B. E. SYLLABUS

ELECTRICAL & ELECTRONICS ENGINEERING

VII & VIII SEMESTER

With Scheme of Teaching & Examination
## Detailed scheme and syllabus for 2012-16 Batch

### VII Semester

<table>
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<tr>
<th>Sub Code</th>
<th>Title</th>
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### VIII Semester

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**L** – Lecture  **T** - Tutorials  **P** – Practical  **S** – Self Study

**Recommended OPEN Electives:**

- 12MA8x01 Graph Theory
- 12HU8x02 Intellectual property rights
- 12PH8x04 Advanced Material Technology
- 12ME8x09 Entrepreneurship Management
- 12EC8x12 Information and Communication Technology

**Other Open electives:**

- 12CS8X15 Principles of Programming languages
- 12IS8x17 Storage Technologies
- 12MA8x03 Probability and Statistics
Syllabus – VII Semester 2012-16 Batch

Sub code: 12EE701  Computer Techniques in Power System Analysis

Contact Hours : 3*-2-0-0  Credits : 4
Total Hours : 39*+26  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisites: ENT-I (12EE302), EPG (12EE403), T&D (12EE505), TIM (12EE402), PSAS (12EE601).

*Note: Lecture hour indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

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

1. Understand the concepts and applications of network topology and graph theory
2. Represent a power system network using the concept of graph theory and formulate $Y_{bus}$ and $Z_{bus}$
3. Formulate and solve load flow problem of a power system network using different load flow techniques.
4. Appreciate and justify the need of Economic operation of Power System and suggest economic generation scheduling.
5. Comprehend the concept of Transient stability and predict system stability using Numerical integration techniques

UNIT - I

NETWORK TOPOLOGY: Introduction, Elementary graph theory -oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices -Element-node, Bus incidence, Branch – path, Basic cut-set, Augmented cut-set, Basic loop and Augmented loop; Primitive network – impedance form and admittance form. 8+5 Hours

UNIT - II


UNIT - III

LOAD FLOW STUDIES: Introduction, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson Method – Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only); Algorithm for Fast Decoupled load flow method; Comparison of Load Flow Methods. 8+6 Hours

UNIT - IV

ECONOMIC OPERATION OF POWER SYSTEM: Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula; Optimal scheduling for Hydrothermal plants – problem formulation, solution procedure and algorithm. 8+5 Hours

UNIT - V

TRANSIENT STABILITY STUDIES: Numerical solution of Swing Equation – Point-by-point method, Modified Euler’s method, Runge-Kutta method, Milne’s predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts. 8+5 Hours
TEXT BOOKS:

REFERENCE BOOKS:
4. Elements of Power System Analysis: W.D Stevenson
Sub Code: 12EE702  High Voltage Engineering

Contact Hours : 3-0-0-1*  Credits : 4
Total Hours : 52  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisite: T&D (12EE505), SGP (12EE602), TIM (12EE402), DCSM (12EE303).

*Self Study Topics – To be covered under the supervision of the course instructors.

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

1. Appreciate the necessity of high voltage for bulk power transmission.
2. Comprehend the theory of breakdown in insulting medium.
3. Justify the requirement of generation of HV AC/ DC and impulse voltages for testing the insulting medium.
4. Comprehend the principles of measurement of high voltages.
5. Understand the methods of testing of insulators and high voltage apparatus. And justify the application of Non Destructive Testing.

UNIT-I

INTRODUCTION: Introduction to HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory.

Self study Topics: {Important applications of high voltage.}  5 Hours

BREAKDOWN PHENOMENA:

Self Study Topics: {Classification of HV insulating media. Properties of important HV insulating media under each category.}


UNIT-II

Breakdown in solid dielectrics: Intrinsic Breakdown, avalanche breakdown, thermal breakdown, and electromechanical breakdown.

Self Study Topics: {Breakdown of liquids dielectric dielectrics: Suspended particle theory, electronic Breakdown, cavity breakdown (bubble’s theory), electro convection breakdown}  4 Hours

GENERATION OF HV AC AND DC VOLTAGE: HV AC-HV transformer; Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit- principle of operation and advantages. Tesla coil. HV DC- voltage doubler circuit, cock croft- Walton type high voltage DC set. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop  6 Hours

UNIT-III

GENERATION OF IMPULSE VOLTAGE AND CURRENT:

Triggering of impulse generator by three electrode gap arrangement. Triggering gap and oscillograph time sweep circuits. Generation of switching impulse voltage.

Self Study Topics: {Generation of high impulse current.}  10 Hours

UNIT-IV

MEASUREMENT OF HIGH VOLTAGES: Electrostatic voltmeter principle, construction and limitation. Chubb and Fortescue method for HV AC measurement. Generating voltmeter- Principle,
construction. Series resistance micro ammeter for HV DC measurements. Standard sphere gap
measurements of HV AC, HV DC, and impulse voltages.
Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Surge
current measurement-Klydanograph and magnetic links.

**Self Study Topics:** [Factors affecting the HV measurements.]

10 Hours

**UNIT-V**

**NON-DESTRUCTIVE INSULATION TESTING TECHNIQUES:**
Dielectric loss and loss angle measurements using Schering Bridge, Transformer ratio Arms Bridge.
Need for discharge detection and PD measurements aspects. Factor affecting the discharge
detection. Discharge detection methods-straight and balanced methods.

6 Hours

**Self Study Topics:** [HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS:
Definitions of terminologies, tests on isolators, circuit breakers, cables insulators and
transformers]

4 Hours

**TEXT BOOKS:**


**REFERENCE BOOKS:**

1. Extra High Voltage AC Transmission Engineering - Rakosh Das Begamudre, Wiley Eastern
Sub Code: 12EE703  
Industrial Drives & Applications  

Contact Hours : 3*-2-0-0  
Total Hours : 39*-26  
Exam Hours : 3  

Credits : 4  
CIE : 50 Marks  
SEE : 50 Marks  

*Note: Lecture hour indicated are for teaching theoretical concepts. Illustrative examples and numerical problems are to be worked out in tutorial classes.

Prerequisites: PE (12EE504), TIM (12EE402), DCSM (12EE303)

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

1. Analyze basic principle of Industrial Drives and their selection based on source / load requirements
2. Model the drive for thermal characteristics and study the transient analysis of DC drives.
3. Understand the power electronics based drives to control the DC Motors.
4. Develop steady / transient models of Induction motor drive to control using power electronics controllers.
5. Control the Synchronous Motor Drives using power electronics controllers. And apply the acquired knowledge in selection of drives for real world Industrial applications.

Unit-I

AN INTRODUCTION TO ELECTRICAL DRIVES & ITS DYNAMICS:


Dynamics of electrical drives, Fundamental torque equation, speed torque conventions and multi-quadrant operation. Equivalent values of drive parameters, components of low torques, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization.

8+5 Hours

Unit-II

SELECTION OF MOTOR POWER RATING: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating.

DC MOTOR DRIVES:
Starting braking, transient analysis

3+2 Hours

Unit-III

DC MOTOR DRIVES(Contd):

Single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor.

Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled rectifier control of dc separately excited motor, multi-quadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor, Chopper control of series motor.

8+6 Hours

Unit-IV

INDUCTION MOTOR DRIVES:

(a) Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis.

(b) Stator voltage control variable voltage frequency control from voltage sources , voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery, speed control of single phase induction motors.

8+6 Hours
Unit-V

SYNCHRONOUS MOTOR DRIVES: Operation form fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thruster inverter.  

INDUSTRIAL DRIVES: Rolling mill drives, cement mill drives, paper mill dries and textile mill drives.

TEXT BOOK:

REFERENCE BOOKS:
Sub Code: 12EE704          Relay and High Voltage Laboratory
Contact Hours : 0-0-3-0    Credits : 2
Total Hours    : 39       CIE    : 50 Marks
Exam Hours     : 3       SEE    : 50 Marks

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

1. Find breakdown voltage & dielectric strength of given transformer oil.
2. Understand the principle of operation of relays like electromechanical and static relays.
3. Get desired values pertaining to the operation of relays
4. Measure HVDC and HVAC by sphere gap
5. Measure HVAC by rod gap techniques.

(Total 10 experiments are to be conducted)

PART – A (Choose at least two experiments)
1. Over current relay:
   a. IDMT non-directional characteristics
   b. Directional features
   c. IDMT directional
2. IDMT characteristics of over voltage or under voltage relay. (solid stare or electromechanical type)
3. To determine 50% probability flashover voltage for air insulation subjected to impulse voltage.
   a. Generation of standard lightning impulse voltage and to determine efficiency and energy of impulse generator. Operating characteristics of over voltage or under voltage relay. (Solid stare or electromechanical type).
4. Operation of negative sequence relay.
5. Bias characteristics of differential relay.
6. Current-time characteristics of fuse.

PART – B (Choose at least one experiment)
1. Operating characteristics of microprocessor based (numeric) over –current relay.
2. Operating characteristics of microprocessor based (numeric) distance relay.
3. Operating characteristics of microprocessor based (numeric) over/under voltage relay.

PART – C (Choose at least one experiment)
1. Generator protection – Merz-Price- protection scheme.
2. Feeder protection scheme-fault studies.

PART – D (Choose at least two experiments)
1. Spark over characteristics of air insulation subjected to high voltage AC with spark over voltage corrected to STP.
2. Spark over characteristics of air insulation subjected to high voltage AC, with spark over voltage corrected to STP for uniform and non-uniform field configuration.
4. Breakdown strength of transformer oil using oil-testing unit.
5. Field mapping using electrolytic tank for any one-model cable/capacitor/transmission line/Sphere gap models.
Sub Code: 12EE705  
Power System Simulation Laboratory

Contact Hours: 0-0-3-0  
Total Hours: 39  
Exam Hours: 3  
Credits: 2  
CIE: 50 Marks  
SEE: 50 Marks

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

1. Determination of power angle diagram and swing curve of an alternator
2. Formation of Y Bus by various methods and determination of bus currents, bus power and line flows for a specified system
3. Determination of fault current and voltage in a single transmission system with Y-Δ transformers at a specified location for various faults
4. Load flow analysis using various techniques.
5. Optimal generator scheduling for thermal power plants.

Power system simulation using MATLAB (or equivalent) Software Packages and C++

1. Determination of Power angle diagrams for Salient and Non-Salient pole Synchronous machines, reluctance power, excitation e.m.f. and regulation.
2. Y Bus formation for power system with & without mutual coupling by Singular transformation.
3. Y Bus formation for power system by Inspection method.
5. ABCD Parameters:
   i) For symmetric Π/T configuration.
   ii) Verification of AD-BC = 1.
   iii) Determination of Efficiency and Regulation.
6. Determination of bus current, bus power & line flows for a specified system voltage (bus) profile.
7. To determine fault current and voltage in a single transmission system with Y-Δ transformers at a specified location for SLGF, DLGF and LLF
8. Load flow analysis using Gauss – Seidel method for both P-Q and P-V buses
10. Optimal Generator scheduling for thermal power plants.
11. Plot swing curve for a single machine connected to infinite bus through a pair of identical transmission lines, for a 3 phase fault on one of the lines for variation of inertia constant/line parameters/fault location/clearing time/pre fault electrical output.
Syllabus – VII Semester

Code: 12EE706

Major Project Phase I

Contact Hours: 0-0-3-0
Exam Hours: --

Credits: 1
CIE: 50 Marks
SEE: -- Marks
Elective: 12EE71x

Sub Code: 12EE711

Contact Hours : 3-0-0-0
Total Hours : 39
Exam Hours : 3

Credits : 3
CIE : 50 Marks
SEE : 50 Marks

Prerequisites: PSAS (12EE601), PE (12EE504)

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

1. Introduce the power quality problems and their classes.
2. Analyze the voltage sags and interruptions, their sources, estimation and protection
3. Analyze of transient over voltages, fundamentals of harmonics, harmonic sources and effects of harmonic distortions.
4. Understand power quality bench marking process, power quality contract and estimation, interface to utility
5. Understand the Monitoring considerations and standards, measurement equipments, and application of intelligent systems

Unit -I
Definitions: general classes of power quality problems, Transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms
5 Hours

Voltage sags and interruptions: Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, monitoring sags.
3 Hours

Unit -II
Transients over voltages: Sources of transient over voltages, principles of overvoltage protection, utility capacitor switching transients, Fundamentals of harmonics: Harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intraharmonics
8 Hours

Unit -III
Applied harmonics: harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics
7 Hours

Unit - IV
Power quality benchmark: introduction, benchmark process, power quality contract, power quality state estimation, including power quality in distribution planning, Interface to utility system, power quality issues, interconnection standards
8 Hours

Unit -V
Power quality monitoring: Monitoring considerations, power quality measurement equipments, assessment of power quality measurement data, application of intelligent systems, power quality monitoring standards
8 Hours

TEXT BOOKS:

REFERENCES BOOKS:
Sub Code: 12EE712  
**Reactive Power Management**

Contact Hours : 3-0-0-0  
Total Hours : 39  
Exam Hours : 3

**Credits : 3**  
CIE : 50 Marks  
SEE : 50 Marks

**Prerequisites:** ENT (12EE302), T&D (12EE505), PSAS (12EE601)

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

1. Importance of reactive power, its generation and absorption in power system.
2. Study of various methods of voltage or reactive power control.
3. Study of principle of transmission system compensation, Effect of harmonics on reactive power control.
4. Analysis of resonance, shunt capacitors and filters.

**UNIT - I**
Introduction, Importance of reactive power control in Electrical Power System, Generation and absorption of Reactive power, Relation between Voltage, Power and Reactive power at a node.  
9 Hours

**UNIT - II**
Methods of voltage or Reactive power control: Shunt reactor, Shunt capacitor, Series capacitor, Synchronous condenser, Static VAR system  
8 Hours

**UNIT - III**
7 Hours

**UNIT - IV**
Resonance, Shunt capacitors and Filters, Telephonic Interference.  
7 Hours

**UNIT - IV**
Reactive power coordination: Reactive power management, Transmission benefits, Reactive power dispatch and equipment impact.  
8 Hours

**TEXT BOOKS:**

**REFERENCES:**
1. Prabha Kunder – Power System Stability and Control (TATA McGRAW-HILL)
Sub Code: 12EE713  
Advanced Microprocessor

Contact Hours : 3-0-0-0  
Credits : 3

Total Hours : 39  
CIE : 50 Marks

Exam Hours : 3  
SEE : 50 Marks

Prerequisites: MC (12EE603)

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

1. Enumerate the architecture and architectural feature of 8086 microprocessors.
2. Understand different assembler instruction formats and different instruction available.
3. Comprehend the concept of modular programming, stacks, procedure, interrupts and macros.
4. Identify and use the byte, string manipulation and i/o programming instructions.
5. Understand the concept of multiprocessor configuration and the architectural feature of 8087, 8089, 801486, and Pentium processors.

Unit - I
8086 architecture, internal operation, addressing modes, instruction formats, instruction executing timing  
8 Hours

Unit- II
Assembler instruction format, data transfer instructions, arithmetic instructions, branch instructions, loop instructions, FLAG instructions, logical instructions, SHIFT AND ROTATE instructions, directives and operators, structures assembly process.  
8 Hours

Unit - II
Modular programming linking and relocation, stacks, procedures, procedure communication, recursive procedures, interrupts and interrupt routines, macros  
7 Hours

Unit IV
Byte and string manipulations: string instructions, rep prefix  
2 Hours
I/O programming: fundamental I/O programming, programmed I/O, interrupt I/O, DMA  
2 Hours
System bus structure: typical system bus architecture, 8086 configurations, minimum mode system, maximum mode systems  
4 Hours

Unit - V
Multiprocessor configurations: co-processor configurations, loosely coupled configurations, architecture and working of 8087 NDP, architecture and working of 8089 IOP  
5 Hours
Architecture of 80486 and Pentium processors  
3 Hours

TEXT BOOKS

1. Y.C.Liu & G.A.Gibson microprocessor systems: The 8086/8088 family PHI

REFERENCE BOOKS

1. Microprocessor and interfacing- Douglas V. Hall TMH
Subject Code : 12EE714  
Programmable Logic Controllers

Contact Hours : 3-0-0-0  
Total Hours : 39  
Exam Hours : 3  
Credits : 3  
CIE : 50 Marks  
SEE : 50 Marks

Prerequisites: DEC (12EE305)

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

1. Justify the role of PLC in automation / SCADA and the hardware capabilities of PLC in industrial automation and Identify various I/O devices and their characteristics for interfacing with PLC.
2. Program a PLC using Ladder Diagram, Functional Block Diagram (FBD).
3. Program a PLC using Instruction list (IL), Sequential Functions Charts (SFC) and Structured Text (ST) methods Incorporating internal relays.
4. Incorporating timers /counters to program a PLC.
5. Program a PLC using shift registers, data handling instructions, Comprehend the real world industrial applications of PLC using ladder diagram and instruction list.

Unit I

INTRODUCTION: Introduction to Programmable logic controller (PLC), role in automation (SCADA), advantages and disadvantages, hardware, internal architecture, sourcing and sinking, characteristics of I/O devices, list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses.

7 Hours

Unit II

PROGRAMMING: Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering ladder programs, functional blocks, program examples, location of stop and emergency switches

7 Hours

Unit III

PROGRAMMING LANGUAGES: Instruction list, sequential functions charts, structured text

INTERNAL RELAYS: ladder programs, battery- backed relays, one - shot operation, set and reset, master control relay, example programs, jump and call subroutines.

8 Hours

Unit IV

Timers and counters: Types of timers, programming timers, OFF- delay timers, pulse timers, programming examples, forms of counter, programming, up and down counting, timers with counters, sequencer.

8 Hours

Unit V

Shift register and data handling: shift registers, ladder programs, registers and bits, data handling, arithmetic functions, closed loop control, temperature control and bottle packing applications.

7 Hours

Note: Discussing the programming should be restricted to only one type of PLC (Mitsubishi)

Text Books:

Reference Books:

Sub Code: 12EE721  
Energy Management and audit

Contact Hours : 3-0-0-0
Total Hours : 39
Exam Hours : 3

Credits : 3
CIE : 50 Marks
SEE : 50 Marks

Prerequisites: BEE (12EE105)

Course Outcomes: at the end of the course student will be able to
1. Understand the energy situation and need for energy economic analysis
2. Understand the concept of energy auditing.
3. Comprehend various energy tariffs and understand the need for pf correction.
4. Understand the need for Electrical System Optimization
5. Understand the concept of Demand Side Management

Unit - I
Energy Economic Analysis: The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems.

Unit - II
Energy Auditing: Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.

Unit - III
Electrical Equipment and power factor – correction & location of capacitors, energy efficient motors, lighting basics, electrical rate tariff.

Unit - IV
Electrical System Optimization: The power triangle, motor horsepower, power flow concept.

Unit - V
Demand Side Management: Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning, load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs.

Text Books:
3. Pabla “Electrical distribution”, TMH, 2004

References Books:
4. Hand book on energy auditing - TERI (Tata Energy Research Institute)
Sub Code: 12EE722  Modern Power System Protection

Contact Hours : 3-0-0-0  Credits : 3
Total Hours : 39  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisites: PSAS (12EE601), SGP (12EE602)

Course Outcomes: at the end of the course student will be able to
1. Enumerate various static relays used in PS protection.
2. Understand the need of Comparators and list out various comparators and their characteristics.
3. Understand the concept of static over current, timer and voltage relays.
4. Comprehend the use and implementation of distance relays.
5. Understand the principle of Principles of Digital/ Numerical Relays

Unit-I
Static Relays: Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices. 7 Hours

Unit-II
Comparators: Replica impedance, Mains Transformers, General equation of phase and Amplifiers, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Dualist principal, Static amplifier comparator – Rectifier bridge circulations current type, sampling comparator, static phase comparator incidence circuits type Rectifier phase comparator, Block split comparator, Zen or diode phase comparator, 8 Hours

Unit-III
STATIC OVER CURRENT, TIMER AND VOLTAGE RELAYS:
Instantaneous over current relay, Definite time lay relay, inverse time over current relay, static timer relay, Basic relay circuits, mono stable delay circuits Single phase Instantaneous over voltage and under voltage relays, instantaneous over voltage relay using Op amp. 8 Hours

Unit-IV
Distance Relay: general Principal of operation, Zone discrimination, Fault area on impedance diagram, Basic measuring elements, Different characteristics used in distance relaying- Impedance, Reactance, Admittance. Ohm, Distance relay settings, Distance measurement Problems. 7 Hours

Unit-V
Principles of Digital/ Numerical Relays: Definition of Numerical Protection System, Advantages of Numerical relays, Block diagram of Numerical Relays, Processing Unit, non machines Interface, communication in protective relays, Information handling with substation monitoring system. 4 Hours

Digital Relays: Block Schematic approach of microprocessor based relays, over current relay, Protection Transformer differential protection, Directional relay scheme, Impedance relay scheme. 5 Hours

TEXT BOOKS:
REFERENCE BOOKS:
2. Ravindranath. B and Chanda M. “Power System Protection and switchgear” New age
Sub Code: 12EE723  Electrical Power Utilization

Contact Hours : 3-0-0-0  Credits : 3
Total Hours : 39  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisites: PE (12EE504), T&D (12EE505), TIM (12EE402), DCSM (12EE303)

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

1. Enumerate different methods of electrical heating and electrical welding practices.
2. Discuss various state of the art electrolytic processes.
3. Comprehend the role of electric motors for traction.
4. Understand various AC traction equipment including electric and hybrid vehicles.
5. Describe various lighting systems and energy conservation methods for illumination. And understand the working of Electric, Hybrid Vehicles

UNIT-I

HEATING AND WELDING: Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, control device and welding equipment 9 Hours

UNIT-II

ELECTROLYTIC PROCESS: Fundamental principles, extraction, refining of metals, electroplating. Factors affecting electro deposition process, power supply for electrolytic process. 7 Hours

UNIT-III

ELECTRIC TRACTION: System of traction, speed time curve, tractive effort at /co-efficient of adhesions, selection of traction motors, method of speed control, energy saving by series parallel control, 7 Hours

UNIT-IV

AC traction equipment. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, diesel electric equipment, train lighting system, specific energy, factors affecting specific energy consumption. 7 Hours

UNIT-V

ILLUMINATION: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps, incandescent, fluorescent, vapor and CFL and their working, Glare and its remedy 7 Hours

INTRODUCTION ELECTRIC AND HYBRID VEHICLES:

Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption 2 Hours

TEXT BOOKS:

1. Utilization Of Electric Energy- Openshaw Taylor

REFERENCE BOOKS:

2. Electrical Power by Dr. S.L.Uppal Khanna Publications
Sub Code: 12EE724  
**VLSI Circuits and Design**

**Contact Hours:** 3-0-0-0  
**Total Hours:** 42  
**Exam Hours:** 3  
**Credits:** 3  
**CIE:** 50 Marks  
**SEE:** 50 Marks

**Prerequisites:** ENT – 1(12EE302), AEC (12EE304), DEC (12EE305)

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

1. Review the components, characteristics for VLSI technology.
2. Analyze electrical characteristics of MOS transistors.
3. Understand the design procedure, rule to be followed and the concept of MOSFET Scaling in VLSI.
4. Analyze the Geometry Effects and characteristics of MOS Inverters and universal gates.
5. Discuss advanced techniques and applications to CMOS logic circuits.

**UNIT -I**

**CMOS Processing:** Introduction to IC Technology, Moore’s law, VLSI design flow, VLSI Technology, Wafer fabrication process using Czochralski method, Photolithography, Well and Channel Formation, Gate oxide, Gate and Source/Drain formation, Contact & Metallization, fabrication of nMOS Transistor, Depletion type and Enhancement type MOS, CMOS n-well and P-well process, twin tub process, BiCmos

7 Hours

**UNIT -II**

**MOS TRANSISTORS (Electrical Characteristics):** Two terminal MOS structure, flat band voltage, MOS system under external bias, structure and operation of MOS transistors, threshold voltage, drain to source current $I_{ds}$ verses $V_{ds}$ relationships, body effect, channel length modulation, mobility variation, Tunneling, punch through, hot electron effect MOS, models, small signal AC Characteristics

8 Hours

**UNIT -III**

**Design:** Mask Layer, Stick Diagram, Symbolic diagram, Sheet resistance, capacitance layer, inverter delays, rise time, fall time, cascading and super buffer. RC delay model, Linear Delay Model, Logical effect, Parasitic Delay, Design Rules

6 Hours

**Scaling:** MOSFET SCALING AND GEOMETRY EFFECTS: Introduction, constant field scaling, constant voltage scaling, short channel Effects, narrow channel effects, Comparison of MOSFET parameters due to scaling

3 Hours

**UNIT -IV**

**Application-MOS INVERTERS STATIC CHARACTERISTICS:** Introduction, voltage transistor characteristics, noise immunity and noise margin, power and area considerations, resistive load inverter calculation of $V_{oh}$, $V_{ol}$, $V_{il}$, $V_{ih}$, inverters with n type MOSFET load (enhancement, depletion) characteristics, CMOS inverter static characteristics (excluding derivation) design of CMOS inverter, latch up bulk CMOS

9 Hours

**UNIT -V**

**Application- 2 input NOR and NAND gates:** MOS based 2 input NOR and NAND gate (with derivation), CMOS based 2 input NOR and NAND gate (excluding derivation)

3 Hours

**Application-OTHER FORMS OF CMOS LOGIC:** Pseodo nMOS logic, dynamic CMOS logic, clocked CMOS logic, CMOS domino logic, parity generator, multiplexer, dynamic shift registers.

4 Hours

**TEXT BOOKS:**

2. Basic VLSI design by Douglass a Pucknell, amran Esharagian, 3 rd edition, PHI Publication
3. CMOS VLSI design by Neil Weste, David Harris 4th edition, Addison-Wesley
REFERENCE BOOKS:
2. Carver Mead and Lynn Conway" Introduction to VLSI Systems" BS Publication
Sub Code: 12EE801

Industrial Management, Electrical Estimation & Economics

Contact Hours : 3-0-0-1*  Credits : 4
Total Hours : 52  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisite: BEE (12EE105)

*Self Study Topics - to be covered under the supervision of the course instructors.

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

1. Comprehend the concept of management in engineering and technology and apply managerial / entrepreneurship skill in designing, planning and operation of an Industry.
2. Understand the management and behavioral approach, Personnel / Production Management in industry.
3. List and estimate the electrical related works for various interior and exterior Lighting and power circuits.
4. Prepare an estimate of the materials and costing as applied to electrical installations.
5. Justify the need of provision for depreciation fund and evaluation of asset value and depreciation.

Unit - I

INTRODUCTION: Historical prospective, contribution of Taylor, Henry Foyol, Gilberth and HL Gnatt to the evolution of management as a scientific discipline concept of scientific management and its relevance in the Indian context.  
Self Study Topics: { ORGANIZATION: Types of organization; their merits and demerits}

 MANAGEMENT FUNCTIONS: Planning, organizing, staffing, directing, controlling.  

Unit - II

MANAGEMENT AND BEHAVIORAL APPROACH: contribution of Elton mayo and skinner and others to behavioral science, skills of a manager at various levels in an organization and inter related systems, understanding past behavior, predicting future behavior, directing, changing and controlling behavior; Maslow’s hierarchy of needs and satisfaction, goal oriented behavior

Self Study Topics: {Integration of organizational goals and needs of employees, Hawthorn’s studies and its finding, theory X and Y}

Unit - III

Self Study Topics: {PERSONAL MANAGEMENT: Recruitment and selection, training of personnel employer and employee relationship, causes and settlement of disputes.}

PRODUCTION MANAGEMENT: Plant location, plant lay-out, CPM and PERT strategies, line balancing, automation statistical quality control; control chart, motion study.

Unit - IV

INTERIOR WIRING SYSTEM: Wiring system and estimation of wiring installation.

POWER INSTALLATION: Load calculation, wire size selection, wiring materials for power circuits,

Self Study Topics: {Need of Earthing, and types of Earthing}

Unit - V

The estimate for motor installation, pump set, workshop, theater etc., Depreciation and valuation of machinery, Inventory
Self Study Topics: {Economic order quantity, break-even analysis}
TEXT BOOKS:
1. “Introduction to Management”- S. S. Chatterjee,
2. “Engineering Economics and Management” - N. Narasimhaswamy,

REFERENCE BOOKS:
Sub Code: 12EE802  Seminar

Contact Hours : 0-0-2-0  
CIE : 50 Marks  
Total : 50 Marks  
Credits : 1

Sub Code: 12EE803  Major Project

Contact hours: 0-0-12-0  
Credits: 9

Evaluation:

CIE: Report Evaluation : 50  
Seminar : 50  
SEE: Presentation : 50  
Demonstration : 50
Sub Code: 12EE811

Power System Operation and Control

Contact Hours : 3-0-0-0
Total Hours : 39
Exam Hours : 3

Credits : 3

Prerequisites: ENT-I (12EE302), EPG (12EE403), T&D (12EE505), PSAS (12EE601), DCSM (12EE303)

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

1. Understand the importance of Control Center and SCADA system in Power system operation.
2. Enumerate the operation of Automatic Generation Control system in Power system.
3. Analyze and enumerate the operation of power system components and control area problems and Justify the importance of reactive power, generation, control
4. Importance of unit commitment and study of various methods
5. Enumerate various methods and Study of System optimization and security

UNIT – I

CONTROL CENTER OPERATION OF POWER SYSTEMS:
Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators. 8 Hours

UNIT - II

AUTOMATIC GENERATION CONTROL: Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems. 8 Hours

UNIT – III

CONTROL OF VOLTAGE AND REACTIVE POWER: Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse. 8 Hours

UNIT - IV

UNIT COMMITMENT: Statement of the problem, need and importance of unit commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples. 7 Hours

UNIT – V

POWER SYSTEM SECURITY Factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, contingency ranking. 8 Hours

TEXT BOOKS:
4. “Electric Power Systems”-B. M. Weedy,
5. “Power Systems Operation and Control” – P.S.R.Murthy,TMH

REFERENCE BOOKS:
2. “Elements of Power System Analysis”- W.D Stevenson
Sub Code: 12EE812  
HVDC Power Transmission

Contact Hours : 3-0-0-0  
Credits : 3

Total Hours : 39  
CIE : 50 Marks

Exam Hours : 3  
SEE : 50 Marks

Prerequisite: PE (12EE504), T&D (12EE505), PSAS (12EE601)

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

1. Compare the HVDC and HVAC transmission options, justify the advantages of HVDC power transmission. And classify HVDC power transmission system.
2. Analyze different converter circuits, the choice of converter and their control configuration for HVDC power transmission and also analyze bridge converter for different mode of operation
3. Analyze bridge converter for different modes of operation
4. Understand various methods to Control the HVDC converters.
5. Identify different types of protection used for HVDC system.

Unit-I
General aspects of DC transmission and comparison of it with Ac transmission: Historical sketch, constitution of EHV AC and DC links, Limitations and Advantages of AC and DC Transmission.

8 Hours

Unit-II
Converter circuits: Valve Characteristics, Properties of converter circuits, assumptions, single phase, three phase converters, choice of best circuits for HV DC circuits.

7 Hours

Unit-III
Analysis of the bridge converter:- Analysis with grid control but no overlap, Analysis with grid control and with overlap less than 60 deg, Analysis with overlap greater than 60 deg, complete characteristics of rectifier, Inversion

8 Hours

Unit-IV
Control of HVDC converters and systems: grid control, basic means of control, power reversal, limitations of manual control, constant current versus constant voltage, desired feature of control, actual control characteristics, constant -minimum -ignition -angle control, constant -current control, constant -extinction -angle control, stability of control

8 Hours

Unit-V
Protection: general, DC reactor, voltage oscillations and valve dampers, current oscillations and anode dampers, DC line oscillations and line dampers, clear line faults and reenergizing the line.

8 Hours

TEXT BOOKS:

1. EW Kimbark, “Direct current Transmission” Wiley-Blackwell; Volume 1 edition
Sub Code: 12EE813  Micro Electro Mechanical Systems

Contact Hours : 3-0-0-0  Credits : 3
Total Hours : 39  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisites: Engg Physics (12PH102)

Course Outcomes: at the end of the course student will be able to
1. Understand the concept of MEMS Technology and need of scaling in micro domain
2. List different MEMS Materials microfabrication/micromaching process
3. Understand the transcondution principle and MEMS modeling
4. Enumerate the characteristics of RF and Optical MEMS
5. Understand the MEMS devices through case studies and introduce MEMS and Nanotechnology.

Unit-I
INTRODUCTION TO MEMS TECHNOLOGY: Introduction to MEMS and motivation, Basic definitions, history of MEMS

SCALING IN MICRODOMAIN: How small is different- some natural examples, Scaling laws in electrostatic, electromagnetic, rigidity of structures, heating & cooling, Fluid viscosity and fluid interfaces, etc. Scaling in overall system performance considering multiple physical domains 8 Hours

Unit - II
MEMS MATERIALS: Mechanical and other properties of materials used in MEMS
MICROFABRICATION / MICROMACHINING: Overview of microfabrication, Review of microelectronics fabrication processes like photolithography, deposition, doping, etching, structural and sacrificial materials, other lithography methods,. MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods. 8 Hours

Unit-III
TRANSDUCTION PRINCIPLES: Transduction principles in micro-domain
MEMS MODELING: Basic modeling elements in electrical, mechanical, thermal and fluid systems, analogy between 2nd order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems. 7 Hours

Unit - IV
RADIO FREQUENCY (RF) MEMS: Introduction, Review of RF-based communication systems, RF – MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches 5 Hours

OPTICAL MEMS: Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS. 4 Hours

Unit-V
CASE STUDIES: Case studies of Microsystems including micro cantilever based sensors and actuators with appropriate selection of material properties: thermal; mechanical properties. Static and dynamic mechanical response with different force mechanisms: electrostatic, electromagnetic, thermal etc.
Tutorials: The above case study examples are to be implemented in either Coventor Ware or ANSYS Multiphysics.
NANOTECHNOLOGY AND MEMS: Relation between micro and nanotechnologies. Need and issues in handling nano products with the help of MEMS 8 Hours
REFERENCE BOOKS:
Syllabus – VIII Semester

Sub Code: 12EE814  
Computer Control of Electrical Drives

Contact Hours : 3-0-0-0  
Credits : 3
Total Hours : 39  
CIE : 50 Marks
Exam Hours : 3  
SEE : 50 Marks

Prerequisites: MC (12EE603), PE (12EE504), IDA (12EE703)

Course Outcomes: at the end of the course student will be able to
1. Review the applications micro controllers and power electronics in industrial drives
2. Understand the classification and control of AC drive using digital logic
3. Understand the control of synchronous machine and phase controlled converters.
4. Understand the principals of slip power recovery schemes and effect of EMI.
5. Identify the use of expert system application to drives and understand the concept of vector control of ac drives

Unit-I
REVIEW OF MICRO CONTROLLERS IN INDUSTRIAL DRIVES
SYSTEM: Typical Micro controller’s 8 bit 16 bit (only block diagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors.  
4 Hours

EVOLUTION OF POWER ELECTRONICS IN DRIVES: Power semiconductors devices used for drives control, Ratings, comparison and their applications. Block diagram of power integrated circuit for DC motor drives.  
4 Hours

Unit-II
AC MACHINE DRIVES: general classification and National Electrical Manufacturer Association (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.  
8 Hours

Unit-III
SYNCHRONOUS MACHINE DRIVES: Wound field machine, comparison of Induction and wound field synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM), variable reluctance machines (VRM).  
5 Hours

PHASE CONTROLLED CONVERTERS: Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle,  
2 Hours

Unit-IV
Electromagnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers, Current fed Converters.  
3 Hours

PRINCIPALS OF SLIP POWER RECOVERY SCHEMES: Static Kramer’s drive system, block schematic diagram, phasor diagram and limitations, Static Scherbins scheme system using D.C link converters with cyclo converter modes of operation, modified Scherbins Drive for variable source, constant frequency (VSCF) generation  
5 Hours

Unit-V
PRINCIPLE OF VECTOR CONTROL OF A C DRIVES: Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control, synchronous motor control with compensation.  
4 Hours

EXPERT SYSTEM APPLICATION TO DRIVES (ONLY BLOCK DIAGRAM): Expert system shell, Design methodology, ES based P-I tuning of vector controlled drives system, Fuzzy logic control for speed controller inverter control drives,, structure of fuzzy control in feedback system.  
4 Hours
TEXT BOOKS:

REFERENCE BOOK:
1. “Advanced Microprocessor and Interfacing”- Badri Ram TMH,
Sub Code: 12EE821  

Power System Dynamics and Stability

Contact Hours : 3-0-0-0  
Credits : 3

Total Hours : 39  
CIE : 50 Marks

Exam Hours : 3  
SEE : 50 Marks

Prerequisites: PSAS (12EE601), DCSM (12EE303)

Course Outcomes: at the end of the course student will be able to
1. Perform the system modeling understand the dynamics of synchronous generator
2. Understand the concept of load modeling.
3. Understand the concept of excitation and prime mover controller.
4. Model the different types of prime movers
5. Perform the transient stability analysis for the controller

UNIT - I

SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR: Basic concepts, Review of classical methods, modeling of synchronous machine, Swing equation, Park’s transformation – Park’s voltage equation, Park’s mechanical equation (torque). Applications – (a) Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator. Solution for transient analysis, Operational impedance, Relationship between $T_d^0$ and $T_d^0^*$

8 Hours

UNIT - II

LOAD MODELING: Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB.

7 Hours

UNIT - III

EXCITATION AND PRIME MOVER CONTROLLERS: Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters.

8 Hours

UNIT - IV

MODELING OF PRIME MOVERS: Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine.

8 Hours

UNIT – V

TRANSIENT STABILITY ANALYSIS: Simulation for Transient stability Evaluation, Transient stability controllers.

8 Hours

TEXT BOOKS:

REFERENCE BOOKS:
1. ”Dynamics and Control of Large Electric Power Systems”- Marija Ilic; John Zaborszky, , IEEE Press and John Wiley & Sons, Inc.
Sub Code: 12EE822       Flexible AC Transmission Systems (FACTS)

Contact Hours : 3-0-0-0               Credits : 3
Total Hours     : 39                CIE : 50 Marks
Exam Hours      : 3                SEE : 50 Marks

Prerequisites: PE (12EE504), T&D (12EE505), PSAS (12EE601)

Course Outcomes: at the end of the course student will be able to
1. Appreciate the need of FACTS Controllers
2. Justify the requirement of High power Semiconductor devices for control of power flow
3. Appreciate the application of Current source and Voltage Source Converters
4. Justify the application of Shunt FACTS controllers for enhancement of power transfer capability and damping of power oscillations.
5. Justify the use of series FACTS controllers for controlling / routing the power through the desired transmission paths.

Unit - I
FACTS Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controllers.  8 Hours

Unit - II
POWER SEMICONDUCTOR DEVICES: types of high power devices, principle of high power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT) 8 Hours

Unit - III
VOLTAGE SOURCED CONVERTERS: basic concepts, single phase full wave bridge converter operation, square wave voltage harmonics for a single phase bridge 3 phase full wave bridge converter. 4 Hours

SELF AND LINE COMMUTATED CURRENT SOURCE CONVERTER: basic concepts, 3 phase full wave diode rectifier, thyristor based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter. 4 Hours

Unit - IV
STATIC SHUNT COMPENSATOR SVC AND STATCOM: objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STATCOM, comparison between SVC and STATCOM. 7 Hours

Unit - V
STATIC SERIES COMPENSATORS: GCSC, TSSC, TCSC and SSSC, objectives of series compensation; variable impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators. 8 Hours

TEXT BOOK:

REFERENCE BOOK:
Sub code: 12EE823  
Artificial Neural Networks

Contact Hours : 3-0-0-0  
Total Hours : 39  
Exam Hours : 3

Credits : 3  
CIE : 50 Marks  
SEE : 50 Marks

Course Outcomes: at the end of the course student will be able to
1. Appreciate the concept and use of ANN
2. Understand the concept of supervised learning and various leaning algorithms.
3. Justify the use of Accelerating learning process and need of prediction network
4. Understand the concept of Learning vector quantizing and associative modeling
5. Understand the need of optimization and different optimization algorithms

Unit - I
7 Hours

Unit - II
Supervised learning, single layer networks, perceptrons, linear separability, perceptron training algorithm, guarantees of success, modifications.  
4 Hours
Multiclass networks-I, multilevel discrimination, preliminaries, back propagation, setting parameter values, theoretical results.  
5 Hours

Unit - III
Accelerating learning process, application, mandaline, adaptive multilayer networks.  
4 Hours
Prediction networks, radial basis functions, polynomial networks, regularization, unsupervised learning, winner take all networks.  
4 Hours

Unit - IV
Learning vector quantizing, counter propagation networks, adaptive resonance theorem, topologically organized networks, distance based learning, neocognition.  
4 Hours
Associative models, hop field networks, brain state networks, Boltzmann machines, hetero associations.  
4 Hours

Unit - V
Optimization using hop filed networks, simulated annealing, random search, evolutionary computation.  
7 Hours

Text Books:

References Books:
Sub Code: 12EE824  
Embedded Systems

Contact Hours : 3-0-0-0  
Total Hours : 39  
Exam Hours : 3

Credits : 3  
CIE : 50 Marks  
SEE : 50 Marks

Prerequisites: MC (12EE603)

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

1. Understand the overview of embedded system and associated technologies
2. Understand the various processing element in a embedded system
3. Appreciate the necessity of memory devices which can be used with the embedded system
4. Understand the concepts of interfacing and the type of devices that can be interfaced.
5. Appreciate the importance of RTOS and understand some generally used embedded systems

Unit I

Introduction: Embedded systems overview-design challenge-optimizing metrics-processor technology-IC technology- design technology- automation- synthesis- verification: hardware/software co simulation-trade-offs.  8 Hours

Unit II

Processing Elements: Custom single purpose processor design-RT level custom single purpose processor design-optimizing custom single purpose processors-General purpose processor's software: architecture, operation, programmer's view and development environment – ASIPs - selecting a microprocessor - general purpose processor design.  8 Hours

Unit III

Memory: Introduction-memory write ability and storage Permanence-common memory types-composing memory-memory hierarchy and caches-advanced RAM.  7 Hours

Unit IV


Unit V

RTOS: Principles of RTOS, Task, Task Scheduling, Semaphore, Priorities

Case Study: Digital Camera Example, Tank level monitor using RTOS  8 Hours

Textbook

2. Embedded System Premier, David E Simon, Addison Wesley

References

2. Santanuchattopadhyay, Embedded system Design, PHI Learning Pvt. Ltd., 2010
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Each student should select one of the courses offered by other department as open elective.
OPEN ELECTIVES OFFERED BY E & E Department

Sub Code: 12EE8X10  Non Conventional Energy Systems

Contact Hours : 3-0-0  Credits : 3  
Total Hours : 39  CIE : 50 Marks  
Exam Hours : 3  SEE : 50 Marks  

Prerequisites: Basic Electrical Engineering (12EE105)

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

1. Review various sources of energy their advantages and limitations and understand the solar energy basics
2. Understand the working principle and applications of solar based thermal, electrical and PV systems
3. Appreciate the importance of energy storage and wind energy systems
4. Understand the working principle and applications of biomass systems
5. Understand the process of design and implement of tidal, OTEC based energy conversion systems and comprehend the emerging technologies in the area of RES.

Unit – I
Energy Sources: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. 3 Hours

Unit - II
Solar Thermal Systems: Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green Houses. 4 Hours

Unit – III

Unit - IV

7 Hours

Energy from Ocean: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Estimation of Energy – Single basin and Double basin type TPP (no derivations. Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitation of OTEC.

5 Hours


3 Hours

TEXT BOOKS:

REFERENCE BOOKS:
Syllabus – VIII Semester

Sub Code: 12EE8X11  LINEAR SYSTEMS THEORY

Contact Hours : 3-0-0  Credits : 3
Total Hours : 39  CIE : 50 Marks
Exam Hours : 3  SEE : 50 Marks

Prerequisites: Basic course on Control Systems

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

1. Apply the State variable analysis & design for the given control system problems
2. Understand the importance of Eigen values in control system.
3. Obtain the solution for the state equation for a given control system problems
4. Understand the concept of controllability & observability and apply Pole placement techniques
5. Understand the Liapunov stability criterion and apply it to control system problems

UNIT - I
State variable analysis & design: Introduction, concept of state, state variables & state model, state model of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables. 7 Hours

UNIT - II
Derivation of transfer function from state model, diagonalisation, eigen values, Eigen vectors, generalized Eigen vectors. 7 Hours

UNIT - III
Solution of state equation, state transition matrix & its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method, 8 Hours

UNIT - IV
Concept of controllability & observability, methods of determining the same. Pole placement techniques: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement 9 Hours

UNIT - V
Liapunov stability criteria, Liapunov functions, direct method of Liapunov & the linear system, Hurwitz criterion & Liapunov’s direct method 8 Hours

Text Books:

Reference Books: