COURSE STRUCTURE(R20)
AND
DETAILED SYLLABUS
(IV YEAR)

ELECTRICAL AND 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 JNTUK, Kakinada
Accredited by NAAC with "A" Grade and NBA (CSE,ECE, EEE & ME)
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (EEE)

B. Tech IV-Year Course Structure and Syllabus –R20

IV Year - I Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20EEE-PE4101.1 R20EEE-PE4101.2 R20EEE-PE4101.3 R20EEE-PE4101.4	**Professional Elective Course-3** 1. Power System Operation and Control 2. Renewable Energy Systems 3. Smart Grid Technologies 4. Digital Signal Processing	PE	3	0	0	3
2	R20EEE-PE4102.1 R20EEE-PE4102.2 R20EEE-PE4102.3 R20EEE-PE4102.4	**Professional Elective Course-4** 1. Electrical Machine Modelling and Analysis 2. Utilization of Electrical Energy **3.** Hybrid Electric Vehicles **4.** Energy Conservation, Auditing and Managemen	PE	3	0	0	3
3	R20EEE-PE4103.1 R20EEE-PE4103.2 R20EEE-PE4103.3 R20EEE-PE4103.4	**Professional Elective Course-5** 1. High Voltage Engineering 2. Electrical Distribution Systems **3.** Power System Reforms 4. AI techniques and Applications in Electrical Engineering	PE	3	0	0	3
4	R20CSE-OE4105 R20CSE-OE4106 R20MEC-OE4104 R20ECE-OE4103 R20BSH-OE4102	**Open Elective Courses -3** 1. UNIX and Shell Programming 2. Neural Network and Fuzzy Logic 3. Automobile Engineering 4. Industrial Electronics 5. Optimization Techniques	OE	3	0	0	3
5	R20CSE-OE4107 R20MEC-OE4101 R20ECE-OE4104 R20CSE-OE4108	**Open Elective Courses -4** **1.** Internet of Things 2. Robotics 3. VLSI System Design 4. Fundamentals of Cloud Computing	OE	3	0	0	3
6	R20BSH-HM4101	Universal Human Values -2: Understanding Harmony	HM	3	0	0	3
7	R20EEE-SC4101	PCB Design **(Skill Oriented Course-5)**	SC	0	1	1	2
8	R20EEE-SI4101	**Summer Internship-2 (Evaluation)**	**SI**	0	0	0	3
			Total	**19**	1	1	**23**
Honors Course -4/ Minor Course-4							

IV Year - II Semester							
S. No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
1	R20EEE-PJ4201	Project work	**PJ**	**0**	**0**	**0**	**12**
			Total	**0**	**0**	**0**	**12**

IV Year-I Semester

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. Analyze the optimal scheduling of generators (L4)
2. Solve the unit commitment problems (L3)
3. Understand the generator-load modelling and load frequency control(L2)
4. Analyze the Load frequency control problem in single area and two area systems (L4)
5. Explain how shunt and series compensation helps in reactive power control (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.

Learning outcomes: After Completion of unit, the student should be able to:

- Understand the concept of optimal Operation of Thermal Power Units (L2)
- Analyze the effect of Transmission Line Losses on Optimum Generation Allocation (L4)

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

Learning outcomes: After Completion of unit, the student should be able to:

- Understand optimal scheduling of hydro thermal systems (L2)
- Apply the concept of unit commitment problem to power systems (L3)

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.

Learning outcomes: After Completion of unit, the student should be able to:

- Understand the necessity of keeping frequency constant.(L2)
- Understand the dynamic response and steady state analysis of load frequency control.(L2)

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.

Learning outcomes: After Completion of unit, the student should be able to:

- Understand the concept of load frequency control and economic dispatch control (L2)
- Analyse the Two-Area Load Frequency Control under controlled and uncontrolled case (L4)

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.

Learning outcomes: After Completion of unit, the student should be able to:

- Understand the concept of Reactive Power Control (L2)
- Explain the Different Types of Compensating Equipment for Transmission Systems (L2)
- Explain Load Compensator and Uncompensated and Compensated Transmission Lines (L2)

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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-PE4101.2	Renewable Energy Systems **(Professional Elective Course-3)**	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.

Learning Outcomes: The students are able to

- Understand solar radiation data, extraterrestrial radiation, and radiation on earth's surface (L2)
- Demonstrate the demand supply gap of energy in Indian, world scenario (L2)
- Understand the need of energy conservation (L2)

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.

Learning Outcomes: The students are able to

- Explain solar thermal collectors, solar thermal plants (L2)
- Understand the concepts of heat transfer methods. (L2)

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.

Learning Outcomes: The students are able to

- Construct solar photo voltaic systems. (L3)
- Develop maximum power point techniques in solar PV (L3)

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

Learning Outcomes: The students are able to

- Explain wind energy conversion systems, wind power generators (L2)
- Understand maximum power point techniques in wind energy systems (L2)
- Explain basic principle and working of geothermal systems (L2)

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.

Learning Outcomes: The students are able to

- Explain basic principle and working of tidal power plants and Biomass (L2)
- Understand the concept of converting chemical energy to electrical energy (L2)

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:

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

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.

Learning Outcomes: The students are able to

- Understand the constraints on smart grid(L2)
- Identify the initiative operations and technologies required for the smart grid (L3)

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.

Learning Outcomes: The students are able to

- Understand the necessity of data communication technologies (L2)
- Apply the switching techniques of data communication (L3)

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.

Learning Outcomes: The students are able to

- Understand the importance of encryption and decryption on smart grid (L2)
- Understand the importance of standards for information exchange and security on smart grid (L2)

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.

Learning Outcomes: The students are able to

- Understand the importance of smart metering (L2)
- Analyze the different area networks and protocols on demand side integration (L3)

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.

Learning Outcomes: The students are able to

- Understand the importance of data sources on transmission management system (L2)
- Apply the techniques and modeling tools required in transmission management system (L3)

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 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.

Learning Outcomes: The students are able to

- Describe importance of Digital Signal processing
- Describe LTI system Properties
- Summarize properties of Discrete time systems and 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.

Learning Outcomes: The students are able to

- Determine DFT of a given sequence using linear filtering methods
- Determine time sequence from the given spectrum of a signal using 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.

Learning Outcomes: The students are able to

- Design IIR filter from the given analog transfer function
- Describe features of IIR Filter structures

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.

Learning Outcomes: The students are able to

- Design FIR Digital Filter using windowing techniques for the given specifications

- Identify basic structures of given 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

Learning Outcomes: The students are able to

- Analyze important features of DSP Processors
- Describe Architecture of TMS320C5X
- Identify the applications of multirate signal processing
- Understand the concept of adaptive filters

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 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.

Learning Outcomes: The students are able to

- Understand the Basics of Two Pole Machine modeling (L2)
- Understand about Kron's Primitive Machine (L2)

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.

Learning Outcomes: The students are able to

- Understand the State analysis-Transient State Analysis of DC Motor (L2)
- Analyze the linearization Techniques for small perturbations (L4)

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.

Learning Outcomes: The students are able to

- Convert the 3-phase variables of stationary circuit elements to arbitrary reference frame (L3)
- Study of Stator reference frame model & Rotor reference frame model (L2)

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.

Learning Outcomes: The students are able to

- Derive the voltage equations of synchronous machine in rotor dq0 reference frame variables (L3)
- Understand the dynamic performance of synchronous machine (L2)

UNIT –V

Modeling of Special Machines : Modeling of PM Synchronous motor, modeling of BLDC motor, modeling of Switched Reluctance motor.

Learning Outcomes: The students are able to

- Explain the operation of PM Synchronous Motor & BLDC Motor (L2)
- Analyze the Switched Reluctance Motor and BLDC motor. (L3)

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 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. Identify the suitable motor for electric drives and industrial applications (L4)
2. Calculate the illumination levels produced by various lighting schemes (L3)
3. Identify most appropriate heating and welding techniques for different applications (L4)
4. Understand the basic concepts of electric traction (L2)
5. Calculate the energy consumption levels at various modes of operation (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.

Learning outcomes: The students are able to

- Understand the features of electric motor (L2)
- Identify the suitable motor for electric drives and industrial applications (L4)

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.

Learning outcomes: The students are able to

- Understand the concept of illumination and working principle of various lamps (L2)
- Calculation of Illumination for different lighting schemes (L3)

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.

Learning outcomes: The students are able to

- Understand the electrical heating methods (L2).
- Identify most appropriate welding techniques for various applications (L4)

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.

Learning outcomes: The students are able to

- Understand the concepts of A. C. and D. C. Traction systems (L2).
- Understand the various equipment associated with electric traction system (L2)

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.

Learning outcomes: The students are able to

- Explain the speed time curves of different services (L2)
- Calculate Energy Consumption levels at various modes of operation (L3)
- Understand the concepts of Economic Aspects of Utilizing Electrical Energy (L2)
- Compare the various economic aspects of Utilization of Electrical Energy (L4)

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 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.

Learning outcomes: The students are able to

- Understand the concept of electric vehicles (L2)
- Advantages and applications of Electric and Hybrid Electric Vehicles (L2)

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.

Learning outcomes: The students are able to

- Explain the Architectures of HEVs (L2)
- Comparison of HEV and PHEV (L2)

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.

Learning outcomes: The students are able to

- Apply the power management of PHEVs (L3)
- Understand the concept of vehicle to grid technology (L2)

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.

Learning outcomes: The students are able to

- Apply the Rectifiers used in HEVs (L3)
- Explain the Buck converter used in HEVs (L2)

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

Learning outcomes: The students are able to

- Understand the concept of Energy Storage Parameters (L2)
- Explain the Hydroelectric Energy Storage (L2)

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 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. Understand the current energy scenario and importance of energy conservation (L2).
2. Understand the concepts of energy audit and energy conservation systems. (L2)
3. Make use of audit instruments for energy audit and management (L3).
4. Analyze the performance of electrical utilities and its efficient improvement approaches (L4).
5. Analyze life cycle costing and investment return on energy efficient technologies (L3).

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.

Learning Outcomes:

- Understand the need for energy conservation (L2).
- Understand salient features of energy conservation act-2001(L2).

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.

Learning Outcomes:

- Understand the basic definitions and types of energy audit (L2).
- Understand about energy conservation systems and their representation (L2).

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.

Learning Outcomes:

- Understand the concept of energy management and energy conservation schemes (L2).

- Make use of audit instruments for energy audit and management (L3).

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.

Learning Outcomes:

- Understand the concept of different energy efficient electrical utilities (L2)
- Analyze the performance of electrical utilities and discuss the improvement methods (L4).

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.

Learning Outcomes:

- Analyze different economic aspects in energy management (L4).
- Understand the basic concepts of energy efficient motors (L2).

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

4.

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.

Learning outcomes: The students are able to

- Understand the Concept of Ionization and de-ionization processes (L2).
- Understand the basic concepts related to various breakdown processes in gases insulating materials (L2).

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.

Learning outcomes: The students are able to

- Understand the basic concepts related to various breakdown processes in liquid and solid insulating materials (L2).
- Understand properties of breakdown and application of insulating materials (L2)

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.

Learning outcomes: The students are able to

- Understand the concept of generation of high Currents (L2)
- Understand the concept of Generation of high voltages (L2).

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.

Learning outcomes: The students are able to

- Measure High Voltages and Currents (L5)

- Understand the concept of High Voltage equipment and insulating materials (L2)

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.

Learning outcomes: The students are able to

- Explain the over-voltages arise in a power system (L5)
- Understand the concept of protective measures against over-voltages (L2)

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 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. Understand the various factors effecting the distribution system (L2)
2. Explain about the substations and distribution feeders (L2)
3. Determine the voltage drop, power loss for different load areas (L3)
4. Analyze the various protection schemes and its 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.

Learning Outcome: The students are able to

- Understand the different types of factors and characteristics (L2)
- Classify the different loads and their characteristics(L2)
- Understand the present and future distribution system planning techniques (L2)

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.

Learning Outcome: The students are able to

- Understand the location of substations and benefits of optimal location of substations (L2)
- Understand the distribution feeders (L2)

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.

Learning Outcome: The students are able to

- Determine the voltage drop and power loss calculations(L3)
- Understand the effect of different voltage controllers (L2)

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.

Learning Outcome: The students are able to

- Classify the different types of faults (L4)
- Analyze the operation of different types of protective devices (L4)
- Understand the concept of micro-grid protection (L2)

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.

Learning Outcome: The students are able to

- Classify the different types of power capacitors (L4)
- Analyze the effect of compensation on P.F improvement (L4)

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 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. Understand fundamentals of power system deregulation and restructuring, congestion management.(L2)
2. Analyze OASIS and compute available power transfer capability calculations.(L4)
3. Analyze electricity price volatility and electricity pricing challenges.(L3)
4. Understand operation of power system in deregulated environment.(L2)
5. Understand importance of Ancillary services management.(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.

Learning outcomes: The students are able to

- Understand restructuring models in power systems (L2)
- Understand about power exchange, market and transmission pricing
- Understand congestion management and congestion pricing in power systems (L2)

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.

Learning outcomes: The students are able to

- Understand Available Transfer Capability (L2)
- Utilize different calculations in power transfer capability (L3).

UNIT–III

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

Learning outcomes: The students are able to

- Understand electricity price volatility in power system (L2)
- Utilize electricity pricing Challenges in power system (L3)

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.

Learning outcomes: The students are able to

- Understand the activities of ISO (L2)
- Understand the ISO activity in pool and bilateral markets (L2)
- Understand the planning activities of a GENCO (L2)

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.

Learning outcomes: The students are able to

- Understand the importance Ancillary Services in power system (L2)
- Understand the Ancillary Services providers management in various countries (L2)

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 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.

Learning Outcomes:

- Understanding soft computing techniques and hard computing systems, expert systems(L2)
- Learn the brief history of ANN, Fuzzy and GA (L2)

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.

Learning Outcomes:

- Design of ANN based systems for function approximation used in load forecasting(L3)
- Understanding of Algorithmic based methods and knowledge-based methods(L2)

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.

Learning Outcomes:

- Understand the concept of fuzziness involved in various systems and fuzzy set theory(L2)

- Comprehend the fuzzy logic control and adaptive fuzzy logic to design electrical systems(L3)

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.

Learning Outcomes:

- Understanding various types of coding methods, fitness function, different types of GA operators(L2)
- Apply GA to power system optimization problems(L3)

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 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 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 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

- Understand Basic Concepts of ANN
- Understand the Architecture of Neural Networks Models
- Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines
- Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
- Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

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 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

At the end of this unit the student will be able to

- identify different types of automobiles.(L3)
- explain various parts of the engine.(L2)
- explain the lubrication and cooling system in IC Engines.(L2)

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

Learning Outcomes:

At the end of this unit the student will be able to

- explain clutch functionality and transmission systems.(L2)
- understand the functionality of differential.(L2)
- explain the rear axle assembly. (L2)

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

Learning Outcomes:

At the end of this unit the student will be able to

- Explain types of steering mechanisms.[Level 2]
- Illustrate the steering geometry.(L2)

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

Learning Outcomes:

At the end of this unit the student will be able to

- explain the various electrical components in automobile.(L3)
- Illustrate the components of braking systems.(L3)

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

Learning Outcomes:

At the end of this unit the student will be able to

- Identify the safety systems in automobile.(L2)
- Understand the emission controlling methods.(L3)

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 Code	Course Title	Hrs./Week L: T: P	Credits
R20ECE-OE4103	Industrial Electronics (**Open Elective Courses -3**)	3:0:0	3

Course Objectives:

This course will enable students to:

- 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:

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).

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the importance of Electronics and semiconductor devices in industry, operation of semiconductor devices (L1)
- Describe the working of semiconductor diodes (L1)

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-α, 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.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the working of Transistor and its different configurations (L1)
- Describe the working of CE, CC, CB configurations (L1)

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.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the working of Rectifiers and regulators. (L1)

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.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the principle of operation of Resistance welding, Induction heating and Dielectric heating (L1)
- Apply the process of Resistance welding, Induction heating and Dielectric heating in the industry (L2)

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

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the principle of operation of Ultrasonics and its applications (L1)
- Analyze the thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying in the industry (L3)

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 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.

Learning Outcomes: The students are able to

- Understand the optimization problem, without and with constraint design variables (L2)
- Analyze the various optimization problems (L4)

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.

Learning Outcomes: The students are able to

- Understand the classical optimization techniques to minimize or maximize objective function, without or with constraints (L2)
- Apply Lagrange multipliers & Kuhn – Tucker conditions for solving multivariable Optimization with inequality constraints (L3)

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

Learning Outcomes: The students are able to

- Solve the linear simultaneous equations (L3)
- Apply linear programming for Simplex method, dual Simplex method (L3)

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.

Learning Outcomes: The students are able to

- Explain various non-linear programming techniques for unconstrained & constrained cases (L2)
- Analyze the exterior and interior penalty functions for various optimization problems (L4)

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.

Learning Outcomes: The students are able to

- Understand the Evolutionary Programming Methods to find solutions for complex problems (L2)
- Choose the parameters in the use of Evolutionary Computation (L1)
- Apply partial swarm optimization and genetic algorithm method to solve the various real time problems (L3)

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 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

Learning Outcomes:

After completing this Unit, students will be able to

- Explain IoT architecture.
- Interpret the design principles that govern connected devices.
- Summarize the roles of various organizations for IoT.

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.

Learning Outcomes:

After completing this Unit, students will be able to

- Explain the basics of OSI stack
- Learn communication technologies
- Interact the working of M2M communication

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.

Learning Outcomes:

After completing this Unit, students will be able to

- Interpret different protocols and compare them

- Select which protocol can be used for a specific application
- Utilize the Internet communication protocols for IoT applications

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.

Learning Outcomes:

After completing this Unit, students will be able to

- Analyze business models.
- About organizing data

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.

Learning Outcomes:

After completing this Unit, students will be able to

- Select IoT APIs for an application
- Design and develop a solution for a given application using APIs
- Test for errors in the application
- Implement Cloud platform for IOT applications and services

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 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:

- **Understand** classification of Robots (L1)
- **Identify** and use different types of actuators in robotics (L3)
- **Analyze** the different sensors and their use in Robotics (L3)
- **Explain** the control systems for robots (L2)
- **Evaluate** 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

Learning Outcomes:

- **Define** key terms in robotics, such as specifications, classifications, and applications of robots. (L1)
- **Explain** the historical perspective of robotics, key milestones (L2)
- **Identify** different types of robotic mechanisms (L3)

UNIT 2:

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

Learning Outcomes:

- **List** examples of applications where hydraulic actuators are commonly used (L1)
- **Summarize** the key factors to consider when selecting an actuator for a particular application (L2)
- **Design** a system that uses a specific type of actuator to achieve a desired motion or force output (L3)

UNIT 3:

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

Learning Outcomes:

- **Identify** the different types of sensors based on their applications (L1)
- **Illustrate** the impact of sensor accuracy on system performance (L2)
- **Solve** problems related to calibration and sensitivity of sensors (L3)

UNIT 4:

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

Learning Outcomes:

- **Recall** the different types of feedback devices used in robot control. (L1)
- **Explain** the concept of joint control in robot motion. (L2)
- **Analyze** the advantages and disadvantages of point-to-point control versus continuous path control for a given robotic application. (L4)

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

Learning Outcomes:

- **Discuss** the potential benefits and drawbacks of using robots in different fields (L2)
- **Select** appropriate robots for different applications (L3)
- **Evaluate** the effectiveness of different robot performance testing methods (L4)

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 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. Learn the basic fabrication process of MOS transistors, Area Capacitance and Delay calculation.
2. Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality.
3. Analyze the performance of CMOS Inverter circuits
4. Compare various Scaling models and understand the effect of scaling on device
5. parameters

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.

Learning Outcomes:

After completion of this unit, students will be able to

- Demonstrate a clear understanding of CMOS fabrication flow and technology scaling(L2)
- Analyze the electrical properties of MOS and BiCMOS circuits (L3)
- Design MOSFET based logic circuit (L4)

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.

Learning Outcomes:

After completion of this unit, students will be able to

- Understand the design rules and layout diagram for logic gates, limitations of scaling(L1)
- Draw the Layout of simple MOS circuit using Lambda based design rules (L2)

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.

Learning Outcomes:

After completion of this unit, students will be able to

- Apply basic circuit concepts to MOS circuits. (L2)

- Estimate the propagation delays in CMOS circuits (L3).

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.

Learning Outcomes:

After completion of this unit, students will be able to

- Apply the Lambda based design rules for subsystem design (L2)
- Design of Adders, Multipliers and memories etc(L4)
- Design digital systems using MOS circuits(L4)

UNIT – V

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

Learning Outcomes:

After completion of this unit, students will be able to

- Analyze various architectures and device technologies of PLDs(L3)
- Design simple logic circuit using PLA, PAL, FPGA and CPLD.(L4)

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 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.

Subject Code	Subject Name	L	T	P	C
R20BSH-HM3101	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. Enriches the knowledge on need of Value Education. (L2)
2. Considerate Human being as the Co-existence of the Self and the Body.(L2)
3. Identify the basic unit of human interaction(L3)
4. Comprehend the harmony in the nature (L2)
5. Analyze and exploring Ethical Human Conduct.(L4)

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.

Learning Outcomes:

- Apply Human values to balance their life and profession (L3)
- Identify and incorporate the levels of human values(L2)

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.

Learning Outcomes:

- Distinguish physical facilities the self and body (L4)
- Related to proper upkeep of the body and practice them in their daily routine. (L2)

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.

LearningOutcomes:

- Interpreting Natural acceptance is always for living in harmony(L2)
- Exemplifying Right evaluation leads to fulfilment in relationship(L3)

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 Fulfilment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perceptionof Harmony in Existence.

Learning Outcomes:

- Organizing Confident that they can understand the whole existence made appropriate and holistic.(L2)
- Differentiate between the characteristics and activities of different orders able to see the interconnectedness in the nature(L3)

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.

LearningOutcomes:

- Present sustainable solutions to the problems in society and nature. (L2)
- Able to grasp the right utilization of their knowledge in their streams of Technology to ensure mutual fulfilment.(L3)

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 Code	Course Title	Hrs./Week L: T: P	Credits
R20EEE-SC4101	PCB Design **(Skill Oriented Course-5)**	0:1:2	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. Determine appropriate components to make circuits.
2. Design of a Power Supply Module
3. Design the different types of Rectifiers
4. Design of the Security Systems
5. Design of an electronic printed circuit board for a specific application

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/