COURSE STRUCTURE (R20)

&

DETAILED SYLLABUS

(FINAL YEAR)

ELECTRICAL & ELECTRONICS ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2020-21)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
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
E-Mail: lendi_2008@yahoo.com
Website: www.lendi.org

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NBA and NAAC with "A" Grade
Jonnada (Village), Denkada (Mandal), Vizianagaram Dist. – 535 005
E-Mail: lendi_2008@yahoo.com Website: www.lendi.org

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech Final Year Course Structure – R20 Regulation

IV Year – I Semester							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	**Professional Elective – III**						
	R20EEE-PC4101.1	Power System Operation and Control	PE	3	0	0	3
	R20EEE-PE4101.2	Renewable Energy Systems					
	R20EEE-PE4101.3	Smart Grid Technologies					
	R20EEE-PE4101.4	Digital Signal Processing					
2	**Professional Elective – IV**						
	R20EEE-PE4102.1	Electrical Machine Modelling and Analysis	PE	3	0	0	3
	R20EEE-PE4102.2	Utilization of Electrical Energy					
	R20EEE-PE4102.3	Hybrid Electric Vehicles					
	R20EEE-PE4102.4	Energy Conservation, Auditing and Management					
3	**Professional Elective – V**						
	R20EEE-PE4103.1	High Voltage Engineering	PE	3	0	0	3
	R20EEE-PE4103.2	Electrical Distribution Systems					
	R20EEE-PE4103.3	Power System Reforms					
	R20EEE-PE4103.4	AI techniques and Applications in Electrical Engineering					
4	**Open Elective-III**						
	R20CSE-OE4105	UNIX and Shell Programming	OE	3	0	0	3
	R20CSE-OE4106	Neural network and Fuzzy Logic					
	R20ME-OE4104	Automobile Engineering					
	R20ECE-OE4103	Industrial Electronics					
	R20BSH-OE4102	Optimization Techniques					

IV Year – I Semester							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
5	**Open Elective-IV**						
	R20CSE-OE4107	Internet of Things	OE	3	0	0	3
	R20ME-OE4101	Robotics					
	R20ECE-OE4104	VLSI System Design					
	R20CSE-OE4108	Fundamentals of Cloud Computing					
6	R20HSMC-4101	Universal Human Values 2: Understanding Harmony	HM	3	0	0	3
7	R20EEE-SC4101	PCB Design	SC	1	0	2	2
8	R20EEE-SI4101	*Summer Internship-II	SI	0	0	0	3
Total				**19**	**0**	**2**	**23**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				**3**	**1**	**0**	**4**

*** Industrial/Research 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	R20EEE-PJ4201	Project	PJ	0	0	24	12
Total							**12**

IV Year-I Semester (R20)

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE4101.1	Power System Operation and Control **(Professional Elective Course-3)**	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 ontrolled 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
R20EEE-PE4101.2	Renewable Energy Systems **(Professional Elective Course-**	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. Explain 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. Describe 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, MPPT during partial shading condition.

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- Applications of Fuel cell-DC-DC converter with LED load.

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 – A practical guide for beginners – Chetong Singh Solanki, PHI.
5. 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
R20EEE-PE4101.3	Smart Grid Technologies **(Professional Elective Course-3)**	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*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE4101.4	Digital Signal Processing **(Professional Elective Course-3)**	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
R20EEE-PE4102.1	Electrical Machine Modelling and Analysis **(Professional Elective Course-4)**	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
R20EEE-PE4102.2	Utilization of Electrical Energy **(Professional Elective Course-4)**	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

Selection of Motors: Types of Electric drives, mechanical features of drives- various types of enclosures, name plate details of motor- duty cycle, types of bearings, drive-end nondrive-end, load equalization, temperature rise, applications of electric drives.

UNIT–II

Illumination: Definitions of various illumination terminologies, laws of illumination, polar curves, various types of lamps: incandescent lamp, sodium vapour lamp, fluorescent lamp, CFL and LED, various lightning schemes-Domestic and industrial lamp fitting, design and calculation of illumination, electronic ballast, numerical problems.

UNIT–III

Electric Heating & Electric Welding: Electrical heating: advantages, methods of electric heating – resistance, arc, induction and dielectric heating, methods of temperature control, design of heating element, applications of electric heating.
Electric welding: types – resistance, electric arc, gas welding, ultrasonic, advantages & disadvantages of electric welding, applications of electric welding.

UNIT–IV

Electric Traction – I: Introduction, systems of electric traction, comparison between A. C. and D. C traction, special features of traction motors, the locomotive, transmission of drive, characteristics and control of locomotives, track electrification, DC Equipment, AC Equipment, Electric Braking with DC Motors and AC Motors, Overhead Equipment, Adhesive Weight and Dead Weight, Numerical Problems.

UNIT–V

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.

Economic Aspects of Utilizing Electrical Energy: 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	2	-	2	1	-	2	-	-	2	2	2
CO3	2	2	2	1	-	2	1	-	2	-	-	1	1	2
CO4	3	2	1	1	-	1	1	-	2	-	-	2	1	1
CO5	3	3	2	2	-	2	1	-	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
R20EEE-PE4102.3	Hybrid Electric Vehicles **(Professional Elective Course-4)**	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. Understand the concept of electric vehicles and hybrid electric vehicles (L2)
2. Explain the different configurations of hybrid electric vehicles (L2)
3. Apply the power management used in hybrid electric vehicles (L3)
4. Apply the power converters used in hybrid electric vehicles (L3)
5. Explain different batteries and other energy storage systems (L2)

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, drive train structure, grid to vehicle.

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
R20EEE-PE4102.4	Energy Conservation, Auditing and Management **(Professional Elective Course-4)**	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
R20EEE-PE4103.1	High Voltage Engineering **(Professional Elective Course-5)**	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 (L5)

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
R20EEE-PE4103.2	Electrical Distribution Systems **(Professional Elective Course-5)**	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, Factors affecting system planning, present planning techniques, future trends in planning, 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 with 'n' primary feeders. Benefits derived through optimal location of substations. Optimal location of substations (Perpendicular bisector rule and X, Y co-ordinate method).

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: Importance of voltage control, Methods of voltage control, Equipment for voltage control, Effect of AVB/AVR on voltage control, Line drop compensation, and Voltage fluctuations.

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, introduction to micro-grid protection.
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 – Effect of shunt capacitors (Fixed and switched), Effect of series capacitors, Difference between shunt and series capacitors – 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	2	2	-	2	2	-	2	-	-	1	1	2
CO2	3	2	3	2	-	1	2	-	2	-	-	2	3	2
CO3	3	3	3	2	-	2	1	-	1	-	-	2	3	1
CO4	3	1	3	1	-	2	2	-	2	-	-	2	3	2
CO5	3	3	2	1	-	1	1	-	2	-	-	1	3	1
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
R20EEE-PE4103.3	Power System Reforms **(Professional Elective Course-5)**	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. Discuss 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 Power systems" 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
R20EEE-PE4103.4	AI techniques and Applications in Electrical Engineering **(Professional Elective Course-5)**	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. (L3)
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.

Learning Outcomes:

- Analyze the application of fuzzy logic control to power systems(L4)
- Analyze the application of ANN to power systems(L4)

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
R20CSE-OE4105	UNIX and Shell Programming (**Open Elective Courses -3**)	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 basic Linux commands (L2)
2. Understand and apply commands on file Utilities (L2)
3. Understand and apply about filters, streams and pipes (L2)
4. Understand and apply Grep and Sed commands on patterns (L2)
5. Apply the system calls for the Implementation of file system management (L3)

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	3	-	-	3	-	-	-	-	-	-	-	2	2
CO2	2	2	3	-	-	-	-	-	-	-	-	-	2	1
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	2	1	-	3	-	-	-	-	-	-	-	-	2
CO5	2	2	-	2	-	-	-	-	1	1	-	-	-	2
CO*	3	3	3	2	3	1			1	1		2	2	3

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE4106	Neural Network and Fuzzy Logic (**Open Elective Courses -3**)	3:0:0	3

Course Objectives

- Get the exposure to Artificial Neural Networks & Fuzzy Logic.
- Understand the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines.

Course Outcomes

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

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 (L3)
4. Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems (L3)
5. Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem (L4)

Unit I:

Introduction to Artificial Neural Network: Artificial neural networks and their biological motivation: Terminology, Models of neuron, Topology, characteristics of artificial neural networks, types of activation functions; learning methods: error correction learning, Hebbian learning, Perceptron: XOR Problem, Perception learning rule convergence theorem; Adaline.

Unit II:

Feedforward and Recurrent Neural Networks: Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network.

Unit III:

Fuzzy Logic & Fuzzy Sets : Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.

Unit IV:

Fuzzy Relations & Aggregations: Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, Defuzzification: MOM, COA

Unit V:

Fuzzy Optimization and Neuro Fuzzy Systems : Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Text Books

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.
3. Reference Books
4. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.

Reference Books:

1. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 1996.
2. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.
3. Passino, Kevin M., and Stephen Yurkovich. Fuzzy control. Vol. 42. Menlo Park, CA: Addison-Wesley, 1998.

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	-	-	1	-	-	1	3	1
CO2	2	2	2	3	3	1	-	-	1	-	-	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
R20MEC-OE4104	Automobile Engineering (**Open Elective Courses -3**)	3:0:0	3

Course Objectives:

- The objectives of the course are
- 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

Transmissionsystem: Clutches-Function-Types-Singleplate,Multipleplate, 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

Textbooks:

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,AutomotiveMechanics,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
R20ECE-OE4103	Industrial Electronics (**Open Elective Courses -3**)	3:0:0	3

Course Objectives:

- Describe semi-conductor devices (such as PN junction diode & Transistor) and their switching characteristics.
- Understand the characteristics of AC to DC converters.
- Understand about the practical applications Electronics in industries
- Describe the Ultrasonics and its application.

Course Outcome: After completing the course, the student will be able to

1. Understand the semi-conductor devices and their switching characteristics.
2. Apply the Ultrasonic waves with different applications
3. Analyze the thermal effects of Ultrasonics, soldering and welding by
4. ultrasonics,Ultrasonic Drying in the industry, Interpret the characteristics of AC to DC converters,
5. Develop the practical applications Electronics in industries.

UNIT I

Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semiconductor, Open circuited p-n junction, Diode resistance, Zener diode, Photoconductors and junction photo diodes, Photo voltaic effect, Light emitting diodes(LED).

UNIT II

Introduction, The junction transistor, Conventions for polarities of voltages and currents, Open circuited transistor, Transistor biased in the active region, Current components in transistors, Currents in a transistor, Emitter efficiency, Transport factor and transistor- , Dynamic emitter resistance, Transistor as an amplifier, Transistor construction, Letter symbols for semiconductor Devices, Characteristic curves of junction transistor in common configuration, static characteristic curves of PNP junction transistor in common emitter configuration, The transistor in common collector Configuration.

UNIT III

AC to DC converters- Introduction, Classification of Rectifiers, Half wave Rectifiers, Full wave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Metal Rectifiers, Regulated Power Supplies, Classification of Voltage Regulators, Short period Accuracy of Regulators, Long period .Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Series Voltage Regulators, Complete series voltage regulator circuit, Simple series voltage regulator.

UNIT IV

Resistance welding controls: Introduction, Resistance welding process, Basic Circuit for A.C. resistance welding, Types of Resistance welding, Electronic welding control used in Resistance welding, Energy storage welding. Induction heating: Principle of induction heating, Theory of Induction heating merits of induction heating, Application of induction heating, High frequency power source of induction heating.

Dielectric heating: Principle of dielectric heating, theory of dielectric heating, dielectric properties of typical materials, electrodes used in dielectric heating, method of coupling of electrodes to the R.F. generator, Thermal losses in Dielectric heating, Applications.

UNIT V:

Ultrasonics: Introduction, Generation of Ultrasonic waves, Application of Ultrasonic waves, Ultrasonic stroboscope, ultrasonic as means of communication, ultrasonic flaw detection, Optical image on non-homogeneities, ultrasonic study of structure of matter, Dispersive study of structure of matter, Dispersive and colloidal effect of Ultrasonic, Coagulating action of Ultrasonic, separation of mixtures by ultrasoni8c waves, cutting and machining of hard materials by ultrasonic vibrations, Degassing of liquids by ultrasonic waves, Physio-chemical effects of ultrasonics, chemical effects of ultrasonics, Thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying

TEXT BOOKS:

1. G. K. Mithal, "Industrial Electronics", Khanna Publishers, Delhi, 2000.
2. J.Gnanavadivel, R.Dhanasekaran, P.Maruthupandi, "Industrial Electronics",Anuradha Publications, 2011.

REFERENCE BOOKS:

1. F. D. Petruzulla, "Industrial Electronics", McGraw Hill, Singapore, 1996.
2. M. H. Rashid, "power Electronics Circuits, Devices and Application", PHI, 3rdedition,2004.
3. G. M. Chute and R. D. Chute, "Electronics in Industry", McGraw Hill Ltd,Tokyo, 1995.

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	3	2	-	3	3	-	2	-	-	3	3	2
CO3	3	3	3	3	-	2	3	-	2	-	-	3	3	2
CO4	3	2	3	2	-	2	2	-	2	-	-	3	3	2
CO5	3	3	3	3	-	3	3	-	2	-	-	3	3	2
CO*	3	3	3	3	-	3	3	-	2	-	-	3	3	2

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20BSH-OE4102	Optimization Techniques (**Open Elective Courses -3**)	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 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	3	3	-	2	2	-	2	-	-	3	3	2
CO2	3	3	2	3	-	2	2	-	2	-	-	3	3	2
CO3	3	3	2	3	-	2	2	-	2	-	-	3	3	2
CO4	3	3	3	3	-	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*

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE4107	Internet of Things (**Open Elective Courses -4**)	3:0:0	3

Course Objectives:

- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications and implementation of web based services on IoT devices.
- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms

Course outcomes:

1. Demonstrate knowledge and understanding of the security and ethical issues of the Internet of Things
2. Analyze Business Model for Internet of Things System layers and its standards**.**
3. Illustrate Various Application Layer Protocols and Internet Connectivity Principles.
4. Identify Various Business Process Models.
5. Compare Service Models, Sensor networks and Storage Collection.

UNIT I

Overview of IoT: The Internet of Things: An Overview; The Flavor of the Internet of Things; The "Internet" of "Things"; The Technology of the Internet of Things; Enchanted Objects; Who is Making the Internet of Things?; M2M Communications, Examples of IOT, Design Principles for Connected Devices, Business Models for Business Processes in the Internet Of Things

UNIT II

IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

UNIT III

Communication in the IoT: Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices. Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

UNIT IV

Data Acquiring, Organizing and Analytics in IoT/M2M,Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT V

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube /COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology Sensing the World.

TEXT BOOKS:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015

REFERNCE BOOKS:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things CunoPfister , Oreilly

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	3	3	2	2	3	2	2	-	3	2	3
CO2	3	3	2	3	3	2	2	2	2	2	-	3	2	3
CO3	3	3	3	3	3	2	2	2	2	2	-	3	2	3
CO4	2	2	3	2	3	2	2	2	2	3	-	3	2	3
CO5	3	3	3	3	3	2	2	2	2	2	-	3	2	3
CO*	3	3	3	3	3	2	2	2	2	2	-	3	2	3

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20MEC-OE4101	Robotics (**Open Elective Courses -4**)	3:0:0	3

Course Objectives:

- To provide an understanding of the history, classifications, and applications of
- robots
- To introduce the kinematics and position analysis of robots as mechanisms
- To explore different types of actuators and sensors used in robotics
- To introduce the control systems and control actions used in robotics
- To provide knowledge on the selection of robots based on different factors

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

1. Demonstrate The classification of Robots (L2)
2. Identify the different types of actuators in robotics (L3)
3. Analyze the different sensors and their uses in the Robotics (L4)
4. Develop the control techniques for robots(L3)
5. Analyze robot performance testing methodologies(L4)

UNIT 1:

Introduction to Robotics: Historical Perspective-Specifications of Robots- Classifications of robots, Applications of Robots. Robotics Kinematics, Position Analysis, Robotic Mechanisms

UNIT 2:

Actuators: Characteristics of Actuating Systems, Actuating Devices and Control, Use of Reduction Gears, Comparison of Hydraulic, Electric, Pneumatic Actuators, Hydraulic Actuators.

UNIT 3:

Sensors: Sensor Characteristics, Description of Different Sensors, Vision Sensors, Force Sensors, Proximity Sensors, Tilt Sensors

UNIT 4:

Robot Controls: Point to Point Control, Continuous Path Control, Intelligent Robot, Control System for Robot Joint, Control Actions, Feedback Devices

UNIT 5:

Selection of Robot: Factors influencing the choice of a robot, robot performance testing, economics of robotization, Impact of robot on industry and society

Textbooks:

1. Saeed B. Niku, Introduction to Robotics Analysis, Application, Pearson Education Asia, 1st Edition, 2001.
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things - A Hands-on Approach, First Edition, University Press,1st Edition, 2015.

References:

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano and Lorenzo Sciavicco, 2nd Edition, 2001.
2. "Introduction to Autonomous Robots" by Nikolaus Correll, Bradley Hayes, and Adam Klaptocz, 2020.
3. "Robotics and Control" by M.V. Subramanyam, 2nd Edition, 2018.
4. "Robot Mechanisms and Mechanical Devices Illustrated" by Paul E. Sandin, 2003.
5. "Industrial Robotics: Technology, Programming, and Applications" by Mikell P. Groover and Mitchell Weiss, 1st Edition, 1986.

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	2	3
CO2	3	3	3	2	-	-	-	-	2	-	-	3	3	3
CO3	3	3	-	3	-	-	-	-	2	-	-	3	3	3
CO4	3	2	3	3	-	-	-	-	2	-	-	3	3	3
CO5	3	3	-	3	-	-	2	-	-	-	-	3	3	3
CO*	3	3	3	3	-	2	2	-	2	-	-	3	3	3

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE-OE4104	VLSI System Design (**Open Elective Courses -4**)	3:0:0	3

Course Objectives:

The objectives of the course are to

- Learn and Understand IC Fabrication process steps required for various MOS circuits
- Understand and Experience VLSI Design Flow
- Learn Transistor-Level CMOS Logic Design
- Understand VLSI Fabrication and Experience CMOS Physical Design
- Learn to Analyze Gate Function and Timing Characteristics

Course Outcomes:

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-1

Introduction and Basic Electrical Properties: Introduction to IC Technology Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit-2

VLSI Circuit Design Processes: VLSI Design Flow, Lambda based design rules, Contact cuts , CMOS Lambda based design rules, Layout Diagrams for logic gates, Transistor structures, wires and Scaling of MOS circuits- Scaling models, scaling factors, scaling factors for device parameters, Limitations of Scaling.

Unit-3

Gate Level Design and Layout: Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations, The delay unit, Inverter Delays, Driving large Capacitive Loads.

UNIT – IV

Subsystem Design: Subsystem Design, Shifters, Adders, ALUs, Multipliers: Array multiplier, Serial Parallel multiplier, Parity generator, Comparators, Zero/One Detectors, Up/Down Counter, Memory elements: SRAM, DRAM, ROM, Serial Access Memories.

UNIT – V

Semiconductor Integrated Circuit Design: PLDs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Programmable Logic Array Design Approach.

TEXT BOOKS:

1. Kamran Eshraghian, "Essentials of VLSI circuits and systems", Eshraghian Douglesand Pucknell, PHI, 2005 Edition
2. Wayne Wolf, "Modern VLSI Design", 3rd Edition, Pearson Education, 1997.

REFERENCE BOOKS:

1. John .P. Uyemura, "CMOS logic circuit Design", Springer, 2007.

2. Neil H. E Weste, "CMOS VLSI Design – A Circuits and Systems Perspective", 3rd edition, DavidHarris, Ayan Banerjee, Pearson, 2009.

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	3	-	2	2	-	2	-	-	3	3	3
CO2	3	3	3	3	-	2	2	-	2	-	-	3	3	3
CO3	3	3	3	3	-	2	2	-	2	-	-	3	3	3
CO4	3	3	3	3	-	2	2	-	2	-	-	3	3	3
CO5	3	3	3	3	-	2	2	-	2	-	-	3	3	3
CO*	3	3	3	3	-	2	2	-	2	-	-	3	3	3

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20CSE-OE4108	Fundamentals of Cloud Computing (**Open Elective Courses -4**)	3:0:0	3

Course Objectives:

- Cloud Computing is a large scale distributed computing paradigm which has become a driving force for information technology over the past several years.
- This course introduce cloud computing technology to undergraduate engineering students, so they can learn, apply and use this technology in their future careers.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Understand and analyze different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand and evaluate different cloud service models.
5. Identify, analyze and use different cloud services/applications/tools available from key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing

UNIT-II:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platformas a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:

Cloud Providers and Applications: EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rackspace, VMware, Manjra soft, Aneka Platform**.**

Text Book:

1. Essentials of Cloud Computing, K. Chandrasekhran, CRC press, 2015.

Reference Books:

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley.

2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.

3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly.

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	2	1	2	-	-	3	2	3
CO2	3	3	3	2	2	2	2	1	2	-	-	3	2	3
CO3	3	3	3	3	2	2	2	1	2	-	-	3	2	3
CO4	3	3	3	3	2	2	2	2	2	-	-	3	2	3
CO5	3	3	3	3	2	2	2	2	2	-	-	3	2	3
CO*	3	3	3	3	2	2	2	2	2	-	-	3	2	3

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

Subject Code	Subject Name	L	T	P	C
R20BSH-HM4101	Universal Human Values-2:Understanding Harmony	3	0	0	3

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.(L3)
- Relate the harmony in the human being, family, society and nature/existence(L4)
- Outline and strengthening of self-reflection.(L2)
- Improvement of commitment and courage to act.(L5)
- Integrate the humanistic constitution and humanistic universal order.(L2)

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

1. Apply elements and process of value education to live happy life (L3)
2. Develop thoughts, emotions, physical sensations of the self & body and harmonize their Inter and Intra relations(L3)
3. Analyze human relations and their role in ensuring harmonious family and society(L4)
4. Analyze the holistic perceptions of harmony in existence with reference to nature(L4)
5. Develop professional ethics with universal human values and holistic technologies(L3)

UNIT-I :

Introduction to Value Education: Understanding Value Education- Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity – Basic Human Aspirations- Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario.

Application:

- Natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT-II:

Harmony in the Human Being: Understanding Humanbeing as the Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self -Understanding Harmony in the Self - Harmony of the Self with the Body.

Application:

- Differentiate between prosperity and accumulation.
- Discuss program for ensuring health vs dealing with disease

UNIT-III:

Harmony in the Family and Society: Harmony in the Family –Basic Unit of Human Interaction - Values in Human-to-Human Relationship - 'Trust' – Foundational Value in Relationship-'Respect'–Right Evaluation -Understanding Harmony in the Society -Vision for the Universal Human Order.

Application:

- Reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc., Gratitude as a universal value in relationships.

UNIT-IV:

Harmony in the Nature/Existence: Understanding Harmony in the Nature - Inter connected ness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence.

Application:

- Human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V:

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of HumanValues - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models.

Application:

- DiscussExercises and Case Studies will be taken up in Practice

Text Book

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, RAsthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN978-93-87034-47-1

Reference Books

1. JeevanVidya:EkP arichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, NewAge Intl.Publishers, NewDelhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful -E. FSchumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-J C Kumarappa
8. Bharat Mein Angreji Raj -Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj o rIndian Home Rule-by Mohandas K.Gandhi
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland (English)
13. Gandhi-Romain Rolland(English)

E-Resources:

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAIC4003.pdf
2. https://gyansanchay.csjmu.ac.in/wp-content/uploads/2022/09/UHVE-2.0-Class-Notes-Part-1-of-4-1.pdf

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	-	-	-	-	-	1	2	3	2	1	-	2	-	1
CO2	-	-	-	-	-	2	2	3	2	1	-	2	-	1
CO3	-	-	-	-	-	2	2	3	2	1	-	2	-	1
CO4	-	-	-	-	-	2	2	3	2	1	-	2	-	1
CO5	-	1	-	-	-	2	2	3	2	1	-	2	-	1
CO*	-	1	-	-	-	2	2	3	2	1	-	2	-	1

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

Course Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-SC4101	PCB Design **(Skill Oriented Course-5)**	1:0:2	2

Course Objectives:

1. To select appropriate components to make circuits.
2. To learn the Power Supply Modules
3. To study the different types of Rectifiers to design the circuit
4. To know the Security Systems
5. To Know the Design of an electronic printed circuit board for a specific application

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

1. Design reliable circuits using appropriate electronic components for various practical applications(L3)
2. Design power supply modules (±5V, ±9V, ±12V, ±15V) with appropriate components, ensuring voltage, current, and safety requirements using Proteus for schematic and PCB layout design(L3)
3. Simulate and implement rectifier circuits (half and full-wave) using Proteus for schematic and PCB layout design. (L3)
4. Design & simulate security systems, such as alarm circuits etc., using PCB design software like Proteus. (L3)
5. Fabricate an electronic printed circuit board (PCB) for a specific application by applying schematic capture and PCB layout techniques. (L3)

List of Experiments:

1. Introduction to Proteus and EDA Tool Software
2. Design of a ±5V, ±9V, ±12V, and ±15V Power supply
3. Schematic Creation and simulation of an electronic circuit
4. Design and simulation of a Half and Full Wave Rectifier
5. Design of a PCB layout of Low pass filter
6. Design of a PCB layout of CE Amplifier
7. Design and Simulation of Simple 7 Segment Circuit
8. Design of simple water level indicator
9. Design of a Laser Light Security Alarm
10. Design of touch less door bell using proximity sensor
11. Design of simple over temperate detector
12. Design of time delay generator using NE555

TEXT BOOK:

1. Simon Monk, “Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards(Electronics)” 2017

REFERENCE BOOK:

1. S. Yogesh, “OSCAD: An Open Source EDA Tool for Circuit Design, Simulation, Analysis and PCBDesign”, Shroff Publishers & Distributors Pvt. Ltd, 2013.

WEB RESOURCE:

1. https://www.udemy.com/course/circuit-design-simulation-and-pcb-manufacturing-bundle
2. https://www.allaboutcircuits.com/technical-articles/pcb-thermal-management-techniques/

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	3	2	2	2	3	2	1	2	2	2
CO2	3	3	3	2	3	2	2	2	3	2	1	2	2	2
CO3	3	3	3	2	3	2	2	2	3	2	1	2	2	2
CO4	3	3	3	2	3	2	2	2	3	2	1	2	2	2
CO5	3	3	3	2	3	2	2	2	3	2	1	2	2	2
CO*	3	3	3	2	3	2	2	2	3	2	1	2	2	2

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