of power quality

**Text Books**

**Reference Books**

**12EE217 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY**

**Credits 0:0:2**
1. Formation of $Y_{bus}$ Matrix using Direct Inspection Method
2. Formation of $Y_{bus}$ Matrix using Singular Transformation Method
3. Load Flow Analysis by Newton- Raphson Method
4. Load Flow Analysis by FDLF method
5. Automatic Load Frequency Control
6. Automatic Voltage Regulator
7. $Z_{bus}$ Formation using building algorithm
8. Analysis of Symmetrical Faults
9. Economic Load Dispatch
10. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
11. Harmonic Analysis of simple electrical circuit using MATLAB-SIMULINK
12. Speed Control of DC motor using MATLAB-SIMULINK

**12EE218 POWER SYSTEM PROTECTION AND SWITCHGEARS**

**Credits 3:0:0**

**Course Objective**
• To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
• To understand the characteristics and functions of relays and protection schemes.
• To understand the problems associated with circuit interruption by a circuit breaker.

Course Outcome
• Choose the appropriate relay for the application.
• Design Protective schemes for various Electrical apparatus.
• Analyze the testing of circuit breakers.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE219 CONTROL SYSTEMS

Credits 3:1:0

Course Objective
• Understand the methods of representation of systems and getting their transfer function models.
• Impart adequate knowledge in the time response of systems and steady state error analysis.
• Impart basic knowledge about the frequency response and stability of a closed loop system.

Course Outcome
• Have a sound knowledge in the basic concepts of control theory
• Design closed loop system projects.
• Work out the practical problems by using state variable analysis.

Unit I
INTRODUCTION: Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems – Mechanical systems, Translational and Rotational systems, Electrical network. Transfer function of DC Generator, DC servomotor, AC servomotor, Synchros, Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs – Mason’s gain formula.

Unit II

Unit III
FREQUENCY RESPONSE ANALYSIS: Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.
Unit IV

Unit V
**STATE VARIABLE ANALYSIS**: Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms - Transfer function from state space representation - controllability - observability.

**Text Books**

**References Books**

**12EE220 DIGITAL ELECTRONICS**

**Credits 3:1:0**

**Course Objective**
- To introduce the concepts of Boolean algebra.
- To make them familiar with the implementation of combinational logic functions.
- To make them understand about the working of counters and flip flops.

**Course Outcome**
- Apply Boolean Algebra & K –Map To Digital Circuits.
- Design Combinational and Sequential Circuits.
- Design the Logic Circuits to Specific Applications.

**Unit I**

**Unit II**

Unit III

Unit IV
SEQUENTIAL LOGIC DESIGN-II: Basic models of sequential machines – concept of state table – state diagram – state reduction through partitioning & implementation of synchronous sequential circuits – Introduction to asynchronous sequential logic design.

Unit V
LOGIC FAMILIES: RTL, DTL, TTL families, Schottky – clamped TTL, Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL), MOS inverters, CMOS inverters, Comparison of performance of various logic families.

Text Books

Reference Books

12EE221 LINEAR INTEGRATED CIRCUITS

Credits 3:0:0
Course Objective
Students will be able to
- Understand the functionality of various linear integrated circuits.
- Understand the usage of different linear ICs for different applications.
- Acquire a good knowledge in designing the circuits.

Course outcome
- Understand the linear ICs and its various modes of operation.
- Utilize and Construct various applications using the linear ICs.
Design suitable voltage regulation with protection circuit.

Unit I

Unit II

Unit III
NONLINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS: Comparator – Regenerative comparator, Zero crossing detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, Multiplier and Divider, Square and Triangular waveform generators.

Unit IV
IC VOLTAGE REGULATORS & SPECIAL FUNCTION ICs: IC Voltage Regulators - Fixed and adjustable three terminal regulators - Block diagram of 723 General purpose voltage regulators – Circuit configurations, Current limiting schemes, Output current boosting, Switching regulators.
SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs.

Unit V
DIGITAL TO ANALOG CONVERTERS: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Parallel types – DAC/ADC performance characteristics.

Text Books

Reference Books

12EE222 LINEAR AND DIGITAL IC LABORATORY

Credits 0:0:2

1. Performance characteristics of Op-amp IC
2. Instrumentation amplifier using Op-amp ICs.
3. Maximally flat active filter using Op-amp IC.
4. Precision full wave and half wave rectifier, using Op-amp IC.
5. Wien’s bridge oscillator using Op-amp IC.
6. Astable multivibrator and Schmitt trigger, using Op-amp IC
7. Realization of different flip-flops, using logic gates.
8. Realization of simple switching functions, using NAND or NOR gates.
10. Shift register and Ring counter
11. Multiplexer and Demultiplexer
12. Digital to Analog converter

12EE223 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Course Objective:
- To learn the basic 8085 Microprocessor architecture, working and programming.
- To understand the operation of 8051 Microcontroller.
- To accumulate the knowledge about PIC Microcontroller.

Course Outcome
- Knowledge about the processing of microcontroller and microprocessor.
- Able to use it for real time applications.
- Clear idea about PIC Microcontroller.

Unit I

Unit II
ARCHITECTURE OF 8051: Block diagram of Microcontroller – Comparison with Microprocessor and Microcontroller – Pin details of 8051 – ALU – Special function registers – ROM – RAM – RAM Memory Map (including registers and register banks) – Program Counter
Unit III

Unit IV

Unit V
INTERFACING EXTERNAL DEVICE WITH 8051: 8051 interfacing to external memory – 8051 interfacing with the 8255 – Sensors interfacing – Parallel ADC and Serial ADC interfacing – DAC interfacing - Keyboard interfacing – Seven segment and LCD display interfacing – Stepper Motor interfacing – DC motor interfacing and PWM.

Text Books

Reference Books

12EE224 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credits: 0:0:2

1. Simple addition, Subtraction, Division and Multiplication of two 8-Bit numbers using INTEL 8085
2. Finding the maximum and minimum value in an array using INTEL 8085
3. Arranging the given data in Ascending, Descending order using INTEL 8085
4. BCD to HEX conversion and HEX to BCD conversion using INTEL 8085
5. HEX to ASCII and ASCII to Binary conversion using INTEL 8085  
6. Interfacing ADC with 8085 Processor  
7. Interfacing 8279 keyboard/ display controller with 8085 microprocessor  
8. Simple addition and Subtraction of two 8-Bit numbers using 8051 Microcontroller  
9. Multiplication and division of two 8-Bit numbers using 8051 Microcontroller  
10. Stepper motor control using 8051 Microcontroller  
11. DC Motor control using PIC Microcontroller  
12. AC Power control using PIC Microcontroller  

12EE225 DIGITAL SIGNAL PROCESSING

Credits 3:1:0

Course Objective
- To analyze signals and systems.
- To study various transformation techniques and filter design.
- To study about a programmable digital signal processor & quantization effects.

Course Outcome
- Students will be able to select appropriate DSP processors for particular applications.
- Apply various transformation techniques for signal processing applications.
- Design filters for different real time applications.

Unit I
SIGNALS AND SYSTEMS: Classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect - Digital signal representation; Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance.

Unit II

Unit III

Unit IV
FIR FILTER DESIGN: Structures of FIR – Linear phase FIR filter – Filter design using windowing techniques, Frequency sampling techniques – Finite word length effects in digital Filters.
Unit V
APPLICATIONS: Multi-rate signal processing – Speech compression – Adaptive filter –
Musical sound processing – Image enhancement - selecting digital signal processors -
Introduction to Commercial Processors.

Text Books

Reference Books
   and Applications’, Tata McGraw- Hill Education India Private Limited, New Delhi,
   2003.

12EE226 DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2
1. Generate basic Discrete Time Signal waveform
2. Basic operations on signals and properties of discrete time systems
3. Convolution
4. Time and frequency response of DT system
5. Realization of transfer function
6. Compute Discrete Fourier Transform of given sequence
7. Spectrum Analysis
8. IIR filter design
9. FIR filter design
10. Signal Reconstruction
11. Perform Sampling rate conversion
12. Least Means Square algorithm

12EE227 C++ AND DATA STRUCTURES

Credits 3:0:0

Course Objective
- To study the basics of C++ programming.
- To know various programming methods in C++.
- To know the various applications using programming language.
Course Outcome

- Understand the fundamental concepts of C++ programming.
- Apply programming skills for various applications including electrical applications.
- To have analytical ability by quick programming.

Unit I
INTRODUCTION TO DATA STRUCTURES: Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue.

Unit II

Unit III
INTRODUCTION TO C++: C++ fundamentals – data types, operators and expressions, control flow, arrays, strings, pointers and functions. A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, Constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

Unit IV
OPERATOR OVERLOADING: Overloading Unary and Binary Operator, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, pointers to pointer.

Unit V
VIRTUAL FUNCTIONS: Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

Text Books

Reference Books
12EE228 C++ AND DATA STRUCTURES LABORATORY

Credits: 0:0:2

1. Basics of C++ Programming
2. Implementation of Classes and Objects
3. Implementation of Constructor and Destructor
4. Implementation of Overloading
5. Implementation of Inheritance
6. Illustration on Pointers
7. Implementation of Abstract Class and Virtual Functions
8. Implementation of Class Template
9. Implementation of Stack and Queue
10. Implementation of Linked List
11. Implementation of Searching Techniques
12. Implementation of Sorting Techniques

12EE229 MEASUREMENTS AND INSTRUMENTATION

Credits: 3:0:0

Course Objective
- Understand about the operation of an indicating instrument and use them for measurement of electrical quantities.
- Adequate knowledge of comparison methods of measurement.
- Exposure to various transducers and data acquisition system.

Course Outcome
- Knowledge of various measurement techniques available.
- Basic working of instruments used for measurement
- Errors in measurements and their rectifications.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Book

Reference Books

12EE230 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credits 0:0:2
5. Study of Resistive, Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine armature (Open Slot) using AutoCAD
8. Drawing of field magnetic frame of a DC machine using AUTOCAD
9. Drawing of the commutator of a DC machine using AUTOCAD
10. Drawing of the stator of a three-phase motor using AUTOCAD
11. Drawing of squirrel cage rotor with fan using AUTOCAD
12. Drawing of one limb of a three phase oil cooled power transformer using AUTOCAD.
12EE231 MATERIAL SCIENCE

Credits 3:0:0
Course Objective
- To understand the concepts of Crystals, Metals and Alloys.
- To realize the Qualitative study of various polarization.
- To impart knowledge on Advanced Materials.

Course Outcome
- Knowledge of different materials and their applications.
- Analyze and understand Qualitative study of various polarization
- Perform classification of insulating materials on temperature basis.

Unit I

Unit II
SEMI-CONDUCTING MATERIALS: Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors-Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski’s technique and zonerefining technique, Hall effect – Hall coefficient in extrinsic semiconductors, experimental determination of hall coefficient, Application of hall effect, Semiconductor devices –Solar cells and LCD.

Unit III
DIELECTRIC MATERIALS AND DEVICES: Qualitative study of various polarizations, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – BaTiO₃ and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism.

Unit IV
MAGNETIC MATERIALS AND DEVICES: Ferro and Ferri magnetic materials – properties, Helesenbelg and domain theory of ferromagnetism, Hysteresis ferrite- structure and properties, Applications— floppy disks, CD ROM, Magnetic optical recording.

Unit V
ADVANCED MATERIALS: Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys-Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors.

Text Books

Reference Books

12EE232 ENERGY SYSTEMS

Credits: 3:0:0

Course Objective
- Impart knowledge about the various non conventional energy sources.
- Understand concept of illumination systems, heating and welding systems.
- Learn the requirements of traction systems.

Course Outcome
- Technological basis for harnessing these renewable energy sources including their possibilities and limitations.
- Determination of appropriate lighting control techniques and equipment to a sample project.
- Select the suitable drive for traction application.

Unit I

Unit II

Unit III

Unit IV
ILLUMINATION, ELECTRIC HEATING & WELDING: Electric lamps – gaseous discharge- construction and application – control equipment, efficiency and losses – Lighting calculations – determination of MHCP and schemes – polar curves of different types of sources –

Unit V

Text Books

Reference Books

12EE233 COMMUNICATION ENGINEERING

Credits 3:0:0

Course Objective
- Learn the basic principles, concepts and types of communication systems.
- Understand the various design issues in a communication system.
- Gain knowledge about optical communication.

Course Outcome
- Analyze and design basic communication systems, particularly with application to noise-free analog and digital communications.
- Apply concepts and techniques from circuit analysis to communication systems.
- Develop the ability to compare and contrast the strengths and weaknesses of various communication methods.

Unit I
RADIO COMMUNICATION SYSTEM: Types of signals – Analogue and digital signals - Spectrum of signals – Telecommunication services – Telecommunication paths - Concept of modulation - Principle of AM and FM – AM and FM transmitters and receivers.

Unit II

UNIT III
DATA COMMUNICATION SYSTEM: Data Communication codes – Bar codes – Error control – Error detection – Error correction – Data communication hardware – Data communication circuits – Data communication Modems.

UNIT IV

UNIT V

Text Books

Reference books

12EE234 BIOMEDICAL INSTRUMENTATION

Credits 3:0:0

Course Objective
- Study different types of electrodes used in bio potential recording.
- Understand the characteristics of bio amplifiers and different types of recorders.
- Understand how to measure various biochemical and nonelectrical parameters of human system.

Course Outcome
- The concepts of physiological and the Electrical Components of a Biomedical System will be known.
- Knowledge of the measurement of physiological parameters.
• The concepts of Imaging System and Telemetry and the various Therapeutic Equipments used in Medicine will be known.

Unit I

Unit II

Unit III

Unit IV

Unit V
IMAGING SYSTEMS AND TELEMETRY: Computerized Tomography (CT) – MRI instrumentation – Ultrasound scanner – X-ray machine – Fluoroscopic techniques – Angiography – Cardiac Catherisation lab – Echo cardiograph – Vector cardiograph – Biotelemetry.

Text Books

Reference Books

12EE235 EMBEDDED SYSTEMS

Credits: 3: 0: 0

Course Objective
- Introduce the basic concepts of Embedded Systems.
• Introduce Interface Issues and Techniques of Embedded Systems.
• Introduce real time operating systems.

Course Outcome
• Knowledge about the architecture of embedded processors.
• Knowledge about the components of real time operating systems.
• Design of their own embedded systems.

Unit I
SYSTEM DESIGN: Definitions - Classifications and brief overview of micro-controllers microprocessors and DSPs - Embedded processor architectural definitions - Typical application scenario of embedded systems.

Unit II

Unit III
TECHNIQUES FOR EMBEDDED SYSTEMS: State Machine and state Tables in embedded design – Event based, Process based and Graph based models – Petrinet Models - Simulation and Emulation of embedded systems - High level language descriptions of S/W for embedded system - Java based embedded system design.

Unit IV
REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS: Real time languages - Real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services

Unit V
MICRO C/OS-II REAL TIME OPERATING SYSTEM: Study of Micro C/OS-II RTOS – RTOS System Level Functions – Task Service Functions – Time Delay Functions – Memory Allocation Related Functions – Semaphore Related Functions – Mailbox Related Functions – Queue Related Functions

Text Book

Reference Books

12EE236 SPECIAL ELECTRICAL MACHINES
Credits 3:0:0

Course Objective
- Differentiate the constructional features and principle of operation, characteristics of various special machines.
- Devise suitable control techniques for the special machine considered.
- Control of special machines with microprocessor and microcontrollers.

Course Outcome
- Selecting an energy efficient linear or rotary motor based on the characteristics of the load & application
- Incorporating the correct control technique to the machine for efficient operation
- Improving the performance of the motor by enhancing the motor suitably.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Book

Reference Books

12EE237 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Course Objective
- Study about the Virtual instrumentation system and LabVIEW based Virtual Instrumentation.
- Study about the hardware and software involved programming techniques in VI.
- Study about the basic of Programming Techniques.

Course Outcome
- Understand the advantages of Data flow programming
- Use VI for instrumentation and control
- Design a LabVIEW based instrumentation system

Unit I
REVIEW OF VIRTUAL INSTRUMENTATION: Historical perspective, advantages, Block diagram and Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II
INTRODUCTION TO LabVIEW: Introduction to LabVIEW-Advantages of LabVIEW-Software Environment-Creating and Saving VI- Controls and Indicators- Data types. SubVI: Creating- Opening-Editing-Placing an SubVI in a block- Creating a Stand Alone Application

Unit III
PROGRAMMING TECHNIQUES: Loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit IV
DATA ACQUISITION BASICS: Signals Handling and Classification – Signal Conditioning - Analog Interfacing (I/O) - Counters & Timers – Digital (I/O) - DAQ Hardware – DAQ Software Architecture - DAQ Assist

Unit V

Textbooks

Reference Books

12EE238 ILLUMINATION ENGINEERING

Credits: 3:0:0

Course Objective
- To design an electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
- To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
- To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Course Outcome
- Perform indoor & outdoor lighting design calculations.
- Determine appropriate lighting control techniques and equipment to a sample project.
- Perform basic lighting energy audit to a sample project.

Unit I

Unit II

Unit III

Unit IV

Unit V
Text Books

Reference Books

12EE239 AUTOMOTIVE ELECTRONICS

Credits 3:0:0

Course Objective
- Study the concepts of sensors, actuators, drives.
- Study Electronics Fuel Injection System and Lighting system and accessories.
- Study the digital control of starting and braking methods in the automobile system.

Course Outcome
- Understanding the significance of automation in automobile.
- Understanding the Digital engine control system.
- Understanding the significance of automotive electronics in leveraging the passenger safety.

Unit I
SENSORS AND ACTUATORS: Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II

Unit III

Unit IV
LIGHTING SYSTEM & ACCESSORIES: Insulated & earth return systems, Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive
methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

Unit V

Text Book

Reference Books

12EE240 RENEWABLE ENERGY SOURCES

Credits: 3:0:0

Course Objective
- To explain concept of various forms of renewable energy
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels.

Course Outcome
- Have knowledge about various renewable energy sources.
- Be able to choose the appropriate renewable energy as an alternate for conventional power in any application.
- Be able to analyze the cost effect of renewable energy sources.

Unit I
SOLAR ENERGY: Solar radiation its measurements and prediction - solar thermal flat plate collectors, concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes.

Unit II
WIND ENERGY: Atmospheric circulations – classification - factors influencing wind - wind shear – turbulence - wind speed monitoring - Betz limit - Aerodynamics of wind turbine rotor-
site selection – wind resource assessment - wind energy conversion devices - classification, characteristics, and applications. Hybrid systems - safety and environmental aspects.

**Unit III**

**BIO-ENERGY:** Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of Biogas Plants- applications

**Unit IV**

**HYDROGEN AND FUEL CELLS:** Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types – construction and applications.

**Unit V**

**OTHER TYPES OF ENERGY:** Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection and geothermal power plants.

**Text Book**


**Reference Books:**


**12EE241 DIGITAL SYSTEM DESIGN**

**Credits 3:0:0**

**Course Objective**

- To review the concepts of Digital logic circuits
- To understand PLDs and FPGA Programming techniques
- To have a appreciable knowledge on the programmable logic devices and its programming abilities.

**Course Outcome**
• Understand the sequential logic circuits and the other symmetric functions.
• Get knowledge on the programmable logic devices and its programming abilities.
• Have an understanding on the FPGA and its programming using VHDL.

Unit I

Unit II
PROGRAMMABLE LOGIC DEVICES: Basic concepts - Programming techniques - Programmable Logic Element (PLE) -Programmable Logic Array (PLA) - Programmable Array Logic (PAL)-Designing an up-down counter using PLA - Structure of Standard PLD’s - Design of combination and sequential circuits using PLD’s.

Unit III

Unit IV

Unit V

Text Book

Reference Books

12EE242 POWER SYSTEM STABILITY

Credits 3:0:0

Course Objective
• Impart knowledge about the concept of stability in a Power System.
• Make the students understand the importance of stability under different conditions like transient and steady state in the power system.
• Learn the methods of improving the stability & use of computations for the analysis of this stability.

Course Outcome
• Realize the situation happening in the power system under various load conditions.
• Have a thorough knowledge about maintaining and improving the stability of a system.
• Get knowledge on methods to analyze transient and steady state stability of a power system.

Unit I
INTRODUCTION TO STABILITY: Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II

Unit III

Unit IV

Unit V

Text Book

Reference Books

12EE243 POWER SYSTEM CONTROL

Credits 3:0:0

Course Objective
- Understand & model power-frequency dynamics and to design power-frequency controller.
- Understand & model reactive power-voltage interaction.
- Understand different methods of control for maintaining voltage profile against varying system load.

Course Outcome
- Realize the importance of maintaining the frequency and voltage within the safe range.
- Have a thorough knowledge about modeling of systems under varying conditions
- Get knowledge on SCADA system, its function and state estimation concepts

Unit I
INTRODUCTION: Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops - Real power and Reactive Power improvement methods.

Unit II
REAL POWER AND FREQUENCY CONTROL: Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two area and multi-area system – Steady state instabilities.

Unit III
REACTIVE POWER AND VOLTAGE CONTROL: Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

Unit IV

Unit V
STATE ESTIMATION: Introduction-Least square estimation-static state estimation of power systems-tracking state estimation of power systems- some computational considerations-External
system equivalency- treatment of bad data-network observability and pseudo measurements-
Application of power system state estimation

Text Books
   Education India Private Limited, New Delhi, 1983.

Reference Books
   New Jersey, 1953.
   Analysis and Control”, Tata Mc Graw-Hill Education India Private Limited, New Delhi,
   1990.

12EE244 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits 3:0:0

Course Objective
• Expose the students to the concepts of Single layer and Multi layer feed forward Neural
  Networks.
• Provide adequate knowledge about feedback neural networks.
• Provide comprehensive knowledge about the applications of Neural Networks and Fuzzy
  Systems in Electrical Engineering.

Course Outcome
• Apply the concept of neural network for optimization of any system performance.
• Use an appropriate network for to data in Real Time Applications.
• Apply the concepts of neural networks for Process Identification and Power Plants.

Unit I
INTRODUCTION TO NEURAL NETWORKS: Organization of human brain – Comparison
between computer & human brain – Comparison between Artificial and Biological Neural
Network - Artificial Neuron Model & Mcculloch Pitts Neuron Model – Characteristics of Neural
Networks – Applications – Advantages of Neural Networks – Types of Activation function –
Neural Networks Architectures – Learning Strategy – Types of learning Rules.

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE245 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 3:0:0
Course Objective

- Introduce the concept of Micro Electro Mechanical Systems
- Outline different methods of micromachining, microstructures, micro sensors, and micro actuators
- Study the various applications of MEMS

Course Outcome

- Have knowledge about various Micro Electro Mechanical Systems.
- Understand Material Processing and Device Fabrication using which can do Microsystems Design for various applications.
- Understand the Applications of MEMS in various fields.

Unit I
INTRODUCTION TO MEMS: Historical background of Micro Electro Mechanical Systems, role of MEMS in improved efficiency, Smart materials and structures, materials-processing, synthesis, Multifunctional Polymers.

Unit II
MATERIAL PROCESSING AND DEVICE FABRICATION: Lithography, Ion Implantation, Etching, Wafer bonding, integrated processes, Bulk silicon micromachining, surface micro machining, CVD oxide process.

Unit III
MICRO SENSORS AND MICRO ACTUATORS: Micromechanical components – springs, bearings, gears and connectors, High temperature sensors, Capacitive pressure sensor, bulk micro-machined accelerometer, Surface micro machined micro spectrometer.

Unit IV
MICROSYSTEMS DESIGN AND PACKAGING: Design considerations, Mechanical Design, Process design, Realization of MEMS components using Intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

Unit V

Text book

Reference Books

12EE246 COMPUTER ARCHITECTURE

Credits 3:0:0

Course Objective

- Familiarize students about hardware design and behavior of the various functional modules of the computer.
- Understand and evaluate constraints and tradeoffs in microprocessor design.
- Highlight the important issues in computer architecture, organization, its performance, design and relation to the system software.

Course Outcome

- Recognize different types of architectures and the difference between computer architecture and organization.
- Know how to design a computer system.
- Bridge the software, hardware, and firmware gaps.

Unit I

INTRODUCTION: Register transfer language-register, bus and memory transfers–Arithmetic logic and shift micro operations.


Unit II

CENTRAL PROCESSOR ORGANIZATION: General register organization – Stack organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline.

Unit III

ARITHMETIC PROCESSING: Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations.

Unit IV


Unit V
INTRODUCTION TO PARALLEL PROCESSING: Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.

Textbooks

Reference Books

12EE247 OPERATING SYSTEMS

Credits 3:0:0

Course Objective
- Study the evolution of Operating Systems.
- Analyze the concepts of memory management and process management systems.
- Understand the procedure of each and every management system and do case study.

Course Outcome
- Understand the concepts of operating systems.
- Gain understanding of memory and process management.
- To have a better knowledge on different windows versions and its development.

Unit I

Unit II

Unit III
Unit IV

Unit V

Text Books

Reference Books

12EE248 COMPUTER COMMUNICATION

Credits 3:0:0

Course Objective
- Study the communication networks in computer
- Know various data communication techniques.
- Know the various applications using network protocols.

Course Outcome
- Understand the concepts of Computer Communication
- Understand the peripheral connections in a computer.
- It also gives broad idea on networking which are available for daily use.

Unit I

Unit II

Unit III
DATA COMMUNICATION TECHNIQUES: Asynchronous and synchronous communication – BISYNC, SDLC, HDLC – X.2.5 protocols – Error control coding.

Unit IV

Unit V

Text Books

References Books

12EE249 GRID COMPUTING

Credits 3:0:0

Course Objective
- Introduce about the grid computing techniques.
- Explain and describe the structure of Grid Computing in Business.
- Make a complete case study of enterprise grid, engine and grid cyber-infrastructure.

Course Outcome
- Acquire knowledge about open grid service architecture.
- Understand about the grid taxonomy, grid infrastructure provider.
- Know about the security in grid computing.

Unit I
Unit II

Unit III

Unit IV

Unit V
CASE STUDIES: The MCNC enterprise grid-SUN N1 grid engine-LSF suite-the NEES grid cyper-infrastructure the globus toolkit 4 service container.

Text Book

Reference Book

12EE250 NANO COMPUTING

Credits 3:0:0

Course Objective
- To make the students know about the introduction to nanoelectronics.
- To be aware of the different architecture.
- To be aware of the different Nanosystems.

Course Outcome
- Have good knowledge in the basis of Nanotechnology.
- Be aware of the development of Nanoelectronics.
- Have an idea about the nanosystems that could be used in information systems.

Unit I
of Action, Charge, and Flux – Electrons behaving as waves – Electrons in potential wells – Diffusion process

Unit II

Unit III

Unit IV

Unit V
NANOSYSTEMS AS INFORMATION PROCESSING MACHINES: Nanosystems as functional machines-information processing as information modification system design and its interfaces-requirements of nanosystems. Uncertainties: Removal of Uncertainties by nano machines- Uncertainties in nano systems – Uncertainties in the development of nano electronics.

Text Books
2. Rainer Waser, “Nanoelectronics and Information Technology”, John Wiley& Sons, Germany, 2005

Reference Books
12EE251 BASICS OF MEDICAL ELECTRONICS

Credits 3:0:0

Course Objective
- Have knowledge about the various devices used in medical field.
- Have an awareness of the safety aspects of medical instruments.
- Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Course Outcome
- Have knowledge about various devices used in medical field
- Have the basic understanding of how the signals are obtained from the body
- Be aware of the safety aspects in this field.

Unit I
ANATOMY AND PHYSIOLOGY: Elementary ideas of cell structure- Cell potential- Heart and circulatory system- Central nervous system-Muscle action-Respiratory system-Body temperature and reproduction system

Unit II

Unit III
TRANSUDCERS: Classification and characteristics of Transducer, pressure transducer – LVDT pressure transducer, Strain gauge pressure transducer, temperature transducer- Thermocouple, Electrical Resistance Thermometer, Thermistor, photoelectric transducer – photovoltaic, Photo emissive.

Unit IV
PATIENT MONITORING SYSTEMS: Heart rate measurement-Pulse rate measurement-Respiration rate measurement-Blood pressure measurement- Use of Microprocessor in patient monitoring.

Unit V

Text Books
2. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007

Reference Books

12EE252 BASICS OF ELECTRIC AND HYBRID VEHICLE

Credits: 3:0:0

Course Objective
- To understand the concepts of electric and hybrid vehicle
- To know the necessity of alternative and novel energy sources.
- To study the various machines and controller used in electric and hybrid vehicle.

Course Outcome
- Develop a hybrid vehicle with existing renewable system.
- Design a new controller for hybrid electric vehicle.
- Apply control techniques to store the energy.

Unit I
INTRODUCTION: Electrical Vehicle History- Battery electric vehicles- Hybrid vehicle-Fuelled electric vehicles- Solar powered vehicles- Electric vehicles which use flywheels or super capacitors.

Unit II
BATTERIES: Introduction- Battery Parameter-Self-discharge rates-Battery temperature, heating and cooling needs -Battery life- Introduction to Lead Acid Batteries, Nickel-based Batteries, and Lithium Batteries, use of batteries in Hybrid Vehicles.

Unit III

Unit IV
ELECTRIC MACHINES FOR HYBRID VEHICLE: Operation of the DC motor- Induction motor – Brushless DC Motor – Switched Reluctance Motors – converters for BLDC and SRM.

Unit V

Text Books
Reference Books

12EE253 BUILDING AUTOMATION

Credits: 3:0:0

Course Objective
- Understand about the building automation and its management system.
- Study about the security and safety systems in smart building.
- Suggest suitable possibilities to integrate system and its managements for intelligent building.

Course Outcome
- Construct and design structured building system by enabling integrated system connections.
- Apply the building automation system and telecommunication facilities in modern intelligent buildings; and apply networking technologies in building automation.
- Evaluate the comprehensive specifications of an importance of energy conservation components for a modern commercial building.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE254 FUNDAMENTALS OF ELECTRICAL SAFETY

Credits: 3:0:0

Course Objective
• Exhibit knowledge of safety rules and regulations, and demonstrate awareness of hazards in the workplace.
• Explain the use of personal protective equipment.
• Understand the various reasons for electrical accidents

Course Outcome
• Demonstrate proper safety procedures.
• Demonstrate proper use of hand and power tools.
• Identify various trades used in the construction industry.

Unit I

Unit II
STUDY OF ELECTRICAL SAFETY COMPONENTS: Introduction to conductors and insulators- Wire Characteristics- Ampacity, Insulation Type, Wire Size, Cables & Cords – Electrical Standards- Safety against over voltages- Safety against Static Electricity.

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE255 ARTIFICIAL ORGANS & REHABILITATION ENGINEERING

Credits: 3:0:0

Course Objective
- Provide knowledge about various types of assist devices.
- Give a basic idea of the artificial organs that can aid a human to live a normal life.
• Provide the awareness of how a help can be rendered to a differently abled person

Course Outcome
• Students will have knowledge about various types of assist devices.
• Students will have the ability to choose which type of assist device is suitable for various disorders and legal aspects related to rehabilitation.
• Students will have the urge to develop new devices based on the basic knowledge gained in different assisting devices.

Unit I
INTRODUCTION TO ARTIFICIAL ORGANS: Biomaterials used in artificial organs and prostheses, Outlook for Organ replacement – Design considerations – Evaluation Process.

Unit II

Unit III

Unit IV

Unit V
VISUAL AIDS: Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter

Text Books

Reference Books

12EE256 ADVANCED CONTROL SYSTEMS

Credits: 3:0:0

Course Objective
• Insight a wide knowledge on the description and stability of non-linear system.
• Understand the analysis of digital control system using state-space formulation.
• Look at the formulation and analysis of multi input multi output (MIMO) system.
Course Outcome

- Gain knowledge in analysis of non-linear system and digital control of linear system.
- Implement the concept of MIMO system.
- Find non-linear system stability using the trajectory methods.

Unit I
STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS: State variable representation – Conversion of state variable form to transfer function and vice versa – Eigen values and Eigenvectors – Solution of State Equation – Controllability and observability – Pole placement design – Design of State observer.

Unit II

Unit III
STATE SPACE ANALYSIS OF DISCRETE TIME SYSTEMS: State variables – Canonical forms – Digitization – Solution of state equations – Controllability and Observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems.

Unit IV

Unit V

Text Book

Reference Books

12EE257 HIGH VOLTAGE ENGINEERING

Credits 3:0:0

Course Objective
- To understand the various types of over voltages in power system and protection methods.
- To impart knowledge of breakdown mechanism in solid, liquid and gaseous dielectrics.
- Generation and measurement of over voltages.

Course Outcome
- Understand the causes of over voltages and Insulation Coordination, Choice of Insulation Design.
- Generation and Measurement of High Voltages and Currents.
- Testing of Electrical Power Apparatus

Unit I
TRANSIENTS IN POWER SYSTEMS AND INSULATION COORDINATION:

Unit II
ELECTRIC BREAKDOWN OF GASES, LIQUID AND SOLID MATERIALS:

Unit III

Unit IV

Unit V

Text Book

Reference Books

12EE258 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2
1. Study of Lighting Schemes
2. Study of accessories used in wiring and types of wiring.
3. Exercises in house wiring and power wiring
5. Experiment on the various types of Electrical Machines.
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.
10. Measurement of RLC.
11. Characteristics of PN junction diode and Zener diode.
12. Transducers.

12EE259 DESIGN LABORATORY

Credits: 0:0:2
1. Design and Fabrication of Power Supply Circuit.
2. Design and Assembling of a Single Phase Transformer.
3. Design and Fabrication of Instrumentation Amplifier.
4. Design and Fabrication of PID Controller.
5. PWM Generation using IC555 for DC Motor Control.
6. Design of 3 Bit ADC using OP-AMP.
7. Trouble shooting of Induction Motor.
10. UJT firing scheme.

12EE260 POWER ENGINEERING SIMULATION LABORATORY

Credits: 0:0:2
1. Simulation of Half Wave Controlled Rectifier using MATLAB/SIMULINK.
2. Simulation of Single Phase AC Voltage Controllers using MATLAB/SIMULINK.
3. Automatic Load Frequency Control using MATLAB/SIMULINK.
4. Automatic Voltage Regulator (AVR) using MATLAB/SIMULINK.
5. Simulation of Single Phase Full Bridge Sinusoidal PWM Inverter using MATLAB/SIMULINK.
6. Simulation of Multilevel Inverter using MATLAB/SIMULINK.
7. Simulation of Single Phase Fully Controlled Rectifier using PSIM.
8. Simulation of Buck – Boost Converter using PSIM.
9. Simulation of Three Phase Sinusoidal PWM Inverter using PSIM.
10. Simulation of One Quadrant Chopper Circuit with current Feedback using MATLAB/SIMULINK & PSIM Co-simulation.
11. Simulation of Single Phase AC Voltage Controllers using PSIM.
12. Simulation of ZCS and ZVS Resonant Converter using PSIM.

**12EE261 CONTROL SYSTEMS LABORATORY**

**Credits: 0:0:2**

1. Determination of transfer function parameters of a DC servo motor.
2. Determination of transfer function parameters of AC servo motor.
3. Analog simulation of type-0 and type-1 system.
4. Digital simulation of linear systems.
5. Digital simulation of non-linear systems.
6. Design and implementation of compensators.
8. Stability analysis of linear systems.
9. Closed loop control system.
10. Study of synchros.
11. Design of Lag Compensator.
12. Design of Lead Compensator.

**12EE262 HVDC TRANSMISSION**

**Credits: 3:0:0**

**Course Objective**
- The course aims at use of high voltages as the key to efficient transmission and distribution of electrical power.
- To have an overview about different forms of insulation and their behavior, over voltage conditions and protection of equipments.
- To analyze the malfunctioning of converters and protection.

**Course Outcome**
- facilitate a basic understanding about high voltage insulators, cables, bushings, occurrence of over voltages and protection of HV equipments from failure due to over voltage
- Outline the benefits of using DC transmission, terminal converters its operation and control.
- Analyze the Challenges and its solutions available in High voltage DC transmission.

**Unit I**

Unit II
ANALYSIS OF HVDC CONVERTERS: Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60º – With overlap greater than 60º – Complete characteristics of rectifier and Operation of Inverter.

Unit III
CONVERTER AND HVDC SYSTEM CONTROL: Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV

Unit V

Text Books

Reference Books

12EE263 HVDC AND FACTS

Credits: 3:0:0

Course Objective
• To study the various types of Modern transmission systems
• To impart knowledge on HVDC and FACTS
• To study the effect of FACTS controllers on AC transmission system

Course Outcome
• Understand the various components of HVDC and FACTS.
• Analyze the different control schemes of HVDC and FACTS systems.
• Derive the optimal operating condition for HVDC and FACTS systems.

Unit I
HIGH VOLTAGE DIRECT CURRENT (HVDC): HVDC system Introduction -Principle of operation, Standard transmission voltages, Power handling capacity and line losses.

Unit II
DC POWER TRANSMISSION TECHNOLOGY: comparison of AC and DC transmission, application of DC transmission – Description of DC transmission system planning for HVDC transmission-modern trends in DC transmission.

Unit III
FACTS: Basic concepts of static VAR Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

Unit IV
TYPES OF FACTS & APPLICATIONS: Operation of SVC-Voltage control by SVC- influence of SVC on system voltage- Operation of the TCSC – Different modes of operation- Applications of SVC and TCSC.

Unit V

Text Book

Reference Book

12EE301 POWER SEMICONDUCTOR DEVICES

Credits: 4:0:0

Course Objective
• To understand various static and dynamic performances of static switches.
• To familiarize the student on switching and steady state characteristics power electronic devices.
• To analyze the control circuits and switching losses in power devices.
Course Outcome

- Design switching using power semiconductor devices.
- Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
- Select the components, interpret terminal characteristics of the components, model components, design circuit, and understanding operation of power electronics circuits.

Unit I

Unit II
THYRISTORS: Physics of device operation - Electrical rating - Switching and steady state characteristics – Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - Light fired Thyristor - switching losses.

Unit III
SPECIAL TYPES OF THYRISTORS: TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods – Series, Parallel operation of GTO Thyristors.

Unit IV

Unit V

Text Book

Reference Books

12EE302 POWER CONVERTER ANALYSIS – I

Credits: 3:1:0

Course Objective
- To give in depth knowledge of the various power electronics circuits
- To analyze the behavior of the Power Electronic circuits along with the design.
- To understand the control methods of various power converters.

Course Outcome
- Analyze the circuits and select them for the suitable applications.
- Trouble shooting the power electronic circuits
- Design various firing circuits for the converters

Unit I

Unit II

Unit III

Unit IV

Unit V
CYCLOCONVERTERS: Principle of operation – Single phase and three phase cycloconverters – Load Commutated cycloconverters

Text Book

Reference Books:

12EE303 POWER CONVERTER ANALYSIS – II

Credits: 3:1:0

Course Objective:
- To give in depth knowledge of the inverters and its configurations
- To Analyze the behavior of the Power Electronic circuits along with their design
- To understand the control methods of various power converters

Course Outcome:
- Analyze the circuits and select them for the suitable applications
- Construct PE system for specific applications
- Design various firing circuits for the converters

Unit I
SINGLE PHASE INVERTERS: Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques

Unit II
THREE PHASE VOLTAGE SOURCE INVERTERS: 180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: sinusoidal PWM, space vector modulation techniques.

Unit III
CURRENT SOURCE INVERTERS: Single phase CSI with ideal switches – Capacitor commutated inverters with R Load – Auto sequential commutated inverter (ASCI) – comparison of current source inverter and voltage source inverters

Unit IV
MULTILEVEL INVERTERS: Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters

Unit V
RESONANT INVERTERS: Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

Text Book

Reference Books

12EE304 SOLID STATE DC DRIVES

Credits: 3:1:0

Course Objective
- To understand the fundamentals of various electromechanical systems.
- To understand the basic concept of DC Drives.
- To understand the various control techniques involved with DC Drives.

Course Outcome:
- Design and Analyze different control techniques of DC Drives.
- Select suitable DC Drive for different requirements
- Apply appropriate control method for the application.

Unit I
DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS: DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives. Characteristics of electrical system – dynamic equations, components of torque – Types of load requirements of drives characteristics – Multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

Unit II
CONVERTER CONTROL: Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics – Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

Unit III
CHOPPER CONTROL: Introduction to time ratio control and frequency modulation- Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes-Multi-phase chopper- Related problems.

Unit IV
CLOSED LOOP CONTROL: Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed DC drive.

Unit V
DIGITAL CONTROL OF D.C DRIVE: Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

Text Book

Reference Books
braking – CSI fed IM variable frequency drives – comparison – Impact of Harmonics on the drive performance.

Unit III
**ROTOR CONTROLLED INDUCTION MOTOR DRIVES:** Static rotor resistance control - injection of voltage in the rotor circuit – Static scherbius drives - Power factor considerations – Modified Kramer drives

Unit IV
**VECTOR CONTROL:** Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

Unit V
**SYNCHRONOUS MOTOR DRIVES:** Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self control – Load commutated Synchronous motor drives - Brush and Brushless excitation.

Text Book

Reference Books

**12EE306 GENERALISED THEORY OF ELECTRICAL MACHINES**

Credits: 3:1:0

Course Objective
- To impart knowledge on the generalized representation and steady state analysis of Synchronous Machines.
- To impart knowledge on the analysis of harmonics in Induction machine using Matlab/Simulink.
- To impart knowledge on the generalized representation of Synchronous Machine using Matlab/Simulink.

Course Outcome
- Describe the Generalized Representation of machines and their analysis.
- Describe the steady state analysis and transient analysis of various machines.
• Describe the performance of Induction and Synchronous machines and their representation.

Unit I
GENERALIZED THEORY: Conversions - Basic two pole machines - Transformer with movable secondary –Transformer voltage and speed voltage - Kron's Primitive Machine - Analysis of Electrical Machines.

Unit II
BASICS OF ELECTRICAL MACHINES AND TRANSFORMATIONS: Electrical radians and Synchronous speed – Flux per pole and Induced voltage – Spatial mmf distribution of a winding – winding inductances – Developed torque of a Uniform airgap machine – Invariance of Power – Three phase transformations – Clarke’s Transformation – Park’s Transformation – dq0 Transformation applied to line elements – Transformation between abc and Stationary dq0 – Transformation between abc and Rotating dq0 – Case studies – Simulation of various transformations using MATLAB/SIMULINK.

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE307 SPECIAL MACHINES AND CONTROLLERS

Credits: 4:0:0

Course Objective:
- To impart knowledge on the construction, principle of operation and the control techniques of stepper motor and Switched Reluctance Motors.
- To study the characteristics of permanent magnet brushless DC motor
- To understand the control methods, applications of PMSM and linear motors

Course Outcome:
- Differentiate the working of different drives and performance
- Select a suitable special machine drive based on the application
- Incorporate an appropriate control scheme for the application specified

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Book
Reference Books

12EE308 ADVANCED DIGITAL SIGNAL PROCESSING

Credits :4:0:0

Course Objective
- To have an overview of signals and systems and DFT & FFT Transforms.
- To study the design of IIR & FIR filters.
- To study the applications of DSP techniques in processors.

Course Outcome
- Understand types of digital signals and Transforms and its application to signals and systems.
- Design of IIR & FIR filters.
- Understand different DSP processors and basic programming skills.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12EE309 DSP BASED CONTROL OF ELECTRIC DRIVES

Credits: 4:0:0

Course OBJECTIVE
- Basics of motion control Digital Signal Processor and generation of PWM Signals
- Concept of Event Handling, Interrupts and Interface Conversion
- Control of Motor using a DSP

Course OUTCOME
- Select a suitable Digital Signal Processor for the control of the machine.
- Implement the DSP based Control for the machine.
- Use real time DSP system for online control

Unit I

Unit II
GPIO, INTERRUPTS, EVENT MANAGERS AND ANALOG TO DIGITAL CONVERTER:
General Purpose I/O Overview – Multiplexing and General Purpose I/O Control Registers – Using the General Purpose I/O ports – Introduction to Interrupts – Interrupt hierarchy – Interrupt Control Registers – Initializing and servicing interrupts in Software - Overview of the Event Manager – Event Manager Interrupts – General Purpose Interrupts – General Purpose Timers –
Compare units – Capture units and Quadrature Encoded Pulse (QEP) circuitry – Operation of Analog to Digital Converter – Analog to Digital Converter usage.

Unit III
CLARKE’S & PARK’S TRANSFORMATION AND SPACE VECTOR MODULATION:

Unit IV

Unit V

Text Book

Reference Books

12EE310 ADVANCED TOPICS IN POWER ELECTRONICS

Credits: 4:0:0

Course Objective
- To impart the knowledge of latest advances in the field of power electronics
- To understand the basics of modeling of power converters
- To introduce the phenomena of non-linearity in power converters

Course Outcome
- To understand the effect of power electronic converter in a system using their models and transfer functions
- Ability to design filters for converters
- To understand the impact of non-linear phenomena in power electronic circuits

Unit I

Unit II
CONVERTER TRANSFER FUNCTIONS: Analysis of converter transfer functions – Graphical construction of impedances and transfer functions – Graphical construction of converter transfer functions – Measurement of AC transfer functions and impedances – Problems.

Unit III

Unit IV
NON-LINEAR PHENOMENA IN DC-DC CONVERTERS: Basics of bifurcation and chaos theory - Border collision bifurcations in the current mode controlled boost converter - Bifurcations and chaos in the latched voltage controlled buck converter - Routes to chaos in the voltage controlled buck converter without latch - Saddle-node and Neimark bifurcations in PWM dc-dc converters - Nonlinear analysis of the operation in discontinuous conduction mode - Nonlinear phenomena in the Cuk converter.

Unit V

Text Books

Reference Books

12EE311 POWER ELECTRONICS LABORATORY

Credits: 0:0:2

2. Design, Testing of Single Phase Full Bridge Converter Bridge on R & R – L Load
3. Design, Testing of Single Phase Semi Converter Bridge on R & R – L Load
4. Design, Testing of Three Phase Half wave Converter with R & R – L Load
5. Design, Testing of MOSFET based DC Chopper on R & R – L Load
7. Design, Testing of Single Phase Series Inverter with R & R – L Load
9. Design of triggering circuits using microcontrollers
10. Switched Mode Power Supply (SMPS)
11. Simulation of Semi & Full Bridge Converter using PSIM
12. Simulation of AC Voltage Controller using MATLAB

12EE312 ELECTRIC DRIVES AND CONTROL LABORATORY

Credits: 0:0:2

1. IGBT Based Inverter Fed Induction Motor Drive
2. Chopper Fed DC Motor Drive
3. Multilevel Inverter Fed Induction Motor Drive
4. DSP (TMS320F2812) Based Switched Reluctance Motor Drive
5. Space Vector PWM Control of Induction Motor.
6. Three Phase Rectifier Fed DC Motor Drive
7. Three Phase AC Voltage Controller Fed Induction Motor Drive
8. Matrix Converter Fed Induction Motor Drive
9. DSP (TMS320F2407) Based Permanent Magnet Synchronous Motor Drive
10. Control of DC Motor using dSPACE ACE 1103 Control Kit
11. DSP (TMS320F2812) BLDC Motor Drive
12. FPGA Based Motor Control

12EE313 PHOTOVOLTAIC SYSTEMS

Credits: 4:0:0

Course Objective
- To provide necessary knowledge about the modeling, design and analysis of various PV systems
- To show that PV is an economically viable, environmentally sustainable alternative to the world's energy supplies
- To understand the power conditioning of PV system’s power output

Course Outcome:
- Model, analyze and design various photovoltaic systems
- Know the feasibility of PV systems as an alternative to the fossil fuels
- Design efficient stand alone and grid connected PV power systems

Unit I
INTRODUCTION TO PHOTOVOLTAIC (PV) SYSTEMS: Historical development of PV systems- Overview of PV usage in the world-Overview of PV usage in India- Solar Map-Solar
energy potential for PV- irradiance, solar radiation and spectrum of sun- geometric and atmospheric effects of sunlight-Photovoltaic effect-conversion of solar energy into electrical energy.

Unit II
SOLAR CELLS AND ARRAYS: Behavior of solar cells-basic structure and characteristics: types - equivalent circuit-modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current-Solar cell arrays- PV modules-PV generators- shadow effects and bypass diodes- hot spot problem in a PV module and safe operating area- Terrestrial PV module modeling- Interfacing PV modules with different loads.

Unit III

Unit IV
INVERTERS FOR PV SYSTEMS: Inverter control topologies for standalone and grid-connected operation-Analysis of inverter at fundamental frequency and at switching frequency- Feasible operating region of inverter at different power factor values for grid connected systems and stand-alone PV systems. Consumer applications-residential systems-PV water pumping-PV powered lighting-rural electrification.

Unit V
POWER CONDITIONING OF PV SYSTEMS: Power conditioning and maximum power point tracking (MPPT) -Maximum power point tracking (MPPT) algorithms-Grid-connected PV systems-Active power filtering with real power injection-Modeling and simulation of complete stand-alone and grid-connected PV systems.

Text Books

Reference Books

12EE314 POWER ELECTRONIC CIRCUITS
Credits: 3:1:0
Course Objective
- To impart the knowledge of various conversion techniques of electrical energy using power electronic components.
- To establish the link between efficient usage of power and conservation of energy resources of the world.
- To provide the design details of various power electronic converters.

Course Outcome
- Understand the significance of the characteristics of various power semiconductor switches
- Design of power electronic conversion systems
- Understand various modulation (control) techniques such as pulse width modulation and selective harmonic elimination.

Unit I
POWER SEMICONDUCTOR SWITCHES: Classification of power converters-Ideal switch and rectifier-Semiconductor power switching devices used in power electronic circuits: Diode, bipolar junction transistor (BJT), silicon controlled rectifier (thyristor), Gate turn-off thyristor (GTO), MOSFET, insulated gate bipolar transistor (IGBT), integrated gate commutated thyristor (IGCT)- I-V characteristics, operation principles, maximum voltage and current ratings. Gating circuits for controlled semiconductor switches- Series and parallel commutation circuits for turning-off of thyristors.

Unit II

Unit III
DC TO DC CONVERTERS: DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper– Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit IV

Unit V
Text Book

Reference Books

12EE315 SOLAR THERMAL ENERGY CONVERSION

Credits: 4:0:0

Course Objective
• To provide a comprehensive engineering basics for solar thermal system and its design
• Know about the different technologies of solar thermal systems.
• Know about the different types of solar heating & cooling.

Course Outcome
• Calculate the Solar Radiation on Horizontal and Tilted Surfaces
• Analyze the performance of Different Solar Collectors
• Choose the right type of solar collector for an application and design Solar heating and cooling systems.

Unit I
RADIATIVE PROPERTIES AND CHARACTERISTICS OF MATERIALS: Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials.

Unit II
FLAT-PLATE COLLECTORS: Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors- Thermal analysis; Evacuated tubular collectors.

Unit III
SOLAR THERMAL ENERGY STORAGE: Types: Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage system.
Unit IV
CONCENTRATING COLLECTOR: Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V
SOLAR HEATING & COOLING SYSTEM: Solar water heating systems, Liquid based systems for buildings, solar air heating systems, Methods of modeling and design of solar heating system, Cooling requirements of buildings, Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; solar desiccant cooling.

Text Books

Reference Books

12EE316 ADVANCED CONTROL TECHNIQUES FOR INDUCTION GENERATORS

Credits: 3:1:0

Course Objective
• To understand the transient and steady state modeling of induction generators.
• To give an in-depth knowledge about the different control techniques of induction generators.
• To enhance the students’ perspective on optimized control of induction generators which are widely used in renewable energy systems.

Course Outcome:
• Understand the complex control concepts
• Ensuring energy economy and efficiency.
• Apply the optimization techniques for maximum performance

Unit I

Unit II

Unit III
SCALAR CONTROL OF INDUCTION GENERATORS: Scalar Control background – Scalar Control Schemes –Open control schemes – closed loop control schemes– Problems.

Unit IV
VECTOR CONTROL OF INDUCTION GENERATORS: Vector Control – Axis Transformation – Space Vector Notation – Field Oriented Control – direct vector control- indirect vector control- Problems

Unit V
OPTIMIZED CONTROL OF INDUCTION GENERATORS: Optimization Principles – Application of Hill Climbing Control (HCC) for Induction Generators- HCC based Maximum Power Search – Fuzzy Logic Controller based Maximum Power Search - Problems

Text Books

Reference Books

12EE317 ENERGY ENGINEERING

Credits: 4:0:0

Course Objective
- To create environment-friendly and energy-efficient buildings
- To deal with actively harnessing renewable natural resources like solar energy and utilizing materials that cause the least possible damage to the global commons – water, soil, forests and air.
- To deal with global and Indian energy scenario.

Course Outcome
- Effectively manage the energy requirements
- Work out for the new available sources and its utilization
- Manage the environmental issues regarding the energy sources

Unit I
INTRODUCTION TO ENERGY: Definition and Units of energy, power, Forms of energy, Conservation of energy, Energy flow diagram to the earth. Conventional and nonconventional energy sources- Origin of fossil fuels, time scale of fossil fuels, Renewable Energy Resources, Role of energy in economic development and social transformation. Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time,

Unit II
NATIONAL AND GLOBAL ENERGY SCENARIO: Energy resources available in India, urban and rural energy consumption, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources. Energy consumption in various sectors, projected energy consumption for the future, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

Unit III

Unit IV
ENVIRONMENTAL IMPACT: Kyoto protocol- Environmental degradation due to energy production and utilization, Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment.

Unit V

Text Books

Reference Books

12EE318 WIND ENERGY

Credits: 3:1:0

Course Objective:
• To develop a detailed understanding of the issues associated with the development of wind energy for electrical energy supply.
• To know the current state of wind energy development domestically and internationally
• To understand the issues of location and grid connection of wind energy power plants

Course Outcome:
• Understand the role which wind energy plays and can play in the electricity supply system and its role in meeting the country’s obligations in terms of greenhouse gas abatement
• Gain knowledge regarding wind energy resources and the ability to assess those resources
• Gain knowledge of construction, characteristics, control and performance of wind turbines

Unit I
ROLE OF WIND ENERGY: World’s energy requirements – Role of wind energy in Electricity production – Renewable energy policy, National and International; The role of wind energy in greenhouse gas abatement – Economics of Wind Energy – Commercial and regulatory issues – Energy trading, green credits and carbon taxes – Economic assessment of wind energy systems – Funding of wind energy projects

Unit II

Unit III

Unit IV
Unit V
SITING OF WIND TURBINES AND INTEGRATION WITH SUPPLY NETWORKS:
Wind turbine site selection – Operational issues of wind turbines – Embedded generation and wind turbines – Impacts of wind turbines on electrical supply networks – Network issues frequency control, voltage control, fault levels – Quality of supply issues associated with wind turbines – Control of network interface – Supervisory control – Backup supply – Energy storage – Integration with other energy sources – Hybrid systems

Text Book

Reference Books

12EE319 HYDROGEN AND FUEL CELLS

Credits: 4:0:0

Course Objective:
- To understand hydrogen energy technology
- To understand fuel cell technology
- To enlighten the student community on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

Course Outcome:
- Know detail on the hydrogen production methodologies, possible applications and various storage options.
- Know the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics
- Analyze the cost effectiveness and eco-friendliness of Hydrogen and Fuel Cells.

Unit I

Unit II
Unit III  
**FUEL CELLS:** History – principle – working – thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery vs fuel cell

Unit IV  
**FUEL CELL – TYPES:** Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

Unit V  
**APPLICATION OF FUEL CELL AND ECONOMICS:** Fuel cell usage for domestic power systems – large scale power generation – Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell – Future trends in fuel cells.

**Text Book**  

**Reference Books**  

**12EE320 ENERGY MANAGEMENT AND AUDIT**

**Credits:** 3:1:0

**Course Objective**  
- To understand various energy management techniques
- To understand energy auditing techniques
- To understand the importance of energy conservation

**Course Outcome**  
- Become efficient energy managers
- Know different energy auditing methods and the implementation procedures
- Plan for the energy requirement

**Unit I**  
codes –model energy codes, Labeling system- Star Labeling for Electrical appliances. Role of BEE in star labeling.

Unit II
ENERGY AUDIT: Definition – needs–types-approaches; energy costs, bench marking, energy performance, matching energy supply to requirement, fuel and energy substitution, energy audit instruments, duties and responsibilities of energy auditors

Unit III
ENERGY ACTION PLANNING: Key elements, force field analysis, energy policy- purpose, perspective, contents, formulation, ratification; location of energy management, top management support, managerial function, energy manager-accountability, motivation- information system-strategies- marketing and communicating- training and planning.

Unit IV
MONITORING AND TARGETING: Defining – elements, data and information analysis; techniques, energy consumption, production, cumulative sum of differences, energy service companies, energy management information systems, SCADA

Unit V
ELECTRICAL ENERGY MANAGEMENT: Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC and FACTS; Demand Side: conservation in motors, pumps and fan systems, energy efficient motors, lighting.

Text Book

References
5. World on transition-Towards sustainable Energy systems, German Advisory council on global change Handbook, Earthscan publication, 2004

12EE321 BIO-MASS ENERGY

Credits: 4:0:0

Course Objective:
- To deal about the thermal biomass conversion and biological pathways.
- To provide an introduction about the power generation techniques.
• To deal with the Design, Selection, Construction and Operation of Biogas Plants.

Course Outcome:
• Understand the thermal biomass conversion.
• Understand about the Pyrolysis, Gasification and Liquefaction and fermentation process
• Communicate effectively about issues in environmental aspects for bio energy conversion and also to design the biogas plants by the students.

Unit I

Unit II

Unit III

Unit IV

Unit V
DESIGN, SELECTION, CONSTRUCTION AND OPERATION OF BIOGAS PLANTS:
Design of the digester – design based on end user requirements – scaling of biogas plants – digester sizing – optimal design – design of fixed dome digester – Electricity Production from biomass.

Text Books

References Books

12EE322 ENERGY MODELLING, ECONOMICS AND PROJECT MANAGEMENT

Credits: 3:1:0

Course Objective
• To impart greater understanding of energy modeling in renewable energy technology.
• To throw light on the economic aspects involved in renewable energy technology.
• To enlighten the students on the various techniques involved in project management.

Course Outcome
• Gain clear perspective on energy economy.
• Forecast the energy demand and plan wisely.
• Become excellent managers of the energy resources.

Unit I

Unit II

Unit III
ENERGY DEMAND ANALYSIS AND FORECASTING: Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting -Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

Unit IV

Unit V

Text Books
Reference Books

12EE323 SOLAR ENERGY LAB
Credits: 0:0:2
1. Solar energy measurement
2. Solar energy forecasting
4. Characteristics of PV Panel
5. Perturb and Observe MPPT Technique
6. Fuzzy Logic based DC-DC Converter for PV System
7. Neural Network based DC-DC Converter for PV System
8. Simulation of Stand-alone PV systems using Matlab-Simulink.
9. Simulation of grid connected PV systems using Matlab-Simulink.
10. Study of the Effects of Partial Shading on PV Array Characteristics
11. Thermal Modeling and Simulation of a Building
12. Modeling and Simulation of Solar Water Heater

12EE324 WIND ENERGY LAB
Credits: 0:0:2
1. Wind Turbine Modeling and Simulation
2. Permanent-magnet Synchronous Generator Modeling and Simulation
3. Fuzzy Logic based Wind Energy Forecasting
4. ANN based Wind Energy Forecasting
5. Wind Power Curve Estimation
6. Maximum power tracking of a wind energy system
7. Fuzzy logic control based maximum power tracking of a wind energy system
9. Simulation of a phasor model of a squirrel-cage induction generator driven by a variable pitch wind turbine
10. Simulation of a phasor model of a variable speed doubly-fed induction generator driven by a wind turbine
11. Simulation of model of a variable pitch wind turbine
12. Reactive power control in wind power plants

12EE325 SIMULATION OF POWER ELECTRONIC SYSTEMS
Credits: 3:1:0
Course Objective

- To study the basics of static and dynamic models of power electronic switches
- To learn the usage of the software tools like MATLAB, PSIM and PSPICE
- To understand the operation of different types of power electronic converters using the above mentioned tools

Course Outcome

- do the mathematical modeling of power devices under steady state and dynamic conditions
- use the various functional blocks available in the simulation packages for the problems specified
- design and simulate any power electronic circuits and compare the performance with other simulation tools

Unit I

INTRODUCTION: Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of MATLAB and SIMULINK, PSIM, and PSpice, Mathematical modeling of power electronic systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of power electronic systems.

Unit II


Unit III


Unit IV

PSIM: General information – Power circuit components – Control circuit & other components – Analysis specification – Circuit schematic design – Waveform processing – Error and warning Messages- Simulation of PWM inverters- Simulation of BLDC and SRM

Unit V


Text Books


Reference Book

12EE326 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS
Credits: 3:1:0

Course Objective
• To understand the safe and secure operation of simple power system.
• To suggest suitable possibilities to extend power system operation.
• To understand the recent advancements in power systems using the power electronic systems.

Course Outcome
• Find the solutions for eliminating harmonics and EMI present in the output due to fast switching devices.
• Apply power system fundamentals to the design of a system that meet specific needs.
• Design necessary filter circuit require to the distributed network.

Unit I
INTRODUCTION: High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II
CONVERTER CONTROL: Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III
WIND ENERGY CONVERSION SYSTEM: Sic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV
HVDC SYSTEMS : Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: FACTS: Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.
Text Book

Reference Books

12EE327 NEURO-FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credits: 4:0:0

Course Objective
• To impart the knowledge on the fundamental concept of neurons and their artificial models
• To understand the Structure of fuzzy logic controller and its application to electric drives
• To provide comprehensive knowledge of fuzzy logic and neuro controllers

Course Outcome
• Explain the various learning algorithms derived from the biological neurons
• Apply the concept of neural network for optimization of any system problem
• Use appropriate network for fault diagnosis and pattern recognition

Unit I
INTRODUCTION TO NEURAL NETWORK: Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks- Single layer, multiple layer- Feed forward, feedback networks; Back propagation - Learning and training –Hopfield network.

Unit II
NEURO CONTROLLER: Neural network. for non-linear systems - Schemes of Neuro control- System identification forward model and inverse model- Indirect learning neural network control applications.

Unit III
INTRODUCTION TO FUZZY LOGIC: Fuzzy sets- Fuzzy operation - Fuzzy arithmetic - Fuzzy relations- Fuzzy relational equations - Fuzzy measure - Fuzzy functions - Approximate reasoning - Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV

Unit V

Text Books

Reference Books

12EE328 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credits: 4:0:0

Course Objective
- To study the basics of various photovoltaic energy conversion
- To analyze the performance of self-excited and grid related problems
- To learn the Wind energy system and stand alone power supply systems

Course Outcome
- Understand various factors which affect the wind energy conversion system.
- Design isolated power generators used in wind energy conversion system.
- Design PV cells to meet the requirement of battery operated vehicle and other related applications

Unit I
INTRODUCTION: Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

Unit II
PHOTOVOLTAIC ENERGY CONVERSION: Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India -
Switching devices for solar energy conversion - Maximum power point tracking. DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters – synchronized operation with grid supply - Harmonic problem – Applications.

Unit III

Unit IV

Unit V
STAND ALONE POWER SUPPLY SYSTEMS: Wind/solar PV integrated systems - Optimization of system components - storage – Reliability evolution.

Text Book

Reference Books

12EE329 HVDC TRANSMISSION
Credits: 4:0:0
Course Objective
- To have an overview about HVDC system, different forms of converters and various means of control
- To analyze the various malfunctioning of the HVDC system
- To study the basics of harmonics and their reduction mechanism

Course Outcome
- Outline the benefits of using dc transmission and its operation & control
- Use the various power electronics resources for the betterment of hvdc system
- Analyze the challenges and its solutions available in high voltage engineering
Unit I
DC POWER TRANSMISSION TECHNOLOGY: Historical development – Types of HVDC Systems – Equipments for HVDC – Comparison: Economics of Power Transmission, Technical Performance, and Reliability – Limitations of HVDC.

Unit II

Unit III

Unit IV
CONVERTERS FAULTS & PROTECTION: Converter faults: Commutation failure, Arc through, Misfire, Current extinction and Short circuit in a bridge – Protection against over currents – Over voltages in a converter station – Protection against over voltages – Functions of smoothing reactor.

Unit V
HARMONICS AND FILTERS: Problems due to harmonics – Characteristic harmonics – Non characteristic harmonics – Filters: Design criteria of ac filters – Types of ac filters – DC filters - Active filter – Carrier frequency and RI noise.

Text Books

Reference Books

12EE330 PLC AND AUTOMATION

Credits: 4:0:0

Course Objective
- To learn the basics of PLC.
- To study the programming of PLC and HMI systems.
• To study about the DCS and understand the concept of Automation.

Course Outcome

• Understand the concepts of PLC and basics of Programming
• Programming using PLC for various industrial applications
• Design of controllers for industrial automation systems

Unit I

Unit II
PROGRAMMING OF PLC & HMI SYSTEMS: Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - HMI systems - Necessity and Role in Industrial Automation, Text display - operator panels -Touch panels - Panel PCs - Integrated displays (PLC & HMI)

Unit III

Unit IV

Unit V

Text Books

Reference Books
5. Practical Distributed Control Systems (DCS) for Engineers and Technicians

12EE331 ELECTRIC AND HYBRID VEHICLES

Credits: 3:1:0

Course Objective
- To understand the concept of Electric Vehicle Technology.
- To understand various architectures of Hybrid Electric Vehicle (HEV) technology.
- To know about various Energy storage devices.

Course Outcome
- The students will be able to understand the need of Hybrid Vehicles and Electric vehicles.
- The students will be able to design different types of Architectures in Electric & Hybrid Vehicles.
- The student will be capable to generate Electrical Power through renewable energy sources.

Unit I
ELECTRIC VEHICLES: Layout of an Electric Vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

Unit II
HYBRID VEHICLES: Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

Unit III

Unit IV
ELECTRIC PROPULSION SYSTEM AND MOTOR CONTROL SYSTEM: DC Motors, AC Motors Permanent Magnet Motors, Brushless DC and Reluctance Motors: Characteristics - Regenerative Braking - Control System Principles - speed and torque control.

Unit V
ENERGY STORAGES & GENERATORS: Electromechanical batteries – types of batteries – lead acid batteries - nickel based batteries - lithium based batteries - electrochemical reactions -
thermodynamic voltage - specific energy - specific power - energy efficiency - ultra capacitors – DC Generators, AC Generators: Voltage and Frequency regulations.

Text Book

Reference Books

12EE332 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Credits: 4:0:0

Course Objective
- To understand different Electro Magnetic Interference problems and various mitigation Techniques
- To understand EMI Sources, EMI problems and their solution methods in PCB level Subsystem and system level design
- To understand EMC Design and Standards

Course Outcome
- Design a compatible system with less interference.
- Provide solution methods in PCB level / Subsystem and system level design.

Unit I
EMI ENVIRONMENT: Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters.

Unit II
EMI COUPLING PRINCIPLES & EMI SPECIFICATION / STANDARDS / LIMITS: Conducted, Radiated and Transient Coupling - Common Impedance Ground Coupling - Radiated Common Mode and Ground Loop Coupling - Radiated Differential Mode Coupling - Near Field Cable to Cable Coupling - Power Mains and Power Supply Coupling - Units of specifications, Civilian standards Military standards.

Unit III
Unit IV
EMI CONTROL TECHNIQUES: Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

Unit V

Text Book

Reference Books

12EE333 OPTIMIZATION TECHNIQUES

Credits: 3:1:0

Course Objective
• To insist the importance of optimization problems and their applications
• To instruct the steps for formulating optimization problems
• To impart the knowledge of traditional and modern optimization techniques

Course Outcome
• Students will be able to state the different types of optimization problems, their formulation and solution techniques.
• Students will be able to understand the mechanisms of various traditional and modern optimization techniques
• Students will be able to apply the optimization techniques for practical applications

Unit I

Unit II
LINEAR PROGRAMMING: Linear programming definition – Pivotal reduction of general system of equations – Simplex algorithms – Two phases of the simplex method- Karmarkar’s Method.
Unit III

Unit IV

Unit V

Text Book

Reference Book

12EE334 POWER ENGINEERING SIMULATION LABORATORY
Credits: 0:0:2
1. Simulation of Buck-Boost Converter using PSIM
2. Simulation of Synchronous Rectifier using PSIM
3. Simulation of Three Phase SVPWM Inverter using PSIM
4. Simulation of Soft Switching Converters using PSIM
5. Simulation of Multilevel Inverter using MATLAB
6. Simulation of SRM Drive using MATLAB
7. Formation of BUS Admittance Matrix using Direct Inspection Method using MATLAB
8. Determination of BUS bar Voltages using FDLF Method using MATLAB
9. Automatic Load Frequency Control using MATLAB
10. Load Flow Studies using ETAP
11. Simulation of SMIB using ETAP
12. Fault Analysis of AC Power System using PSCAD / EMTDC

12EE335 FLEXIBLE AC TRANSMISSION SYSTEMS
Credits: 4:0:0
Course Objective:
• To introduce the students to the concept of FACTS, and familiarize them with the basic design and principle of operation of HVDC systems.
• To understand the implementation of UPFC in real time applications.
• To the design the FACTS controllers for various non-linear structure controls.

Course Outcome:
• Identify, formalize, model and analyze problems in a power network
• Select the suitable FACTS devices to enhance the security, capacity and flexibility of power transmission systems.
• Increase existing transmission network capacity while maintaining or improving the operating margins necessary for grid stability.

Unit I

Unit II

Unit III

Unit IV

Unit V
MODERN FACTS DEVICES: Basic concepts – Centre Node Unified Power Flow Controller (C-UPFC) – Fault Current Controller (FCC) – Interlined Power Flow Controller (IPFC) – location of FACTS.

Text Books

Reference Books

12EE336 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Credits: 4:0:0

Course Objective
- To understand the concepts of Conventional and Digital Transducers
- To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
- To study the Microprocessor based instrumentation

Course Outcome
- Select the type of transducer for the Industrial application.
- And apply in case studies and mini projects in industries.
- Design the Microprocessor based Controllers.

Unit I

Unit II
DIGITAL TRANSDUCERS: Direct digital transducers – Absolute and incremental displacement transducers – Moiré Fringe transducers – Transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III
INDUSTRIAL HEATING & PHOTOELECTRIC DEVICES: Industrial Heating using high frequency dielectric heating – Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV
MICROPROCESSOR BASED INSTRUMENTATION: Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based Voltmeter and Ammeter – Microprocessor based Speed monitoring Unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring Unit – Microprocessor based over and under voltage and over current protection.

Unit V
SMART TRANSDUCERS: Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – measurement of flow, pH with smart transducers.

Text Books

Reference Books

12EE338 PASSIVE SOLAR ARCHITECTURE

Credits: 4:0:0

Course Objective
- To understand the building laws and architectural design.
- To understand the role the site and its context play in designing a building, with an emphasis on the climate and other environmental conditions.
- To understand the concepts of a comfortable thermal environment and the passive solar design principles, passive ventilation and solar shading to create a comfortable thermal environment.

Course Outcome
- Analyze the site and its context in preparation for designing a building, particularly with respect to climate and other environmental conditions and translate the analysis data into useable design data and design concepts.
- Design and build environments that are both thermally comfortable and thermally delightful by utilizing passive solar design principles.
- Utilize the combined site-specific potentials of sun, light, wind and rain for creating a sustainable, comfortable and delightful built environment.

Unit I
INTRODUCTION: Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building.

Unit II
THERMAL ANALYSIS AND DESIGN FOR HUMAN COMFORT: Thermal comfort; Criteria and various parameters - Psychometric chart - Thermal indices, climate and comfort zones - Concept of solar temperature and its significance - Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation - Introduction to design of shading devices - Overhangs; Factors that effects energy use in buildings - Ventilation and its significance - Air-conditioning systems - Energy conservation techniques in air-conditioning systems.

Unit III
PASSIVE COOLING AND HEATING CONCEPTS TYPES: Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces - Passive cooling concepts: Evaporative cooling, radiative cooling - Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling - Roof radiation traps; Earth air-tunnel.

Unit IV
HEAT TRANSMISSION IN BUILDINGS: Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows - Heat transfer due to ventilation infiltration, internal heat transfer - Solar temperature - Decrement factor - Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations - Computer packages for carrying out thermal design of buildings and predicting performance - Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V
BIOCLIMATIC CLASSIFICATION: Bioclimatic classification of India - Passive concepts appropriate for the various climatic zones in India - Typical design of selected buildings in various climatic zones - Thumb rules for design of buildings and building codes.

Text Books

Reference Books:

12EE339 GREEN BUILDING

Credits: 4:0:0

Course Objective
- To learn green building concepts and ecological design concepts applicable to modern buildings
- Acquaint students with the principle theories, materials, construction techniques and to create green buildings
- To provide exposure to various national and international rating systems as compliance requirements for green buildings

Course Outcome
At the end of the course, the student will be able to:
- Understand and actively participate in the overall iterative and multidisciplinary process of conceptualizing and designing an environmentally friendly building (low-emissions, low resource-consumption, small environmental footprint),
• Choose and size building components, as well as energy and environmental systems suitable for different categories of buildings, and different climate zones, such as to achieve the smallest feasible life-time environmental impact,

• Evaluate the economic performance of buildings (operating & maintenance costs, real estate value), as related to their resource-consumption and environmental performance.

Unit I
GREEN BUILDING PROCESS AND ECOLOGICAL DESIGN: Conventional versus green building delivery systems - Green building project execution - the integrated design process - green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

Unit II

Unit III
GREEN BUILDING IMPLEMENTATION: Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

Unit IV

Unit V
ECONOMICS OF GREEN BUILDINGS: Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits.

Text Book

Reference Books

12EE340 DATA MINING FOR RENEWABLE ENERGY TECHNOLOGY
Course Objective
• To enlighten the students’ on the basic concepts of data mining.
• To improve the students’ competence in the algorithms and learning schemes of data mining.
• To enable the students to exploit the data mining techniques for research in renewable energy.

Course Outcome
• understand the importance of data-driven performance optimization of renewable energy technology.
• exploit the vast database available in the renewable energy sector and devise ways to make renewable energy a competitive source of supply.
• find the various research opportunities provided by this field.

Unit I
INTRODUCTION: Data Mining – Kinds of Data – Functionalities – Classification – Primitives – Major Issues – Data Preprocessing – Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation - Data Reduction

Unit II
DATA WAREHOUSE: AN OVERVIEW: Data Warehouse – Multidimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – From Data Warehousing to Data Mining. Mining Frequent Patterns, Associations: Basic Concepts and a Road Map – Efficient and Scalable Frequent Item set - Mining Methods- Mining Multilevel Association Rules

Unit III
CLASSIFICATION AND PREDICTION: Issues regarding classification and prediction - Decision tree Induction - Bayesian Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit IV
CLUSTER ANALYSIS: Types of Data – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods. Mining Stream, Time-Series and Sequence Data Mining- Data Streams – Mining Time-series- Data- Mining Sequence Patterns in Transactional Databases

Unit V

Text Books
Reference Books

12EE341 SOFT COMPUTING TECHNIQUES

Credits: 3:1:0

Course Objective
- To develop an in-depth understanding of various soft computing techniques.
- To analyze the mechanisms of different AI techniques and modern heuristics algorithms.
- To develop skills to apply the soft computing techniques for various practical optimization problems.

Course Outcome:
- State the mechanisms of various soft computing techniques.
- Understand the techniques of various modern heuristic optimization algorithms.
- Apply the soft computing techniques for practical applications.

Unit I
INTRODUCTION: Approaches to intelligent control-Architecture for intelligent control-Symbolic reasoning system, rule-based systems- AI approach- Knowledge representation-Expert systems.

Unit II
ARTIFICIAL NEURAL NETWORKS: Concept of Artificial Neural Networks and its basic mathematical model- McCulloch-Pitts neuron model-simple perceptron - ADALINE, MADALINE, Feed-forward Multilayer Perceptron - Learning and Training the neural network - Data Processing: Scaling, Fourier transformation - principal-component analysis and wavelet transformations - Hopfield network, Self-organizing network - recurrent network - Neural Network based controller

Unit III
FUZZY LOGIC SYSTEM: Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control - Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases- Fuzzy modeling and control schemes for nonlinear systems-Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time-delay system.

Unit IV
MODERN HEURISTIC ALGORITHMS
Basic concept of Genetic Algorithm (GA) and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of Tabu
Search (TS) - Evolutionary Programming (EP) and Ant-Colony Optimization (ACO) techniques for solving optimization problems.

Unit V


Text Books

Reference Books

12EE342 OCEANIC ENERGY

Credits: 4:0:0

Course Objective
- To provide necessary knowledge about the basics, design and analysis of two important oceanic energy components i.e., tidal and wave.
- To make the learner to understand the operation of tidal power plants and wave power plants
- To impart the basic knowledge about integration of tidal and wave power plants with grid

Course Outcome
- Have awareness about the possibilities of power generation from ocean
- Suggest new mechanisms to harvest energy from ocean
- Design efficient tidal and wave power plants

Unit I

INTRODUCTION TO TIDAL ENERGY: Historical Development -Tidal phenomenon-Ocean tides -Types of tides -Propagation of tides in estuaries -Coriolis effect -Barrage effects -Tidal power potential and site selection -Hydroelectric versus Tidal-Electric developments-Site potential estimation-Coefficient of the tide-Major factors influencing project economics-Site selection- Management and organization of investigations-Management-Organization-Feasibility studies

Unit II

Unit III
TIDAL POWER PLANTS: Civil works -Dry versus wet Construction - Design parameters - Caisson design- Dikes- Construction schedules- Electromechanical equipment - Specific requirements for tidal generating equipment- Types of turbines - Generators - Electrical equipment – Transmission-Integration of output with electric utility systems - Absorption of raw tidal energy -Enhancing raw tidal energy output - System considerations

Unit IV
INTRODUCTION TO WAVE ENERGY: Wave structure- Wave power calculations- Global wave energy -Wave energy potential- Wave energy technologies- Wave concentration effects- Tapered channel - Oscillating water column- Mighty whale design

Unit V
WAVE POWER PLANTS: Turbines for wave energy - Ocean wave conversion system-Wave energy power distribution-Grid connection-Wave energy-Environmental impacts

Text Books

Reference Books

12EE343 GEOTHERMAL ENERGY

Credits: 4:0:0
Course Objective:
- To develop a in-depth understanding of the issues associated with the development of geothermal energy
- To make the students to realize the current state of geothermal energy resources and technologies
- To impart the knowledge of exergy analysis applicable to geothermal systems
Course Outcome:
- The students will be able to demonstrate a good understanding of the role which geothermal energy plays in the energy sector
- The students will have knowledge regarding geothermal energy resources and the ability to utilize that resource
- The students will be able to analyze geothermal energy resources based on exergy efficiencies

Unit I
INTRODUCTION: Geology of geothermal regions -The earth and its atmosphere-Active geothermal regions-Model of a hydrothermal geothermal resource-Other types of geothermal resources-Hot dry rock, HDR-Geopressure-Magma energy -Exploration strategies and techniques -Objectives of an exploration program -Phases of an exploration program-Synthesis and interpretation

Unit II
GEOTHERMAL WELL AND RESERVOIR: Geothermal well drilling-Geothermal reservoir and well flow- Well testing - Desired information- Calcite scaling in well casings- Reservoir modeling and simulation

Unit III
GEOTHERMAL POWER GENERATING SYSTEMS: Single-Flash Steam power plants- Gathering system design considerations - Energy conversion system - Thermodynamics of the conversion process -Equipment list for single-flash plants -Double-Flash steam power plants - Gathering system design considerations -Energy conversion system -Thermodynamics of the conversion process -Scale potential in waste brine -Equipment list for double-flash plants -Dry-steam power plants -Origins and nature of dry-steam resources -Steam gathering system -Energy conversion system -Equipment list for dry-steam plants -Binary cycle power plants -Basic binary systems -Working fluid selection -Advanced binary cycles -Equipment list for basic binary plants

Unit IV
ADVANCED GEOTHERMAL ENERGY CONVERSION SYSTEMS: Hybrid single-flash and double-flash systems -Hybrid flash-binary systems -Total-flow systems -Hybrid fossil-geothermal systems -Combined heat and power plants -Hot dry rock (enhanced geothermal systems) Power plants for hypersaline brines

Unit V
EXERGY ANALYSIS APPLIED TO GEOTHERMAL POWER SYSTEMS: First law for open, steady systems - Second law for open, steady systems -Exergy -Exergy accounting for open, steady systems -Exergy efficiencies and applications to geothermal plants.

Text Book:

Reference Books:

12EE344 OPTIMAL CONTROL OF WIND ENERGY SYSTEMS

Credits: 4:0:0

Course Objective
- To understand the importance of optimal control in wind energy systems
- To impart the basics of modeling of wind energy conversion system
- To introduce the various parameters that need to controlled in wind energy systems

Course Outcome
- Learn the various techniques that can be used to obtain optimal control
- Lay the basics of efficient control of wind energy systems and thus to make wind power a main source of renewable energy

Unit I
WECS MODELLING: Electrical Generator Modeling – Drive Train Modeling – Power Electronics Converters and Grid Modeling – Linearization and Eigen value analysis – Case study

Unit II

Unit III
WECS OPTIMAL CONTROL WITH ENERGY EFFICIENCY CRITERION: MPPT strategies – PI control – ON/OFF control – Sliding mode control – Feedback Linearization Control – QFT Robust Control.

Unit IV
WECS OPTIMAL CONTROL WITH MIXED CRITERION: LQ control of WECS – Frequency separation principle – 2LFSP applied to WECS with Rigidly-coupled generator and flexibly-coupled generator.

Unit V

Text Books

Reference Books

12EE345 WIND RESOURCE ASSESSMENT AND FORECASTING METHODS

Credits: 3:1:0

Course Objective
- To understand the basics of assessing potential sites for wind farms
- To learn the mathematical basics involved in forecasting of data
- To equip the student with the latest forecasting techniques

Course Outcome:
- Understand the technical and economical aspect of wind resource assessment
- Enable the student to understand the basics of available forecasting models
- Equip the students to develop accurate forecasting models

Unit I

Unit II

Unit III
Unit IV

Unit V

Text Books

Reference Books:

12EE346 DESIGN OF TURBINES FOR RENEWABLE ENERGY SYSTEMS

Credits 3:1:0

Course Objective
- The students will be exposed to different turbines for renewable energy
- Designing turbines for different power generation schemes using the renewable energy will be highlighted
- Any flaws and faults related to turbines and its design will be discussed

Course Outcome
- Students will have a clear idea about the Turbines, its behavior under various conditions.
- Student will be capable of designing turbines for different power generation
- Students will have an exposure to drawbacks and faults associated with the existing system.

Unit I
Unit II
TURBINE DESIGN FOR SOLAR BASED POWER GENERATION: Solar based power generation types- organic fluid based low temperature system, solar tower based high temperature system- Turbine Models used – designing – Drawbacks and faults related to turbines- Problems.

Unit III
WIND TURBINE DESIGN: Horizontal and vertical axis wind turbines- design- problems related to design - Faults related to wind turbines- softwares for turbine design-overview

Unit IV
TURBINES FOR HYDRO POWER GENERATION: Introduction to hydro power generation- conventional, pumped storage - Different types of hydro turbine designs- Francis, Pelton, Kaplon turbines - Design problems.

Unit V
TURBINES FOR GEOTHERMAL AND OCEAN ENERGY: Turbine for Geothermal plant- Turbine design for Tidal power- Turbines for Ocean thermal energy conversion systems. Design issues- problems

Text Books

Reference Books

12EE347 COMPUTER NETWORKS AND PROTOCOLS

Credits 4:0:0
Course Objective:
- Study the communication networks in computer
- Know various data communication techniques.
- Know the various applications using network protocols

Course Outcome:
- Understand the concepts of Computer Communication
- Understand the peripheral connections in a computer.
- It also gives broad idea on networking which are available for daily use.

Unit I
INTRODUCTION TO COMPUTER NETWORKS: Computer networks – advantage – structure of communication network - point -to-point, circuit switched, packet switched; network topologies; network protocols; OSI reference model, example networks; physical layer
and data transmission – analog and digital; transmission impairments; delay, distortion; transmission media; twisted pair, co-axial, optical fibre, terrestrial microwave, satellite microwave, radio; data encoding and communication: recap on PCM; AM; asynchronous and synchronous transmission; error detection techniques; interfacing: RS-232C, X.21 Digital interface; modems, multiplexer, demultiplexer.

Unit II
MEDIA ACCESS CONTROL AND DATA LINK LAYER: Media access control and data link layer – framing; error detection and correlation methods; stop-and-wait ARQ; Back-N ARQ; Selective Repeat ARQ etc; media access protocols: ALOHA, slotted ALOHA, CSMA/CD, Token Ring, Token Bus, FDDI-I, FDDI-II, ATM.

Unit III
NETWORK LAYER: Network layer – connection oriented vs. connectionless services; routing; X2.5; IP; congestion control, internetworking, network layer in the Internet; IP protocol, IP addresses, subnets, OSPF, BGP, CIDR; network layer in ATM.

Unit IV
TRANSPORT LAYER: Transport layer – transport services and protocols; the Internet transport protocols; TCP and UDP, Remote procedure call, ATM AAL layer protocols.

Unit V
APPLICATION LAYER: Application layer – network security, DNS, SNMP, FTP, Telnet, E-mail, X-400, digital networks-ISDN; B-ISDN

Text Books

References Books

12EE348 MICROCONTROLLERS APPLICATIONS IN POWER ELECTRONICS

Credits: 4:0:0

Course Objective
- To make students aware of various microcontrollers
- To learn and understand the architecture of 8051, 8096 and PIC microcontrollers.
- To understand the design and interfacing of microcontroller based embedded systems.
Course Outcome
- Design simple Microcontroller based systems.
- Write simple program using various Microcontrollers
- Interface / Apply in standard applications.

Unit I
INTEL 8051
Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area-
Addressing modes- Instruction set- Programming examples. Interrupt structure- Timer modules-
Serial features- Port structure- Power saving modes.

Unit II
16-BIT MICRO CONTROLLER: 8096/8097 Architecture-CPU registers –RALU-Internal
memory Interfacing –External I/O interfacing.

Unit III
PIC MICROCONTROLLERS: Program memory – CPU Registers – Register file structure –
Block diagram of PIC 16C74 – I/O Ports - Timers 0,1 and 2 features – Interrupt Logic – Serial
Peripheral Interface – I²C Bus – ADC – UART.

Unit IV
TYPICAL APPLICATIONS TO POWER CONVERTERS & INVERTERS: Firing schemes for
single phase and three phase rectifiers - 3-phase AC Voltage Controller, Firing at variable frequency
environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, types of
pulse width modulation techniques and their implementation using microprocessors.

Unit V
TYPICAL APPLICATIONS TO DRIVES: Stepper motor control – DC motor control –Induction
Motor Control – Synchronous Motor control.

Text Books
1. Mazidi and D.MacKinlay “8051 Microcontroller and Embedded Systems using Assembly
   Delhi, 2005.

Reference Books: