COURSE STRUCTURE (R19)

&

DETAILED SYLLABUS

(FINAL YEAR)

ELECTRICAL & ELECTRONICS ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2019-20)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (ECE, CSE, EEE & ME)
Jonnada (Village), Denkada (Mandal), Vizianagaram Dist – 535 005
Phone No. 08922-241111, 241112
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech Final Year Course Structure – R19 Regulation

IV Year – I Semester							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R19EEE-PC4101	Power System Operation and Control	PC	3	0	0	3
2	R19EEE-PC4102	Utilization of Electrical Energy	PC	3	0	0	3
3	R19EEE-PC4103	Electrical Distribution Systems	PC	3	0	0	3
4	**Professional Elective – III**						
	R19EEE-PE4101.1	Electrical Machine Modelling and Analysis	PE	3	0	0	3
	R19EEE-PE4101.2	Hybrid Electric Vehicles					
	R19EEE-PE4101.3	Energy Conservation and Auditing					
	R19EEE-PE4101.4	Digital Signal Processing					
5	**Professional Elective – IV**						
	R19EEE-PE4102.1	High Voltage Engineering	PE	3	0	0	3
	R19EEE-PE4102.2	Power Quality					
	R19EEE-PE4102.3	AI techniques and Applications in Electrical Engineering					
6	R19EEE-PC4104	Power Systems & Simulation Lab	PC	0	0	2	1
7	R19EEE-PJ4101	Mini-Project	PJ	0	0	8	4
8	R19EEE-SI4101	*Summer Internship-2	SI	0	0	0	0
9	R19EEE-SD4101	PLC and SCADA	SD	1	0	2	0
10	R19EEE-SD4102	Electrical Installation and Estimation	SD	2	0	0	0
Total				**18**	**0**	**12**	**20**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				**3**	**1**	**0**	**4**

*** Summer Internship after third year (to be evaluated during VII semester)**

IV Year – II Semester							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R19EEE-PC4201	Renewable Energy Systems	PC	3	0	0	3
2	**Open Elective-III**						
	R19CSE-OE4201	UNIX and Shell Programming	OE	3	0	0	3
	R19EEE-OE4202	Neural network and Fuzzy Logic					
	R19ECE-OE4201	VLSI Design					
	R19ME-OE4201	Automobile Engineering					
3	**Professional Elective – V**						
	R19EEE-PE4201.1	Optimization Techniques	PE	3	0	0	3
	R19EEE-PE4201.2	Power System Reforms					
	R19EEE-PE4201.3	HVDC and FACTS					
	R19EEE-PE4201.4	Smart Grid Technologies					
4	R19EEE-PJ4201	Project	PJ	0	0	16	8
Total				**9**	**0**	**16**	**17**

IV Year, I-Semester Syllabus (R19)

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC4101	Power System Operation and Control	3:0:0	3

Course Objectives:

- To learn optimum generation allocation
- To impart the knowledge on the unit commitment problems
- To familiarize modeling of turbines and generator-load
- To know the load frequency control of single area and two area systems
- To learn reactive power compensation in power systems

Course Outcomes: After completion of the course, the student will be able to:

1. Apply the operating principles of economic scheduling to minimize the overall cost of generation(L3)
2. Analyze the optimal allocation of hydro-thermal system and unit commitment schedules to ensure optimal operation(L4)
3. Apply the concepts to develop mathematical models for load frequency control in power systems(L3)
4. Examine the Economic dispatch control and load frequency control in two area systems(L4)
5. Describe the methods for reactive power control and its importance in maintaining system stability(L2)

UNIT – I

Economic Operation

Power scenario in Indian grid – National and Regional load dispatching centres – requirements of good power system, heat rate curve – cost curve – incremental fuel and production costs, input-output characteristics, basic concept of load dispatching. Optimum generation allocation with and without line losses, general transmission line loss formula.

UNIT–II

Hydrothermal Scheduling and Unit Commitment

Optimal scheduling of hydrothermal System: Scheduling problems-Short term hydrothermal scheduling problem. Statement of Unit Commitment (UC) problem; constraints in UC, UC solution methods: Priority-list methods, forward dynamic programming approach

UNIT – III

Load Frequency Control-I

Necessity of keeping frequency constant, basics of speed governing system and modelling, block diagram representation of steam turbines and approximate linear Models, generator-load modelling. Definitions of control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

UNIT – IV

Load Frequency Control-II

Proportional plus integral control of single area and its block diagram representation, steady state response – Load frequency control and economic dispatch control. Load frequency control of two-area system – Uncontrolled case and controlled case, Tie-Line bias control.

UNIT – V

Reactive Power Control

Overview of reactive power Control – Reactive Power Compensation in Transmission Systems – Advantages and Disadvantages of Different Types of Compensating Equipment for Transmission Systems; Load Compensation – Specifications of Load Compensator, Uncompensated and Compensated Transmission Lines: Shunt and Series Compensation.

Text books:

1. Modern Power System Analysis,D.P.Kothari and I.J.Nagrath, Tata McGraw Hill Publishing Company Ltd., 3rd Edition, 2003, Ninth Reprint 2007.
2. Allen.J.Wood and Bruce F.Wollenberg, 'Power Generation, Operation and Control', 3rd/e, John Wiley & Sons, Inc., 2013.

Reference books:

1. Power System Analysis and Design, J. Duncan Glover and M.S.Sharma, Thomson, 3rd Edition, 2008.
2. Electric Energy System Theory: An Introduction, OlleIngemar Elgerd, Tata McGraw Hill, 2nd Edition, 1982.
3. Power System Stability and Control, P Kundur, Tata McGraw Hill, 1994, 5th Reprint, 2008.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	2	2	-	2	-	-	1	3	2
CO2	3	3	2	2	-	2	2	-	2	-	-	1	3	2
CO3	3	2	2	2	-	2	2	-	2	-	-	1	3	2
CO4	3	3	2	2	-	2	2	-	2	-	-	1	3	2
CO5	2	2	2	-	-	2	2	-	2	-	-	1	3	2
CO*	3	3	2	2	-	2	2	-	2	-	-	1	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC4102	Utilization of Electrical Energy	3:0:0	3

Course Objectives:

- To understand the laws of illumination and their applications for various lighting schemes.
- To understand the methods of electric heating and electric welding.
- To know the electric traction system and its equipment
- To identify the speed-time curves of different services and energy consumption levels at various modes of operation
- To analyze the economic aspects of utilization of electrical energy

Course Outcomes: After completion of the course, students are able to

1. Describe the suitable motor for electric drives and their various industrial applications. (L2)
2. Apply the concepts of illumination to Calculate the illumination levels required for various lighting schemes(L3)
3. Explain the appropriate heating and welding techniques for different applications. (L2)
4. Apply the concepts of D.C and A.C traction systems(L3)
5. Apply speed-time curves and the energy consumption of different services under various operating conditions(L3)

UNIT–I

Illumination

Basic definition of Illumination, Laws of Illumination, Polar Curves, Calculation of MHCP and MSCP, Lamps: Incandescent Lamp, Sodium Vapour Lamp, Fluorescent Lamp, CFL and LED. Requirement of Good Lighting Scheme, Types, Design and Calculation of Illumination, Street Lighting and Factory Lighting, Numerical Problems, Energy Conservation methods.

UNIT–II

Electric Heating &Electric Welding

Electrical Heating: Advantages, Methods of Electric Heating – Resistance, Arc, Induction and Dielectric Heating, Applications of electric heating.

Electric Welding: Types – Resistance, Electric Arc, Gas Welding, Ultrasonic, Advantages & disadvantages of electric welding, Applications of electric welding .

UNIT–III

Electric Traction – I

Introduction, Systems of Electric Traction, Comparison Between A. C. and D. C Traction, Special Features of Traction Motors, The Locomotive, Wheel arrangement and Riding Qualities, Transmission of Drive, Characteristics and Control of Locomotives and Motor

Coaches for Track Electrification, DC Equipment, AC Equipment, Electric Braking with DC Motors and AC Motors, Overhead Equipment, Numerical Problems.

UNIT–IV

Electric Traction - II

Speed-Time Curves of Different Services, Trapezoidal and Quadrilateral Speed-Time Curves, Numerical Problems, Mechanics of Train Movement, Calculations of Tractive Effort, Power, Specific Energy Consumption, Effect of Varying Acceleration and Braking Retardation, Adhesive Weight and Dead Weight, Adhesive Weight and Coefficient of Adhesion, Problems.

UNIT–V

Economic Aspects of Utilizing Electrical Energy

Power Factor Improvement, Load Factor improvement, Off Peak Loads, Use of Exhaust Steam, Waste Heat recovery, Pit Head Generation, Diesel Plant, General Comparison of Private Generating Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses.

Text Books:

1. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. Art & Science of Utilization of electrical Energy, Partab,Dhanpat Rai & Co., 2004.

Reference Books:

1. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited,1993
2. Electrical Power, S. L. Uppal, Khanna publishers,1988.
3. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	-	2	1	-	2	-	-	2	2	1
CO2	3	3	2	3	-	2	2	-	2	-	-	2	2	2
CO3	2	2	2	2	-	2	1	-	2	-	-	1	1	2
CO4	2	2	1	2	-	1	1	-	2	-	-	2	1	1
CO5	3	3	2	3	-	2	2	-	2	-	-	2	2	2
CO*	3	2	2	2	-	2	1	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC4103	Electrical Distribution Systems	3:0:0	3

Course Objectives:

- To understand the need of distribution system and factors effecting the Distribution system
- To learn about the substations and distribution feeders
- To solve the voltage drop, power loss for different load areas and know the voltage control methods.
- To familiarize the distribution system protection and its coordination.
- To know the effect of compensation on power factor improvement.

Course Outcomes: After completion of the course, the student will be able to

1. Explain the various factors effecting the distribution system(L2)
2. Classify distribution feeders and the benefits of optimal location of substations(L4)
3. Apply the different techniques to calculate the voltage drop and power loss across for different load areas in a power distribution system(L3)
4. Analyze the various protection schemes and their coordination Procedure(L4)
5. Analyze the effect of compensation on P.F improvement(L4)

UNIT – I General Concepts

Introduction to distribution systems, Load modeling and characteristics –Coincidence factor – Contribution factor, loss factor – Relationship between load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II: Substations

Location of substations**:** Rating of distribution substation – Service area within primary feeders – Benefits derived through optimal location of substations.

Distribution Feeders

Design Considerations of distribution feeders**:** Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III: System Analysis

Voltage drop and power–loss calculations: Derivation for voltage drop and power loss in lines – Manual methods of solution for radial networks – Three phase balanced primary lines.

Voltage Control: Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR –Line drop compensation.

UNIT – IV: Protection

Objectives of distribution system protection – Types of common faults and procedure for fault calculations – Protective devices**:** Principle of operation of fuses – Circuit reclosures – Line sectionalizers and circuit breakers.

Coordination: Coordination of protective devices**:** General coordination procedure – Residual current circuit breaker RCCB.

UNIT – V: Compensation for Power Factor Improvement

Capacitive compensation for power–factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location.

Text Book:

1. Electric Power Distribution system, Engineering – by TuranGonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pablo, Tata McGraw–hill Publishing Company, 4thEdition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	-	2	2	-	2	-	-	2	3	2
CO2	3	3	3	2	-	2	2	-	2	-	-	2	3	2
CO3	3	3	3	2	-	2	2	-	2	-	-	2	3	2
CO4	3	3	3	2	-	2	2	-	2	-	-	2	3	2
CO5	3	3	3	2	-	2	2	-	2	-	-	2	3	2
CO*	3	3	3	2	-	2	2	-	2	-	-	2	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4101.1	Electrical Machine Modeling and Analysis	3:0:0	3

Course Objectives:

- To establish unified theory of rotating machines.
- To understand the concept of phase transformation.
- To analyze different electrical machines for improved performance through modification of their characteristics.
- To develop concepts on mathematical modeling of electrical machines.
- To analyze the mathematical modeling of BLDC machine and switched reluctance machine

Course Outcomes: After completion of the course, the student will be able to

1. Understand the basics of Machine modeling (L2)
2. Analyze the mathematical modeling of DC machine (L4)
3. Apply mathematical modeling concepts to 3-phase Induction Machines (L3)
4. Develop the 3-phase Synchronous Machine modeling (L3)
5. Analyze the mathematical modeling of BLDC Machine and Switched Reluctance Machine (L4)

UNIT – I Basic concepts of Modeling

Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous Machine with and without damper bars and 3-phase induction machine, Kron's Primitive Machine-voltage, current and Torque equations.

UNIT – II DC Machine Modeling

Mathematical model of separately excited D.C motor – Steady State analysis-Transient State Analysis, Sudden application of Inertia Load-Transfer function of separately excited D.C Motor, Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.

UNIT- III Reference frame Theory & Modeling of Induction Machine

Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence.

Mathematical modelling single phase induction machines. Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables.

UNIT –IV Modeling of Synchronous Machine

Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame electromagnetic torque- current in terms of flux linkages-three synchronous machine model.

UNIT –V Modeling of Special Machines

Modeling of PM Synchronous motor, modeling of BLDC motor, modeling of Switched Reluctance motor.

Text Books:

1. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications-1st edition -2002.

Reference Books:

1. Analysis of Electrical Machinery and Drive systems – P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
2. Dynamic simulation of Electric machinery using Matlab / Simulink –CheeMunOng-PHl.
3. Modern Power Electronics and AC Drives-B.K. Bose – PHI.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	1	-	-	2	-	-	3	2	2
CO2	3	3	3	3	-	2	-	-	2	-	-	3	2	2
CO3	3	3	3	3	-	2	-	-	2	-	-	3	2	2
CO4	3	3	3	3	-	2	-	-	2	-	-	3	2	2
CO5	3	3	3	3	-	2	-	-	2	-	-	3	2	2
CO*	3	3	3	3	-	2	-	-	2	-	-	3	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4101.2	Hybrid Electric Vehicles	3:0:0	3

Course Objectives:

- To understand the advantages of electric and hybrid electric vehicles.
- To know various architectures of hybrid electric vehicles.
- To learn the power management of plug in electric vehicles.
- To familiarize the different power converters used in electrical vehicles.
- To know different batteries and other storage systems

Course Outcomes: After completion of the course, the student will be able to

1. Outline key concepts of vehicle fundamentals, propulsion loads, electric and hybrid vehicle technologies, and relevant motor systems. (L2)
2. Illustrate the architectures and components of Hybrid Electric Vehicles (HEVs), Plug-in Hybrid Electric Vehicles (PHEVs), and fuel cell vehicles. (L2)
3. Demonstrate the PHEV architectures, power management, battery charging, and how PHEVs interact with electric power grid through vehicle to grid and grid to vehicle technologies. (L2)
4. Analyze the power converters used in hybrid electric vehicles (L4)
5. Identify appropriate energy storage mechanism used in hybrid electric vehicles (L4)

UNIT– I: Introduction

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles, advantages and applications of Electric and Hybrid Electric Vehicles, principle of magnetic levitation, different Motors suitable for of Electric and Hybrid Electric Vehicles.

UNIT–II: Hybridization of Automobile

Architectures of Hybrid Electric Vehicles (HEVs), series and parallel HEVs, complex HEVs. Plug-in hybrid electric vehicle (PHEV), constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III: Plug-in Hybrid Electric Vehicle

PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV: Power Electronics in HEVs

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– V: Battery and Storage Systems

Energy Storage Parameters; Lead–Acid Batteries; Lithium-ion batteries-Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

TEXT BOOKS

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

REFERENCE BOOKS:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.

WEBLINKS:

1. https://onlinecourses.nptel.ac.in/noc22_ee53/preview
2. https://nptel.ac.in/courses/108103009

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	-	-	1	2	-	2	-	-	2	1	-
CO2	2	2	2	-	-	1	2	-	2	-	-	2	1	-
CO3	2	2	1	-	-	1	2	-	2	-	-	2	1	-
CO4	3	3	2	2	-	1	1	-	2	-	-	2	2	-
CO5	2	2	1	-	-	1	1	-	2	-	-	2	1	-
CO*	2	2	1	2	-	1	2	-	2	-	-	2	1	-

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4101.3	Energy Conservation and Auditing	3:0:0	3

Course objectives:

- To discuss essential aspects of the current energy scenario and the importance of energy conservation.
- To acquire knowledge on energy auditing and energy conservation systems.
- To study about energy management and to prepare energy audit report for different energy conservation instances.
- To understand the methods of improving energy efficiency in different electrical systems.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Course Outcomes: After completion of the course, the student will be able to:

1. Analyze the significance of energy conservation and security(L4)
2. Apply the principles and techniques of energy auditing to assess energy consumption in industrial and commercial systems. (L3)
3. Make use of audit instruments for energy audit and management(L3)
4. Analyze the performance of electrical utilities and their efficient improvement approaches. (L4)
5. Analyze the life cycle cost and return on investment of energy-efficient technologies. (L4)

UNIT-I: Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, energy intensity on purchasing power parity (PPP) basis, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. Energy Conservation Act-2001 and its features.

UNIT-II: Energy auditing

Energy audit- Definitions- concept- types of energy audit- energy index- cost index. Energy auditing- general & detailed energy audit.

Energy conservation systems and energy saving potential- short, medium and long-term energy conversation. Industrial energy use. Representation of energy consumption- pie charts- Sankey diagrams- Load profiles.

UNIT-III: Energy Management

Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT-IV: Energy Efficiency and Performance of Electrical Utilities

Electrical system: Electricity billing, electrical load management and maximum demand control, Transformer losses & Energy efficient transformers. Distribution losses in industrial systems.

Assessment of transmission and distribution losses in power systems. Benefits of demand side management- Harmonics-causes-effects-overcoming.

UNIT-V: Economic Aspects and Analysis

Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts). Economics of energy efficient motors and systems.

Textbooks:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995.
4. Amlan Chakrabarti, "Energy Engineering and management", PHI Publication.

Reference Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. S.C.Tripathy,"UtilizationofElectricalEnergyandConservation",McGrawHill,1991.
3. Doty, Steven; Turner, Wayne C, Energy Management Handbook (8th Edition), Fairmont Press, Inc., 978-0-88173-707-3

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	2	1	-	2	-	-	2	3	2
CO2	3	2	2	2	-	3	2	-	2	-	-	2	3	2
CO3	3	2	2	2	-	2	1	-	2	-	-	2	2	2
CO4	3	2	3	2	-	2	1	-	2	-	-	2	2	2
CO5	3	3	2	2	-	2	-	-	2	-	-	2	2	2
CO*	3	2	2	2	-	2	1	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4101.4	Digital Signal Processing	3:0:0	3

Course Objectives:

- To describe discrete time signals and systems.
- To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
- To expose various implementations of digital filter structures.
- To present FIR and IIR Filter design procedures.
- To outline need of Multi-rate Processing.
- To introduce concepts of DSP Processors.

Course Outcomes: After completion of the course, the student will be able to

1. Develop difference equations for the given discrete time systems (L2)
2. Apply FFT algorithms for determining the DFT of a given signal(L3)
3. Design digital filter IIR from the given specifications(L4)
4. Design digital filter FIR from the given specifications(L4)
5. Describe special features of DSP Processor and major applications of Digital Signal Processing.(L2)

UNIT-I

Introduction to Digital Signal Processing:

Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, LTI system Properties. Solution of Linear constant coefficient difference equations, frequency domain representation of discrete time signals and systems. Review of Z-transforms.

UNIT-II

Discrete Fourier Series and Fourier Transforms:

Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

UNIT-III

Design of IIR Digital Filters and Realizations

Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

UNIT-IV

Design of FIR Digital Filters and Realizations

Characteristics of FIR Digital Filters, frequency response. Design of FIR digital filters using window techniques and frequency sampling techniques, comparison of IIR & FIR filters, basic structures of FIR systems.

UNIT-V

Introduction to DSP Processors:

Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs. Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit.

DSP Applications:

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Adaptive filters: Introduction

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing ,PHI.
3. B.Venkataramani, M. Bhaskar, Digital Signal Processors – Architecture, Programming and Applications, TATA McGraw Hill, 2002.

References:

1. Andreas Antoniou, Digital Signal Processing, TATA McGraw Hill, 2006
2. MH Hayes, Digital Signal Processing, Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab, Thomson, 2007.

Weblinks:

1. https://nptel.ac.in/courses/117102060
2. https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/
3. https://www.coursera.org/learn/dsp1

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	-	-	-	-	2	-	-	2	3	3
CO2	3	3	2	1	-	-	-	-	2	-	-	2	3	3
CO3	3	2	3	2	-	-	-	-	2	-	-	2	2	3
CO4	3	3	2	1	-	-	-	-	2	-	-	1	1	3
CO5	3	3	2	2	-	-	-	-	2	-	-	1	3	3
CO*	3	3	2	2	-	-	-	-	2	-	-	2	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4102.1	High voltage Engineering	3:0:0	3

Course Objectives: The objectives of the course are to make the students learn about

- The HV breakdown phenomena in gases.
- The HV breakdown phenomena in liquids and solids dielectric materials.
- The concepts of generation of HVDC, AC and Impulse voltages and impulse currents.
- The measuring techniques of AC, DC and Impulse high voltages and currents.
- The concept of Over-voltages due to Lightning and Switching.

Course outcomes: After completion of the course, the student will be able to

1. Understand the basic concepts related to various breakdown processes in gases insulating materials (L2)
2. Understand the basic concepts related to various breakdown processes in liquid and solid insulating materials (L2)
3. Understand the concept of Generation of high voltages and currents (L2)
4. Measure High Voltages and Currents (L5)
5. Explain the over-voltages arise in a power system (L2)

UNIT – I

Breakdown in Gases

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge.

UNIT – II

Breakdown in liquid and solid Insulating materials

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT – III

Generation of High Voltage and Currents

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT – IV

Measurements of High Voltages and Currents

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT – V

Lightning and Switching Over-voltages

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, and Surge modifiers.

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C.L.Wadhwa, " High Voltage Engineering",New Age InternationalPublishers,2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna-Publishers, 1993.

Reference Books:

1. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
2. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
3. Various IS standards for HV Laboratory Techniques and Testing

Web-links:

1. https://nptel.ac.in/courses/108104048
2. https://nptel.ac.in/courses/108104013

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	-	-	-	2	-	-	3	2	2
CO2	3	2	2	2	-	-	-	-	2	-	-	3	2	2
CO3	3	2	3	2	-	-	-	-	2	-	-	3	2	2
CO4	3	3	3	3	-	-	-	-	2	-	-	3	2	2
CO5	3	2	2	2	-	-	-	-	2	-	-	3	2	2
CO*	3	2	3	2	-	-	-	-	2	-	-	3	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4102.2	Power Quality	3:0:0	3

Course Objectives:

- To understand the different Power quality issues and its standards.
- To understand the sources of sags, swells and interruptions and devices for voltage regulation
- To explain Categories and Characteristics of Electromagnetic Phenomena in Power Systems and principles of voltage regulation.
- To understand the sources of harmonics, harmonic indices and Devices for controlling harmonic distortion.
- To discuss Power quality monitoring considerations and its standards.

Course Outcomes: After completion of the course, the student will be able to

1. Identify the sources and effects of power quality problems. (L2)
2. Apply the concept of compensation for sags ,swells using Voltage regulating devices(L3)
3. Explain the principle of voltage regulation and power factor improvement methods. (L2)
4. Analyse voltage distortion, current distortion and their indices(L4)
5. Explain power quality measurement data according to standards. (L2)

UNIT I

Introduction

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations - CBEMA and ITI Curves.

UNIT II

Voltage Imperfections in Power Systems

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

UNIT III

Voltage Regulation and Power Factor Improvement

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

UNIT IV

Harmonic Distortion and Solutions

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems.

UNIT-V

Power Quality Monitoring

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

Text Books:

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.WayneBeaty, McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

Reference Books:

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. SastryVedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	3	-	-	-	-	-	-	-	1	1	1
CO2	2	1	1	3	-	-	-	-	-	-	-	1	1	1
CO3	2	1	1	3	-	-	-	-	-	-	-	1	1	1
CO4	2	1	1	3	1	-	-	-	-	-	-	1	1	1
CO5	2	1	1	3	1	-	-	-	-	-	-	1	1	1
CO*	2	1	1	3	1	-	-	-	-	-	-	1	1	1

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4102.3	AI techniques and Applications in Electrical Engineering	3:0:0	3

Course Objectives:

- To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
- To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
- To understand the basics of an evolutionary computing paradigm known as genetic-algorithms and its application to engineering optimization problems.

Course Outcome: After learning the course, the students able to:

1. Understand how the soft computing techniques can be used for solving the problems of power systems operation and control(L2)
2. Design of ANN based systems for function approximation used in load forecasting(L3)
3. Design of Fuzzy based systems for load frequency control in power systems(L3)
4. Solve problem of Optimization in power systems(L3)
5. Apply GA to power system optimization problems(L3)

UNIT-I: Introduction

Introduction, definition of AI, difference between soft computing Techniques and hard computing systems, expert systems brief history of ANN, Fuzzy and GA.

UNIT-II: Artificial Neural Networks

Introduction, History of neural network research, Basic concepts of Neural Networks, Human brain, Model of Artificial Neuron, Neural Network architectures, Single layer feed forward Network, Multilayer feed forward network, recurrent networks, and characteristics of NN. Learning Methods Perceptron, ADALINE MADALINE Networks. Architecture of Back propagation Network, Nonlinear activation operators, single and multilayer ANN, learning methods like Back propagation, LM etc. training and testing of ANN.

UNIT-III: Fuzzy Logic

Introduction, Comparison between Fuzzy and crisp logic, Fuzzy sets, Membership function, Basic fuzzy set operations, properties of Fuzzy set, fuzzy relations, Fuzzy interference system, Mamdani, Sugeno, Fuzzy rule-based system, defuzzification methods.

UNIT-IV: Genetic Algorithm

Working principles, difference between GA and traditional methods, Different types of coding methods, fitness function, different types of GA operators 1. Roulette wheel selection 2. Stochastic remainder Roulette wheel selection, Rank selection, Tournament selection and

stochastic universal sampling, different types of cross over methods in GA, Mutation, Schema theorem, elite preserving operator, GA's for constrained optimization, understating of working of GA using flow chart.

UNIT-V: Applications

Applications of ANN, Fuzzy logic and GA in power systems operation and control for solving problems of load forecasting, voltage control, voltage stability, security assessment, feeder load balancing, AGC, Economic load dispatch, Unit commitment, Condition monitoring, Optimal Power Flow, Optimal Reactive Power Dispatch, Available Transfer Capability.

Text Books:

1. Neural Networks, Fuzzy logic and Genetic algorithms By S. Rajasekaran, G. A. Vijayalakshmi Pai PHI publication,
2. Artificial intelligence techniques in power systems by KEVIN WARWICK, ARTHUR EKWUE RAJ AGRAWAL

Reference Books:

1. Optimization for Engineering Design by Kalyanmoy Deb PHI publication
2. Multi-objective Optimization using Evolutionary Algorithms By Kalyanmoy Deb Willey Publication

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	3	-	-	-	2	-	-	1	3	-
CO2	2	2	2	3	3	-	-	-	2	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	2	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	2	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	2	-	-	1	3	-
CO*	3	3	3	3	3	-	-	-	2	-	-	1	3	-

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC4104	Power Systems & Simulation Lab	0:0:2	1

Course Objectives:

- To evaluate the Sequence Impedance of Transformer and Alternator.
- To determine ABCD Parameters of Transmission line.
- To analyze of Load Frequency Controllers & Load Flow Studies of Power System Network.
- To analyze Transient Response of RLC circuits using Simulation
- To design of Single Phase Full Converter & Voltage Controller in Simulation.

Course Outcomes: After completion of the course, the student will be able to

1. Determine the Sequence Impedance of Alternator and Transformer (L5)
2. Determine the Transmission Line Parameters and study the Ferranti Effect (L5)
3. Design & Simulation of Load Frequency Controllers and Load Flow Studies of Power System Network (L3)
4. Simulation of Transient Response of RLC circuits (L3)
5. Simulation of Single Phase Full Converter & Voltage Controller (L3)

Any 10 of the Following Experiments are to be conducted:

1. Sequence Impedances of 3 Phase Transformer.
2. Sequence Impedances of 3 Phase Alternator by Fault Analysis.
3. Sequence Impedances of 3 Phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-Seidel method
6. Load Flow Studies using N-R method.
7. Load Frequency Control of Two Area with & without control
8. Economic Load Dispatch with & without Losses
9. Transient analysis of Single Machine Connected to Infinite Bus (SMIB).
10. Modelling of Transformer and simulation of Lossy Transmission Line.
11. Simulation of Transient Response of RLC circuits.
    a) Response to Pulse Input.
    b) Response to Step Input.
    c) Response to Sinusoidal Input.
12. Simulation of Single Phase Full Converter using RLE Loads and Single Phase AC Voltage Controller using RL Loads.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	-	2	2	2	3	2	1	2	3	3
CO2	3	3	3	2	-	2	2	2	3	2	1	2	3	2
CO3	3	3	-	-	3	-	-	2	2	2	-	2	2	2
CO4	3	3	-	-	3	-	-	2	2	2	-	2	2	2
CO5	3	3	3	2	3	-	-	2	2	2	-	2	3	2
CO*	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**3**	**2**

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-SD4101	PLC and SCADA	1:0:2	0

Course Objectives:

- To study the Basics of Programmable Logic Controllers.
- To study the different timers and Counters in PLC
- To develop the Different logics to start and run the 3-phase induction motor
- To apply the knowledge to control the conveyor belt and traffic light system
- To study the Basics of SCADA system for industrial applications

Course Outcomes: After completion of the course, the student will be able to

1. Understand the Basics of Programmable Logic Controllers (L2)
2. Understand different timers and Counters in PLC (L2)
3. Develop the logic for starting and running of motor in PLC (L3)
4. Apply the knowledge to control the conveyor belt and traffic light system in PLC (L3)
5. Understand the SCADA System for industrial Environment(L2)

Any 10 Experiments are to be conducted:

1. Implementation of basic logic gates
2. Timers and counters
3. Automatic forward & reverse control of 3-phase induction motor
4. Motor starter application
   A. Star delta starter
   B. DOL Starter
5. Conveyor belt operation
6. Traffic light control system
7. Lift mechanism
8. Elevator system
9. Alarm annunciator
10. Doorbell operation, staircase wiring
11. Temperature sensing using SCADA
12. Parameter reading of PLC in SCADA

Text Books:

1. "PLC and Industrial application", Madhu chhandan Gupts and Samarjit Sen Gupta, pernram international pub. (Indian) Pvt. Ltd.,2011.
2. Ronald L Krutz, "Securing SCADA System", WileyPublication

Reference Books:

1. Gary Dunning"Introduction to Programmable Logic Controllers", Thomson,2nd Edition.
2. John W Webb, Ronald A Reis,"Programmable Logic Controllers: Principles and Application", PHI Learning, Newdelhi, 5th Edition
3. Stuart A Boyer, "SCADA Supervisory Control and Data Acquisition", ISA, 4th Revisededition

Weblinks:

1. https://plc-coep.vlabs.ac.in/List%20of%20experiments.html

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	-	-	-	-	-	2	-	-	2	1	1
CO2	2	1	2	-	-	-	-	-	2	-	-	2	1	1
CO3	2	1	2	-	-	-	-	-	2	-	-	2	1	1
CO4	2	1	2	-	-	-	-	-	2	-	-	2	1	1
CO5	2	1	2	-	-	-	-	-	2	-	-	2	1	1
CO*	2	1	2	-	-	-	-	-	2	-	-	2	1	1

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-SD4102	Electrical Installation & Estimation	2:0:0	0

Course Objectives:

- To understand the basic concepts related to design and estimation of distribution systems.
- To make use of different types of wiring for residential and commercial users.
- To understand practical aspects of condition monitoring and maintenance of various electrical equipment in domestic installations.
- To understand practical aspects of condition monitoring and maintenance of various electrical equipment in industrial installations.
- To learn the concept of estimation in sub-stations.

Course Outcomes: After completion of the course, the student will be able to

1. Apply the knowledge of Estimation and costing for real time installations(L3)
2. Describe the use of different types of wiring for residential and commercial(L2)
3. Analyze the condition and Test various electrical equipments(L4)
4. Design and estimate the installations of various industrial equipments(L3)
5. Design and estimate the cost for Transmission and distribution lines(L3)

UNIT-1

Introduction: Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, tender document, net price list, market survey, overhead charges, labor charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization, specimen tender.

UNIT-2

Types of wiring: Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial).Selectionof wires and cables, Protective devices i.e., MCB, ELCB etc. Use of wire-gauge and tables

UNIT-3

Estimating and Costing Domestic installations: Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate

UNIT-4

Estimating and Costing Industrial installations: Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe- phase, 3-phase motor load and the

light load (3-phase supply system) ,Service line connections estimate for domestic and Industrial loads (over-head and Under- ground connections) from pole to energy meter.

UNIT-5

Transmission and distribution lines & Substation

Estimating the material required for Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc., Types of substations, substation schemes and components, estimation of 11/0.4 KV pole mounted substation up to 200 KVA rating, earthing of substations, Key Diagram of 66 KV/11KVSubstation.Installation plan, single line diagram, estimation of cost and list of the material for 2HP 3-phase Induction Motor for screw milling machine.

Text Books:

1. A Course in Electrical Installation, Estimating and Costing by J.B Gupta, S.K Kataria and Sons, 2nd edition, 2013.
2. Electrical Design: Estimation & Costing by Raina & Battacharya, Wiley Eastern, 2nd edition, 2009.

Reference Books:

1. Electrical Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., 2nd edition, 2003.
2. Electrical Wiring, Estimating and Costing by S.L Uppal, Khanna Publishers, 2nd edition, 2004.
3. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, 2nd edition, 2006.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	2	1	-	-	1	1
CO2	2	2	2	2	1	-	-	-	2	-	-	1	1	-
CO3	3	3	3	2	2	-	-	-	2	-	-	-	1	1
CO4	2	2	2	2	1	-	-	-	2	1	-	1	1	-
CO5	3	3	3	3	2	-	-	-	2	1	-	1	2	-
CO*	3	3	3	2	2	-	-	-	2	1	-	1	1	1

** For Entire Course, CO vs. PO-PSO Mapping*

IV Year, II-Semester Syllabus (R19)

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PC4201	Renewable Energy Systems	3:0:0	3

Course Objectives:

- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar thermal collections.
- To study maximum power point techniques in solar Photovoltaic Systems
- To study wind energy conversion systems, Betz coefficient, tip speed ratio and geothermal systems.
- To study basic principle and working of tidal, biomass and fuel cell

Course Outcomes: After completion of the course, the student will be able to:

1. Understand the basic concepts of solar radiation, its data on earth's surface(L2)
2. Explain the different types of solar thermal energy collectors(L2)
3. Develop the maximum power point techniques in solar Photovoltaic Systems(L3)
4. Understand the Wind energy conversion systems and the various geothermal resources(L2)
5. Explain the methods of generation of electricity from tidal and chemical resources(L2)

UNIT–I: Fundamentals of Energy Systems and Solar energy

Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on flat and tilted surfaces – Numerical problems.

UNIT–II: Solar Thermal Systems

Liquid flat plate collectors: Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor – Numerical problems. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants.

UNIT–III: Solar Photovoltaic Systems

Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Cell I-V characteristics and P-V characteristics. Applications and systems – Balance of system components – System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

UNIT–IV: Wind Energy and Geothermal Systems

Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator (synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

Geothermal: Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

UNIT–V: Tidal power systems, Biomass and fuel cells

Tidal power – Basics – Kinetic energy equation – Turbines for tidal power – Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

Biomass Energy: Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.

Fuel cell: Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics

Text Books:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition,2013.

Reference Books:

1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
6. Non-conventional energy source –B.H.khan- TMH-2nd edition.

Weblinks:

1. https://nptel.ac.in/courses/103103206

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO. No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	1	-	2	-	-	2	-	-	-	-	-
CO2	2	2	3	-	-	-	2	-	2	-	-	2	3	1
CO3	3	3	2	2	-	2	2	-	2	-	-	3	3	2
CO4	3	3	3	1	-	-	2	-	2	-	-	2	3	2
CO5	3	3	-	-	-	-	2	-	2	-	-	3	-	-
CO*	3	3	3	1	-	2	2	-	2	-	-	3	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19CSE-OE4201	UNIX and Shell Programming	3:0:0	3

Course Objectives:

- Architecture and Features of UNIX are introduced.
- UNIX File System, File handling Utilities and security permissions for the system are introduced.
- An Overview on Streams, Pipes is presented.
- An introduction to Grep, sed and various scripting concepts is given.
- Av Overview of File Management is presented.

Course Outcomes:

1. Understand the architecture and features of UNIX.
2. Apply the commands for implementation of the File System.
3. Understand the Streams, Pipes and Filters.
4. Apply the pattern reorganization commands and scripting concepts
5. Implementation of system calls for file system

Unit I:

Introduction to Unix:- Architecture of Unix, Features of Unix , Unix Commands – PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip.

Unit II :

Unix Utilities:- Introduction to unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin.Text processing utilities and backup utilities , detailed commands to be covered are tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Unit III :

Introduction to Shells :

Unix Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization.

Filters :

Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

UNIT IV

Grep :

Operation, grep Family, Searching for File Content.

Sed :

Scripts, Operation, Addresses, commands, Applications, grep and sed.

C Shell Programming :

Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Unit V :

File Management :

File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

TEXT BOOKS :

1. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.Thomson
2. Your Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCES :

1. Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.
2. Unix programming environment, Kernighan and Pike, PHI. / Pearson Education
3. The Complete Reference Unix, Rosen, Host, Klee, Farber, Rosinski, Second Edition, TMH.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	3	-	-	-	2	-	-	1	2	2
CO2	3	3	2	2	3	-	-	-	2	-	-	2	2	2
CO3	3	3	2	2	3	-	-	-	2	-	-	2	2	2
CO4	3	3	2	2	3	-	-	-	2	-	-	2	2	2
CO5	3	3	2	2	3	-	-	-	2	-	-	2	2	2
CO*	3	3	2	2	3	-	-	-	2	-	-	2	2	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19CSE-OE4202	Neural network and Fuzzy Logic	3:0:0	3

Course Objectives:

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
- Provide knowledge of supervised and unsupervised learning in neural networks.
- Provide knowledge of computation and dynamical systems using neural networks.
- Understand the need of Fuzzy systems.
- Analyze the operations on Fuzzy systems using sets, cuts etc.,

Course Outcomes:

1. Explain Basic Concepts of ANN(L2)
2. Explain the Architecture of Neural Networks Models(L2)
3. Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines(L2)
4. Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems(L3)
5. Analyze the one-dimensional fuzzy optimization techniques and their applications in solving complex problems. (L4)

UNIT-I: Introduction and ANN Structure.

Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

UNIT-II

Mathematical Foundations and Learning mechanisms. Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.

UNIT-III

Perceptrons: Single layer perceptrons, Structure and learning of perceptrons. Pattern classifier - introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptrons.

UNIT IV

Classical sets : Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations : Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

UNIT V

Fuzzification and Defuzzification : Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, λ - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation.

Fuzzy Systems : Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

TEXT BOOKS:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010.
4. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.

REFERENCE BOOKS:

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997
2. S.Rajasekaran, G.A.Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	3	1	-	-	2	-	-	1	3	1
CO2	2	2	2	3	3	1	-	-	2	-	-	1	3	1
CO3	3	3	3	3	3	2	-	-	2	-	-	2	3	2
CO4	3	3	3	3	3	2	-	-	2	-	-	2	3	2
CO5	3	3	3	3	3	2	-	-	2	-	-	2	3	2
CO*	3	3	3	3	2	2	-	-	2	-	-	2	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19ECE-OE4201	VLSI Design	3:0:0	3

Course Objectives:

- To give exposure to different steps involved in the fabrication of ICs using MOS transistor.
- To explain electrical properties of MOS devices.
- To introduce design rules and scaling effects in CMOS technology.
- To study behavior of inverters designed with various loads.
- To provide concepts required to design combinational and sequential circuits using CMOS and latest Trends in VLSI Design.

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

1. Introduce the various steps involved in the MOS transistor fabrication of integrated circuits(L2)
2. Explain the electrical properties of MOS devices(L2)
3. Introduce design rules and scaling effects in CMOS technology(L2)
4. Observe the behavior of inverters designed with various loads(L2)
5. Provide an overview of testing fundamentals and its testability design(L2)

UNIT-I

Introduction to MOSFETs: Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms ofpull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

Applications:

- used for switching and amplifying electronics signals in the electronic devices
- can be used in electronic DC relay

UNIT-II

MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal,Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams Translation to Mask Form. Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density.

Applications:

- Stick diagrams are useful for planning the layout and routing of integrated circuits
- CMOS used in microcontrollers, static RAM, registers, microchips and other digital circuits

UNIT-III

MOS INVERTERS: Inverters with resistive load, MOSFET load; CMOS inverter: Voltage transfer characteristics, Noise margins, switching characteristics, calculation of delay times; effect of load on switching characteristics and driving large loads, logical effort of paths.

Applications:

- Scaling scenarios for wire capacitance

UNIT-IV

Digital circuits using CMOS: Pseudo NMOS, Pass transistor, transmission gates, Dynamic logic, Domino logic, Differential cascode voltage switch logic, design of combinational circuits, design of sequential circuits, timing requirements.

Applications:

- Flash memory chip designing
- Used to design application-specific integrated circuits (ASICs)

UNIT-V

Trends in CMOS technology: SOI, FINFET and multi-gate FET, 2D materials based FETs, On-chip interconnects. Coping with Interconnects: Capacitive, Resistive and Inductive parasitic, Advanced Interconnect Techniques, Power Grid and Clock design: Power Distribution Design, Clocking and Timing Issues.

Applications:

- MOSFET transistor researchers are exploring device structure and channel material changes to enable further generations of MOSFET scaling

Text Books

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. Neil H.E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th Edition, Pearson Education, 2015.
3. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.

References

1. VLSI Design-Black Book By Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc.2012 Edition.
2. Sung-Mo Kang, Yusuf Leblebici, Chulwookim, Digital Integrated Circuits: Analysis and Design, 4 th Edition, McGraw Hill Education, 2016.
3. BehzadRazavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw Hill Education, 2016.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	2	-	-	-	1	1
CO2	2	2	2	2	1	-	-	-	2	-	-	1	1	-
CO3	3	3	3	2	2	-	-	-	2	-	-	-	1	1
CO4	2	2	2	2	1	-	-	-	2	-	-	1	1	-
CO5	3	3	3	3	2	-	-	-	2	-	-	1	2	-
CO*	3	3	3	2	2	-	-	-	2	-	-	1	1	1

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19ME-OE4201	Automobile Engineering	3:0:0	3

Course Objectives

- The course imparts the parts of the automobile systems .
- To understand the power transmission systems
- To understand steering geometry and classification of steering gear mechanisms.
- To create awareness on suspension system, braking system and electrical system.
- To follow the safety standards and emissions controlling methods.

Course Outcomes After completing the course, the student will be able to

1. Illustrate the construction features of automobile engines and parts.[L2]
2. Analyze parts/modules in transmission system. [L4]
3. Explain types of steering mechanisms.[L2]
4. Outline the working /features of suspension, braking and electrical systems. [L2]
5. Analyze the methods for emission control of engine. [L4]

UNIT- I

Introduction To Automobile and Engine Construction : Layout of four wheeler automobile - Chassis and body - –Power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction details, turbo charging and super charging- valve mechanisms-types– engine lubrication, splash and pressure lubrication systems, oil filters– crank case ventilation –cooling system –types

Applications: Automobile vehicles

UNIT- II

Transmission system: Clutches - Function - Types - Single plate, Multiple plate, Cone clutch and Diaphragm Clutch – Fluid coupling - Gearbox - Sliding - Constant - Synchromesh - Overdrive –Torque converter - Continuously variable transmission - Universal joint - Propeller shaft - Drive types - Differential - rear axles– types – wheels and tyres.

Applications: Automobile vehicles, Marine Engines, Aerospace vehicles

UNIT- III

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages**.**

Application: Automobile vehicles, Marine Engines, Aerospace vehicles

UNIT-IV

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder, pneumatic and vacuum brakes.

ELECTRICAL SYSTEM: Wiring diagram of 4-wheeler and 2-wheeler, battery construction-ignition types– current regulator - voltage regulator - current - voltage regulator – bendix drive , solenoid switch, Charging circuit, horn circuit, wiper circuit.

Applications: Automobile vehicles

UNIT- V

Automobile safety and Emission control: Safety and security - Seat belts - Air bags - Electronic Control Unit (ECU) - Anti lock brake system (ABS) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP)-Traction Control System (TCS) - Global Positioning System (GPS) - Types of pollutants, mechanism of formation, exhaust gas treatment-thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards

Applications: Automobile vehicles

Text Books:

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications.
2. Automobile engineering by R B Gupta , Satya Prakashan publications (P) Ltd.
3. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International .
4. Automobile engineering by R K Rajput-Laxmi publications (P) Ltd.

Reference Books:

1. William.H.Crouse, Automotive Mechanics, 10/e Edition, McGraw-Hill.
2. David A. Corolla, Automotive Engineering: Power train, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd.
3. Bosch, Automotive Hand Book, 6/e SAE Publications year.
4. K. Newton and W. Steeds, The motor vehicle, 13/e Butterworth-Heinemann Publishing Ltd.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	-	2	2	-	2	-	-	3	1	2
CO2	3	3	2	2	-	1	2	-	2	-	-	3	3	3
CO3	3	3	3	2	-	2	2	-	2	-	-	3	3	3
CO4	3	2	2	2	-	2	2	-	2	-	-	3	3	3
CO5	3	3	3	2	-	2	2	-	2	-	-	3	3	2
CO*	3	3	2	2	-	2	2	-	2	-	-	3	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4201.1	Optimization Techniques	3:0:0	3

Course objectives:

- To define an objective function, constraint functions in terms of design variables, and then states the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To study and explain nonlinear programming techniques, unconstrained or constrained, define exterior, interior penalty functions for optimization problems.
- To understand Evolutionary Programming Methods such as PSO and GA, and solve complex problems.

Course Outcomes: After completion of the course, the student will be able to:

1. Analyze the various optimization problems without and with constraint design variables (L4)
2. Identify the optimal solution of problems involving continuous and differential functions (L3)
3. Identify the optimal solution in a function whose equations are represented by linear relationships (L3)
4. Analyze the optimization problem where some of the constraints or objective functions are nonlinear (L4)
5. Apply Genetic Algorithm and PSO technique in various types of engineering problems (L3)

UNIT – I:

Introduction and Classical Optimization Techniques:

Historical Development; Engineering applications of Optimization; – Formulating an Optimization problem – objective function – constraints and constraint surface - classification of Optimization problems.

UNIT – II:

Classical Optimization Techniques

Single and multivariable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn Tucker conditions. Numerical Problems.

UNIT – III:

Linear Programming

Standard form of a linear programming problem – geometry of linear programming problems– definitions and theorems – solution of a system of linear simultaneous equations –

pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method. Applications

UNIT – IV:

Nonlinear Programming:

Unconstrained cases - One dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method. Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods, Introduction to convex Programming Problem.

UNIT – V:

Introduction to Evolutionary Methods:

Evolutionary programming methods - Introduction to Genetic Algorithms (GA)– Control parameters –Number of generation, population size, selection, reproduction, crossover and mutation – Operator selection criteria – Simple mapping of objective function to fitness function – constraints – Genetic algorithm steps – Stopping criteria –Simple examples. Basic Partial Swarm Optimization – Characteristic features of PSO procedure of the global version – Parameters of PSO – Comparison with other evolutionary techniques – Engineering applications of evolutionary methods.

Text Books

1. "Engineering optimization: Theory and practice"-by S. S. Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N. P. Padhy & S. P. Simson, Oxford University
3. Press – 2015

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K. V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by David Goldberg, ISBN:978-81-7758-829-3, Pearson by Dorling Kindersley (India) Pvt. Ltd.
3. "Operations Research: An Introduction" by H. A. Taha, PHI pvt. Ltd., 6 edition.
4. Linear Programming by G. Hadley, Addison Wesley, 1962.

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	2	-	-	-	2	-	-	3	3	2
CO2	3	3	2	3	2	-	-	-	2	-	-	3	3	2
CO3	3	3	3	3	2	-	-	-	2	-	-	3	3	2
CO4	3	3	3	3	2	-	-	-	2	-	-	3	3	2
CO5	3	3	3	3	2	-	-	-	2	-	-	3	3	2
CO*	3	3	3	3	2	-	-	-	2	-	-	3	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4201.2	Power system Reforms	3:0:0	3

Course Objectives:

- To study fundamentals of power system deregulation and restructuring.
- To study available transfer capability.
- To study various electricity pricing methods.
- To study operation of power system in deregulated environment.
- To study importance of Ancillary services management.

Course outcomes: After completion of the course, the student will be able to:

1. Explain different restructuring models, including the roles of Independent System Operators (ISO) and Power Exchanges in a restructured power system. (L2)
2. Apply methodologies to calculate transfer capabilities and reliability margins using the Open Access Same-Time Information System (OASIS). (L3)
3. Analyze electricity price volatility and forecasting methods to address challenges in electricity pricing. (L4)
4. Apply operational planning activities for strategic operation of Gencos in pool and bilateral markets. (L3)
5. Recognize the significance of synchronous generators in providing reactive power as an ancillary service within power systems. (L2)

UNIT–I

Over view of key issues in electric utilities

Introduction – Restructuring models – Independent system operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Management Introduction to congestion management – Methods to relieve congestion, Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT–II

Available Transfer Capability (ATC)

Structure of OASIS – Processing of Information – Transfer capability on OASIS – Definitions Transfer Capability Issues – ATC – TTC – TRM – CBM calculations – Methodologies to calculate ATC.

UNIT–III

Electricity Pricing:

Introduction – Electricity price volatility, electricity price indexes – Challenges to electricity pricing – Construction of forward price curves – Short–time price forecasting.

UNIT–IV

Power system operation in competitive environment:

Introduction –Role of the Independent System Operator (ISO) , Operational-planning activities of ISO – The ISO in pool markets – The ISO in bilateral markets – Operational-planning activities of a GENCO.

UNIT–V

Ancillary Services Management:

Introduction –Types of ancillary services, Classification of ancillary services, Load-generation balancing related services -Frequency regulation -Load following -reserve services ,Reactive power as an ancillary service – A review – Synchronous generators as ancillary service providers, Ancillary Services Management in Various Countries.

Text Books:

1. Kankar Bhattacharya, Math H.J. Boller, JaapE.Daalder, 'Operation of Restructured Power System' Kluver Academic Publisher – 2001.
2. Mohammad Shahidehpour, and Muwaffaqalomoush, – "Restructured electrical Powersystems" Marcel Dekker, Inc. 2001.

Reference Books:

1. Loi Lei Lai; "Power system Restructuring and Deregulation", Jhon Wiley & Sons Ltd., England.
2. Electrical Power Distribution Case studies from Distribution reform, upgrades and Management (DRUM) Program, by USAID/India, TMH

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	-	2	2	-	2	-	-	3	1	2
CO2	3	3	2	2	-	1	2	-	2	-	-	3	3	3
CO3	3	3	3	2	-	2	2	-	2	-	-	3	3	3
CO4	3	2	2	2	-	2	2	-	2	-	-	3	3	3
CO5	3	3	3	2	-	2	2	-	2	-	-	3	3	2
CO*	3	3	2	2	-	2	2	-	2	-	-	3	3	3

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4201.3	HVDC & FACTS	3:0:0	3

Course Objectives:

- To study the HVDC Transmission system
- To analyze the control aspects of HVDC Systems
- To understand the fundamentals of FACTS Controllers
- To know the effect of static shunt and series compensators
- To explain the operation of Combined Controllers

Course Outcomes: After completion of the course, the student will be able to:

1. Apply HVDC technology to design and implement HVDC transmission links for long-distance power transfer. (L3)
2. Analyze various control strategies for HVDC systems(L4)
3. Explain the fundamental principles of FACTS, including their purpose and importance in modern power systems. (L2)
4. Analyze the operational principles and performance characteristics of static shunt compensators and series compensators(L4)
5. Analyze the principles and functionalities of combined compensators(L4)

UNIT – I: HVDC transmission:

HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipment's. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

UNIT – II: Control of HVDC system:

Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics introduction, generation, ac filters and dc filters. Reactive Power Requirements in steady state, sources of reactive power– shunt capacitors-synchronous condensers.

UNIT – III: Introduction to FACTS:

Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

UNIT – IV: Static shunt and series compensators:

Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM comparison. Series compensation – objectives of series compensation, thyristor switched series capacitors

(TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT – V: Combined compensators:

Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC) - basic Operating Principles and Characteristics.

Text Books:

1. K.R.Padiyar, 'HVDC Power Transmission Systems: Technology and System Interactions' New Age International Publishers.
2. Hingorani, L.Gyugyi, 'Understanding FACTS', IEEE Press New York, 2000 ISBN – 078033 4588.

Reference Books:

1. Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series 29
2. S.Kamakshaiah and V.Kamaraju 'HVDC Transmission' Tata McGraw-Hill
3. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
4. Mohan Mathur R. and Rajiv K.Varma , 'Thyristor – based FACTS controllers for Electrical Transmission systems', IEEE press, Wiley Inter science , 2002.
5. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
6. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, Cesar Angeles-Camacho 'FACTS –Modeling and simulation in Power Networks' Wiley, 2004.

Weblinks:

1. https://archive.nptel.ac.in/courses/108/107/108107114/
2. https://nptel.ac.in/courses/108104013

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	1	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	1	-	-	-	-	-	-	3	2
CO3	2	1	2	-	-	1	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	1	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	1	-	-	-	-	-	-	3	2
CO*	3	2	2	-	-	1	-	-	-	-	-	-	3	2

** For Entire Course, CO vs. PO-PSO Mapping*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R19EEE-PE4201.4	Smart Grid Technologies	3:0:0	3

Course Objectives: The objectives of the course are to make the students learn about:

- Overview of the technologies required for the smart grid
- Switching techniques and different means for data communication
- Standards for information exchange and smart metering
- Methods used for information security on smart grid
- Smart metering, and protocols for smart metering

Course Outcomes: After completion of the course, the student will be able to:

1. Understand the constraints and identify the initiative operations, technologies on smart grid (L2)
2. Understand the necessity and apply the switching techniques of data communication technologies (L2)
3. Analyze the encryption, decryption and importance of standards for information exchange security on smart grid (L3)
4. Understand the importance of smart metering and analysis of different area networks, protocols on demand side integration (L2)
5. Analyze the importance of data sources and techniques, modeling tools required on transmission management system (L3)

UNIT – I

The Smart Grid

Introduction, Ageing Assets and Lack of Circuit Capacity, Thermal Constraints, Operational Constraints, Security of Supply, National Initiatives,

Early Smart Grid Initiatives, Active Distribution Networks, Virtual Power Plant, Other Initiatives and Demonstrations, Overview of The Technologies Required for The Smart Grid.

UNIT – II

Communication Technologies

Data Communications: Introduction, Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching, Communication Channels, Wired Communication, Optical Fiber, Radio Communication, Cellular Mobile Communication, Layered Architecture and Protocols, The ISO/OSI Model, TCP/IP.

UNIT – III

Information Security for the Smart Grid

Introduction, Encryption and Decryption, Symmetric Key Encryption, Public Key Encryption, Authentication, Authentication Based on Shared Secret Key, Authentication Based on Key Distribution Center, Digital Signatures, Secret Key Signature, Public Key Signature, Message Digest, Power Systems Management And Association Information Exchange – Data and Communication Security – Applications.

UNIT – IV

Smart Metering and Demand Side Integration

Introduction, smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used – signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output, and communication. Communication infrastructure and protocols for smart metering- Home area network, Neighborhood Area Network, Data Concentrator, meter data management system, Protocols for communication. Demand Side Integration- Services Provided by DSI, Implementation of DSI, Hardware Support, Flexibility Delivered by consumers from the Demand Side, System Support from DSI – Applications.

UNIT – V

Transmission Management Systems

Data Sources, Energy Management System, Wide Area Applications, Visualization Techniques, Data Sources and Associated External Systems, SCADA, Customer Information System, Modeling and Analysis Tools.

Text Books:

1. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012, Reprint 2015.
2. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012, Reprint 2016.

Reference Books:

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

Web-links:

1. https://onlinecourses-archive.nptel.ac.in/noc18_ee42/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee68/preview

COURSE OUTCOMES VS POs & PSOs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	2	2	-	2	-	-	3	3	2
CO2	3	2	2	2	-	2	2	-	2	-	-	3	3	2
CO3	3	3	3	3	-	2	2	-	2	-	-	3	3	2
CO4	3	2	3	2	-	2	2	-	2	-	-	3	3	2
CO5	3	3	3	3	-	2	2	-	2	-	-	3	3	2
CO*	3	3	3	3	-	2	2	-	2	-	-	3	3	2

** For Entire Course, CO vs. PO-PSO Mapping*