LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NBA and NAAC with "A" Grade
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Department of Electrical and Electronics Engineering

B. Tech IV-Year Course Structure (R23 Regulation)

IV YEAR – I SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R23EEE-PC4101	Switchgear and Protection	PC	3	0	0	3
2	R20BSH-HM4101	Managerial Skills for Engineers	HM	2	0	0	2
3	**Professional Elective-IV**			3	0	0	3
	R23EEE-PE4101.1	Advanced Digital Design Using Verilog	PE				
	R23EEE-PE4101.2	Robotics and Automation	PE				
	R23EEE-PE4101.3	Power System Operation and Control	PE				
	R23EEE-PE4101.4	Industrial Drives	PE				
4	**Professional Elective-V**			3	0	0	3
	R23EEE-PE4102.1	FPGA based Control Design	PE				
	R23EEE-PE4102.2	Intelligent Control Techniques	PE				
	R23EEE-PE4102.3	Distribution System Planning and Automation	PE				
	R23EEE-PE4102.4	Hybrid Electric Vehicles	PE				
5	**Open Elective-III**		OE	3	0	0	3
6	**Open Elective-IV**		OE	3	0	0	3
7	R23EEE-SC4101	1. Embedded ARM Programming 2. FPGA Controller for Power Converters 3. Photovoltaic System Design 4. Electric Vehicle Technology 5. PCB Design 6. CAD for Electrical Engineering	SC	1	0	2	2
8	R23BSH-MC4101	Technical Paper Writing & IPR	MC	2	0	0	0
9	R23EEE-MC4101	Power Systems & Simulation Lab	MC	0	0	3	0
10	R23EEE-SI4101	Evaluation of Industry Internship	SI	0	0	0	2
Total				**20**	**0**	**5**	**21**

IV YEAR – II SEMESTER							
S. No.	**Course code**	**Subjects**	**Category**	**L**	**T**	**P**	**Credits**
1	R23EEE-PR4201	Full Semester Internship and Project Work	PR	0	0	24	12
Total							**12**

IV-Year, I-Semester Syllabus

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PC4101	Switchgear and Protection	3:0:0	3

Course Objectives:

- To provide knowledge on the arcing phenomenon and explain the construction and operation of various types of circuit breakers used in power systems.
- To study the working principles, characteristics, and types of electromagnetic protection relays used in electrical networks.
- To gain knowledge of protection schemes for electrical machines like generators and transformers under fault conditions.
- To understand the feeder and bus bar protection systems using modern protection schemes.
- To understand the operation of static relays and identify the various methods of Protection against over voltages

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

1. To analyze the arcing phenomenon characteristics with Rate of Rise of Restriking Voltage (L3)
2. To analyze the characteristics and operational behavior of electromagnetic protection relays, and evaluate their suitability for different protection scenarios. (L4)
3. To apply effective protection schemes for generators and transformers under fault conditions, including differential, earth fault, and overcurrent protection techniques. (L3)
4. To understand the principles and configurations of feeder and bus bar protection systems using advanced methods such as unit and distance protection. (L2)
5. To explain the working of static relays and describe various methods for protecting electrical systems against over voltages (L2).

UNIT – I

Circuit Breakers: Physics of arcing phenomenon, Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, RRRV, Average and Max. RRRV, Current Chopping and Resistance Switching - Description and Operation of Following Types of Circuit Breakers: Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers–selection of circuit breakers, Ratings of circuit breakers, HVDC circuit breaker.

UNIT – II

Electromagnetic Protection Relays: Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification– Instantaneous– DMT and IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Negative sequence and under frequency relays.

UNIT – III

Generator and Transformer Protection: Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples. Transformer Protection: Percentage differential protection– Transformer overheating - Protection against Magnetizing Inrush Current – Buchholz relay protection– Earth fault relays – Protection of earthing transformers – over flexing protection - Numerical examples.

UNIT – IV

Feeder and Busbar Protection: Protection of lines: Over current Protection schemes – PSM, TMS- phase Comparison Carrier Current Protection- carrier aided distance protection- Unit protection - Numerical examples -Carrier current and three zone distance relay using impedance relays–Protection of bus bars by using Differential protection- frame leakage protection.

UNIT – V

Advanced Relay systems and Protection against over voltages: Static relay components– Static over current relays– Static distance relay– Numerical over current relay. Generation of over voltages in power systems**-** Protection against lightning over voltages– Valve type and zinc oxide lighting arresters – Grounded and ungrounded neutral systems–Methods of neutral grounding: Solid–resistance– Reactance–Arcing grounds- Zones of protection

Textbooks:

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.
2. VK Metha," Principles of Power Systems" S. Chand, 2005.
3. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992

Reference Books:

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009.
3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010.
4. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani, 'Protection and Switchgear' Oxford University Press, 2011.

Web Links:

1. https://nptel.ac.in/courses/108107167
2. https://www.electrical4u.com/

Course Code	Course Title	Hrs./Week L:T:P	Credits
R20BSH-HM4101	Managerial Skills for Engineers	2:0:0	2

Course Objectives:

- To Provide fundamental knowledge on Management, Administration, Organizational methodologies
- To Equip with the knowledge of long term business value for the organization
- To Explain basics of human resource management & marketing required for organization
- To Analyze the PERT/CPM techniques for better Project Management
- To Incorporate technology perspectives with Managerial practices

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

- Apply principles of management & designs of organization in practical world.(L3)
- Realize concepts of business value development for organizational growth.(L2)
- Provided awareness of human resource management and marketing concepts.(L3)
- Develop PERT/CPM Charts for projects of enterprise and estimate time & cost of project.(L3)
- Analysis of improved decision making with the implementation of technology in Management(L2)

UNIT-I

Introduction to Management: Management-Concept -Nature-Functions- Evolution of Management Thought -Principles of Management-Theories of Motivation- Managerial skills-Data driven Decision making-Leadership styles - Interpersonal skills-organizational structures.

Applications:

Divide the class into two teams' old employees and new joiners and motivate the work environment with respect to excellent management and the supportive.

UNIT-II

Business Value Development: Business Environment-Building business value through Modernization-Business Analytics- Types-Principles of Value Engineering- Approaches and methods of Business value- Strategies for enhancing Business Value -Corporate Social Responsibility-SWOT analysis of Business.

Application: Analyze a Multi-National company's potentialities and business value.

UNIT-III

Human Resources Management & Marketing Management: Human Resource Management- Definition and Meaning –Managerial and Operative functions-Job Evaluation and Merit rating- Negotiation skill- Employee performance appraisal.

Marketing Management: Concept- Meaning - Nature-Functions of Marketing- Marketing Mix- Marketing Strategies based on Product Life Cycle-Digital Marketing.

Application: Apply Human resource and marketing aspects in professional decisions through case studies

UNIT-IV

Project Management: Project Selection and criteria of choice - Project planning and control - Development of Network - Difference between Program Evaluation Review Technique and Critical Path Method - Identifying critical path-crashing (simple problems).

Application: Analyze various parameters of the project like critical path, crashing etc. for best cost decisions according to operations of the project.

UNIT-V

Technology In Management: AI (Artificial Intelligence) in Management-Finance, Operations, Human Resource- Development Phases of AI for Management Support-Benefits, Challenges and considerations-Best Practices for AI Implementation-Case Examples.

Application: Integrate AI with existing management systems (ERP, CRM).

TEXT BOOKS:

1. Management Science by Aryasri; Publisher: Tata McGraw Hill, 2009
2. L.M. Prasad, Principles and Practice of Management.

Reference Books:

1. Robins, Stephen P., *Fundamentals of Management*, Pearson, India.
2. Kotler Philip & Keller Kevin Lane: Marketing Management 12/e, PHI, 2007
3. Koontz & Weihrich: *Essentials of Management*, 6/e, TMH, 2007
4. Valuing a Business, 5th Edition : The Analysis and Appraisal of Closely Held Companies, Shannon P.Pratt
5. Artificial Intelligence Concepts for Management, Paperback, Katzan Harry Jr, 2023

Web links:

1. www.managementstudyguide.com
2. www.citehr.com
3. www.nptel.ac.in/courses/122106032
4. https://nptel.ac.in/courses/110/106/110106145/
5. www.btechguru.com/courses--nptel--basic-course

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4101.1	Advanced Digital Design Using Verilog	3:0:0	3

Course Objectives:

- Develop advanced proficiency in digital system design using Verilog HDL.
- Design and model complex digital systems at behavioral and RTL levels.
- Understand simulation, verification, synthesis, and implementation flow.
- Explore timing, optimization, and debugging in Verilog-based design.

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

1. Design complex digital circuits using Verilog at behavioral and RTL levels.
2. Simulate and verify Verilog models using test benches.
3. Synthesize and implement Verilog designs for FPGAs/ASICs.
4. Analyze timing and optimize performance of digital circuits.
5. Integrate components into larger digital systems like processors or controllers.

UNIT-I

Verilog Review and Design Methodologies: Overview of Verilog HDL (review of basic syntax, modules, ports); Simulation vs. synthesis; Design abstraction levels: behavioral, RTL; gate; Top-down vs. bottom-up design approaches

UNIT-II

Behavioral and RTL Modeling: Behavioral modeling; A brief look at data types for behavioral modeling; Boolean-Equation – Based behavioral models of combinational logic; Propagation delay and continuous assignments; Latches and Level – Sensitive circuits in Verilog; Cyclic behavioral models of Flip-Flops and Latches; Cyclic behavior and edge detection; A comparison of styles for behavioral modeling; Behavioral models of multiplexers, encoders, and decoders

UNIT-III

Testbenches and Verification: Writing effective testbenches; Stimulus generation and output monitoring; Self-checking testbenches; Delay models (#delay) and timing control; Introduction to assertion-based verification and SystemVerilog (brief)

UNIT-IV

Synthesis and Optimization: Synthesizable vs non-synthesizable Verilog constructs; FSM encoding styles: binary, one-hot, gray; Pipelining and parallelism; Design partitioning, resource sharing; Optimization for area, speed, and power

UNIT-V

Timing and Constraints: Clocking and resets (asynchronous vs synchronous resets); Setup and hold time concepts; Clock domain crossing issues; Static Timing Analysis (STA) basics; Timing constraints: SDC format

Textbooks:

1. Michael D. Celetti: Advanced Digital Design with the Verilog HDL, PHI, 2013
2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson

Reference Books:

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw Hill
2. Douglas L. Perry, Verilog HDL, McGraw Hill
3. Clifford E. Cummings, Verilog Coding Styles and Synthesis Guidelines (IEEE Papers and Notes)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_cs61/preview
2. https://nptel.ac.in/courses/106103358
3. https://onlinecourses.nptel.ac.in/noc21_ee39/preview

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4101.2	Robotics and Automation	3:0:0	3

Course Objectives:

- To introduce the fundamentals of robot kinematics and classification, including forward and inverse kinematics
- To analyze the velocity and acceleration kinematics and understand robot dynamics using standard formulations.
- To apply various path and trajectory planning algorithms in configuration space.
- To model, and control robotic manipulators using classical and modern control techniques.
- To develop and test robotic applications using the Robot Operating System (ROS)

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

- Explain the principles of transformation, rigid motion, and Denavit-Hartenberg parameters. (L2)
- Apply the dynamic equations of motion for robots using Euler-Lagrange and Newton-Euler methods. (L3)
- Develop path and trajectory planning techniques for point-to-point and continuous motion. (L3)
- Apply principles of robot joint modeling and trajectory-following control strategies. (L3)
- Utilize Robot Operating System (ROS) for developing and debugging robotic applications involving motion planning and control. (L3)

UNIT-I

Introduction and Position Kinematics: Types of Robots and applications, Serial Robots, Transformations, Rigid Motions, Forward Kinematics: Denavit-Hartenberg Convention, Inverse Kinematics.

UNIT-II

Velocity Kinematics – The Jacobian: Angular and Linear Velocity: Singularities, Accelerations.
Robot Dynamics: Equations of Motion, Kinetic and Potential Energy, Euler-Lagrange Equations, Recursive Newton-Euler Formulation.

UNIT-III

Path and Trajectory Planning**:** Path vs. Trajectory, The Configuration Space, Path Planning in Configuration Space, Probabilistic Roadmap Planner, Potential Fields, Trajectory Planning, Point to Point Motion, Paths Specified by Via Points,
Sensors and Actuators: Joint Actuating Systems, Drives, Proprioceptive Sensors, Exteroceptive Sensors

UNIT-IV

Robot Control: Modelling Robot joint as a Second-order linear system, Control-law partitioning, trajectory-following control, disturbance rejection, Nonlinear and time- varying systems, multi-input, multi-output control systems, control of manipulators, practical considerations

UNIT-V

Robot Operating System (ROS): Basic ROS concepts, Writing RoS Programs, Log Messages, Graph Resource Name, Launch Files, Parameters, Services, Recording and Replaying Services

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.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_de13/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
3. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
4. https://onlinecourses.nptel.ac.in/noc21_de13/preview
5. https://onlinecourses.nptel.ac.in/noc21_de13/preview

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4101.3	Power System Operation and Control	3:0:0	3

Course Objectives:

- To optimal dispatch of generation with and without losses.
- To study the optimal scheduling of hydro thermal systems and unit commitment
- To study the load frequency control for single area system with and without controllers
- To study the Economic dispatch control and load frequency control in two area systems
- To explain the reactive power control and compensation of transmission lines.

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

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

UNIT – I

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

UNIT–II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Text books:

1. Modern Power System Analysis,D.P.Kothari and I.J.Nagrath, Tata McGraw Hill Publishing Company Ltd., 3rd Edition, 2003, Ninth Reprint 2007.
2. Electric Energy System Theory: An Introduction, OlleIngemar Elgerd, Tata McGrawHill, 2nd Edition, 1982.
3. Power System Stability and Control, P Kundur, Tata McGraw Hill, 1994, 5th Reprint,2008

Reference books:

1. Power System Analysis and Design, J. Duncan Glover and M.S.Sharma, Thomson, 3rd Edition, 2008.
2. Allen.J.Wood and Bruce F.Wollenberg, ‘Power Generation, Operation and Control', 3rd/e, John Wiley & Sons, Inc., 2013.

Web LInks

1. https://nptel.ac.in/courses/108101040/
2. http://nptel.ac.in/courses/108104052/

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4101.4	Industrial Drives	3:0:0	3

Course Objectives:

- To introduce students to the fundamental concepts of electric drives.
- To enable students to analyze the operation and characteristics of DC motor drives.
- To enable students to analyze the operation of Induction and Synchronous motor drives.
- To compare the performance of Vector Control and Direct Torque Control for induction motors
- To introduce the principles and methods of sensor-less control for electric drives.

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

1. Analyze the mechanical dynamics and stability of Industrial drives. (L4)
2. Analyze the operation of DC motor drives using half-controlled and fully-controlled rectifiers and converters. (L4)
3. Analyze the common control strategies for both Induction and Synchronous motor drives. (L4)
4. Analyze the implementation of Vector Control and Direct Torque Control for induction motors. (L4)
5. Analyze sensor-less speed control methods used for scalar and vector controlled drives. (L4)

UNIT-I

Principles, Dynamics, and Power Rating Selection– Need of electric drives, basic parts, present scenario of electric drives, Mechanical Dynamics in an Electric Drive - Speed-torque characteristics of some common motors and loads, multi-quadrant operation, equivalent values of drive parameters, stability of an electric drive, Selection of Motor Power Rating – Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating.

UNIT-II

DC Motor Drive Using Phase Controlled Rectifier – DC motor drive using half controlled and fully controlled single phase and three phase rectifiers, continuous and discontinuous conduction modes of operation, 4-quadrant operation using dual converter, Operating limits of a separately excited DC motor drive.

UNIT-III

Induction Motor Drive – Steady state equivalent circuit and phasor diagram with variable frequency supply, v/f control and constant air gap flux control of induction motor drive, field weakening operation of induction motor drive.

Synchronous Motor Drive – Synchronous motor drive with Variable Voltage Variable Frequency supply, synchronous motor drive using a voltage source inverter, synchronous motor drive using load commutated thyristor inverter, control of synchronous machine using cycloconverter.

UNIT-IV

Vector Control: Indirect rotor flux oriented vector control scheme implementation– tuning - Dynamic simulation.Parameter sensitivity and compensation of vector controlled induction motors-Selection of Fluxlevel - Flux weakening operation - Speed controller design,comparison of DTC and FOC.

UNIT-V

Sensor less Control: Principles for speed sensor less control - Sensor less methods for scalar control, Sensor less methods for vector control, Introduction to observer based techniques.

TEXT BOOKS:

1. Sen, Paresh Chandra. Principles of Electric Machines and Power Electronics, International Adaptation. John Wiley & Sons, 2021.
2. Mohan, Ned, Tore M. Undeland, and William P. Robbins. Power electronics: converters, applications, and design. John wiley & sons, 2003.
3. Bose, Bimal K. "Power electronics and AC drives." Englewood Cliffs (1986).

REFERENCE BOOKS:

1. Krishnan, Ramu. "Electric motor drives: modeling, analysis, and control." (No Title) (2001).
2. Vas, Peter. Sensorless vector and direct torque control. Oxford university press, 1998.

Web Links:

1. https://onlinecourses.swayam2.ac.in/nou24_ee02/preview
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4102.1	FPGA based Control Design	3:0:0	3

Course Objectives:

1. To know about FPGA architecture features and fabrics and basics of VLSI technology
2. To learn about FPGA-based system design and VLSI technology, focusing on digital design principles.
3. To learn about logic implementation and design aspects of FPGA
4. To understand about performance analysis of sequential machines
5. To learn about architectures and multi-FPGA large scale systems

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

1. Understand about features of FPGA and its fabrics
2. Design of FPGA based systems and develop single and multi FPGA systems
3. Apply the basic concepts to design various combinational logic gates using FPGAs
4. Develop sequential logic machines and analyze the performance
5. Analyze and compare different system architectures.

UNIT-I

FPGA ARCHITECTURE AND FABRICS: Programmable Logic Devices-Types-PLA, PAL, FPGA-architectures, SRAM-based FPGAs, Permanently Programmed FPGAs, Chip I/O. Circuit Design of FPGA Fabrics. Architecture of FPGA Fabrics.

UNIT-II

FPGA-BASED SYSTEMS AND VLSI TECHNOLOGY: Introduction, Basic Concepts, Digital Design and FPGAs. FPGA-based system design. Manufacturing Processes, Deriving Transistor Characteristics, CMOS Logic Gates, Wires, Registers and RAM, Packages and Pads.

UNIT-III

COMBINATIONAL LOGIC: The Logic Design Process. Hardware Description Languages, combinational network delay. Power and energy optimization, arithmetic logic, logic implementation for FPGAs. Physical Design for FPGAs. The Logic Design Process.

UNIT–IV

SEQUENTIAL MACHINES: The sequential machine design process. Sequential design styles. Rules for Clocking. Performance Analysis. Power Optimization

UNIT-V

LARGE SCALE SYSTEMS: Architectures and Large-Scale Systems, Behavioral Design, Design Methodologies. Design Example. Buses, Platform FPGAs, Multi-FPGA Systems, Novel Architectures.

Textbooks:

1. FPGA Based System Design, Wayne Wolf, Prentice Hall, 2004..
2. Modern VLSI Design, Wayne Wolf, Pearson Education 2002..

Reference Books:

1. Advanced Digital Design with verilog HDL, Michael D Ciletti, Pearson Education 2005.
2. Verilog HDL, Samir Palnitkar, Pearson Education 2005.
3. A Verilog HDL Primer, J Bhaskar, 2nd edition, B S Publications, 2007.
4. VHDL for Programmable Logic, Kevin Skahill Pearson Education, 2004.

Web Links:

1. https://nptel.ac.in/courses/117108040

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4102.2	Intelligent Control Techniques	3:0:0	3

Course Objectives:

1. Understand the basics of intelligent control techniques and their applications.
2. Design and implement fuzzy logic controllers.
3. Develop and train neural networks for control applications.
4. Apply genetic algorithms to optimize control system parameters.
5. Explore hybrid control systems combining multiple intelligent techniques.

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

1. Understand the fundamental concepts of intelligent control systems
2. Design and implement fuzzy logic controllers (FLCs)
3. Apply neural networks for control system design
4. Use genetic algorithms for optimization in control systems
5. Analyze and design hybrid intelligent control systems.

UNIT-I

Introduction to Intelligent Control: Introduction to traditional control vs. intelligent control, Characteristics of intelligent control systems, Basic elements and structure of an intelligent control system, State-space modelling, Applications: DC motor modelling, Temperature control system

UNIT-II

Fuzzy Logic Control: Introduction to fuzzy sets, fuzzy logic, membership function, and fuzzy operations, Fuzzy inference systems: Mamdani and Sugeno models, Design of fuzzy logic controllers (FLC), Applications of fuzzy logic in real-world control systems, Case study: Fuzzy control for temperature regulation, washing machine, motor speed control.

UNIT-III

Neural Networks in Control: Introduction to artificial neural networks (ANN), Architecture of neural networks: Perceptron, multi-layer perceptrons (MLP), Training algorithms: Back propagation, gradient descent, weight update iterations, neural network-based controllers, Applications: System identification, pattern recognition, Solar PV power forecasting, State-of-charge prediction in EV batteries.

UNIT–IV

Genetic Algorithms in Control: Introduction to evolutionary algorithms and genetic algorithms, Representation, selection, crossover, and mutation, Genetic algorithms for parameter optimization, GA Iterations, Hybrid GA-based control systems, Applications: Tuning PID controllers using genetic algorithms, optimization in energy systems.

UNIT-V

Hybrid Control Systems: Concept of hybrid control: Combining multiple intelligent techniques, Fuzzy-logic and neural network hybrid systems, Fuzzy-logic and genetic algorithm hybrid systems, ANFIS Hybrid Learning iterations, Applications: Adaptive control of drone flight path, Self-learning EV motor drive, and Grid-tied inverter with hybrid control.

Textbooks:

1. "Fuzzy Control Systems" by Witold Pedrycz and Andrzej Skowron.
2. "Neural Networks for Control" by Lipo Wang.

3. "Genetic Algorithms in Search, Optimization, and Machine Learning" by David E. Goldberg.

Reference Books:

1. "Intelligent Control Systems with MATLAB" by D. P. Atherton.
2. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
3. "Introduction to Genetic Algorithms" by S. N. Sivanandam and S. N. Deepa.

Software Tools:

- MATLAB/Simulink (for simulation of fuzzy logic, neural networks, and genetic algorithms).
- Python libraries such as TensorFlow and PyTorch for neural networks.

Web Links:

1. https://www.mathworks.com/products/matlab.html
2. https://www.tensorflow.org/
3. https://scikit-learn.org/

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4102.3	Distribution System Planning and Automation	3:0:0	3

Course objectives:

- To understand the fundamental concepts and need for distribution system planning.
- To familiarize components and layout of sub-transmission systems and distribution substations.
- To calculate voltage drops and power losses in various feeder arrangements.
- To learn the objectives, functions, and benefits of distribution automation in modern power networks.
- **Study** different communication protocols and data acquisition methods used in SCADA-based systems.

Course Outcomes: At the end of the Course the student shall be able to

1. Explain the concepts of distribution system planning and automation. (L2)
2. Explain substation layout and its influence on service area coverage. . (L2)
3. Analyze distribution network performance by voltage drop and power loss calculations(L4)
4. Analyze the communication requirements and RTU functionality for effective implementation of distribution automation. (L4)
5. Analyze the role of SCADA in monitoring and controlling distribution network operations. (L4)

UNIT-I

Distribution Systems Planning:

Introduction, Distribution system planning, Factors affecting system planning, Present distribution planning techniques, Distribution system planning in the future, Future nature of distribution planning, Central role of the computer in distribution planning, Impact of Dispersed Storage and Generation , Load characteristics, Load forecasting, Long term forecasting, Technological forecasting..

UNIT-II

Design of Sub transmission Lines and Distribution substations:

Sub-transmission, Distribution substations, Sub-station bus schemes, Sub-station location, Rating of distribution substation, Substation service area with ‘n’ primary feeders, Comparison of four and six feeder patterns

UNIT-III

Design Considerations of Primary and Secondary Systems:

Radial type and loop type primary feeders, Primary network, Primary feeder voltage levels, Primary feeder loading, Radial feeders with uniformly distributed load and non-uniformly distributed loads, Secondary voltage levels, Secondary banking, and Secondary networks-Secondary mains Voltage drops and power loss calculations- three phase balanced primary lines, non-three phase primary lines.

UNIT-IV

Distribution Automation:

Problems of existing Distribution System, Need for Distribution Automation, Characteristics of Distribution System, Distribution Automation (Objectives, Functions, Benefits), Communication Requirements for DA, Remote Terminal Unit (RTU) ,Network reconfiguration, Improvement in Voltage Profile, Capacitor Placement in Distribution System for Reactive Power Compensation

UNIT-V

SCADA SYSTEM

Introduction, Block Diagram, Components of SCADA, Functions of SCADA, and SCADA applied to Distribution Automation, Advantages of DA through SCADA, Requirements and Feasibility, DA Integration Mechanisms, Communication Protocols in SCADA Systems.

Text Books:

1. Dr M K Khedkar and Dr G M Dhole, “A Textbook of Electric Power Distribution automation”, University Science Press, 1st Edition 2011.
2. Turan Gonen , “Electric Power Distribution system Engineering”, CRC press, 3rd edition, 2014

Reference Books:

1. . A.S. Pabla, “Electric Power Distribution “ Tata Mc Graw-hill Publishing Company, 6 th edition, 2011
2. Control and Automation of Electrical Power Distribution systems by James North cote and Robert Wilson, CRC press, 1st edition 2006.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc22_ee35

2 NPTEL :: Electrical Engineering - Energy Management Systems and SCADA

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–PE4102.4	Hybrid Electric Vehicles	3:0:0	3

Course Objectives:

- To understand the advantages of electric and hybrid electric vehicles.
- To know various architectures of hybrid electric vehicles.
- To learn the power management of plug-in electric vehicles.
- To familiarize the different management strategies electric 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. Classify the different energy management strategies in electric vehicles (L4)
5. Explain different batteries and other energy storage systems (L2)

UNIT– I

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

UNIT–II

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

UNIT–III

Plug-in Hybrid Electric Vehicle: PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging, drive train structure, grid to vehicle.

UNIT–IV

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy management strategies

UNIT– V

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

TEXT BOOKS

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

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.
4. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.

WEBLINKS:

1. https://onlinecourses.nptel.ac.in/noc22_ee53/preview

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–SC4101	Embedded ARM Programming	0:1:2	2

Course Objectives:

1. To understand the ARM Cortex-M3 architecture and LPC1769 microcontroller peripherals.
2. To use port pins as input or output depending on the need with specific pin mode of operation
3. To Understand how to use timers for different purposes
4. To interface peripherals like PWM,ADC and DAC effectively
5. To establish serial communication using UART and SPI protocols for data exchange.

Course Outcomes

1. Analyze the use of GPIO pins for input and output operations including polling and interrupt handling.
2. Configure internal and external oscillators and generate precise time delays using software and timer peripherals.
3. Implement logic-based digital systems and waveform generation using DIP switches, timers, and PWM modules.
4. Apply the ADC and DAC modules in the LPC1769 for analog-to-digital and digital-to-analog conversion.
5. Implement serial communication using UART and SPI protocols for data exchange.

Description: Overview of ARM Cortex-M3 Architecture, LPC1769 Features, Pin Configuration and Block Diagram, Understanding GPIO Registers, Input/Output configuration, LPC1769 Timers overview, interrupt generation on match, stop or reset timer on match, Nested Vector Interrupt Controller (NVIC), PWM operation, configuring for single edge or double edge, LPC1769 ADC Block and Register Structure, UART register configuration, SPI Basics and Register Configuration.

Any 10 of the following Experiments are to be conducted:

(Conduct the following Experiments on LPC1769 ARM CORTEX M3 micro controller board)

1. Implement LED blinking with the help of GPIO pins using pooling and interrupt method.

2. Configure Clock source of controller with internal RC oscillator, Main Oscillator and generate a square wave of 1Hz using delay routine

3. Implement the logic gates using GPIO pins

4. Read 4-bit DIP switch and load correspond ON and OFF values from arrays and generate pulse width waveform accordingly using single Timer peripheral.

5. Read 4-bit DIP switch and load correspond ON and OFF values from arrays and generate pulse width waveform accordingly by using two timers with interrupt.

6. Using Internal PWM module of the ARM controller generate PWM output in single-edge controlled mode.

7. Using Internal PWM module of the ARM controller generate PWM output in double-edge controlled mode

8. Determine the digital output for given analog input using internal ADC of ARM Controller.

9. Interface DAC and Generate Triangular and Square Wave forms.

10. Interface a stepper motor and rotate in clockwise and anti-clock wise direction.

11. Transmit the ADC's digital output values over internal UART of ARM Controller.

12. Develop a program to initialize SPI in master mode and continuously transmit a fixed 8-bit data to a slave device

TEXTBOOKS:

1) Embedded Systems Fundamentals with ARM cortex-M based microcontrollers: A practical Approach, Alexander G. Dean.
2) A Beginner's guide to designing embedded system applications on ARM cortex-M microcontrollers, Ariel Lutenberg, Pablo Gomez, Eric Pernia.

REFERENCE BOOKS:

1) LPC1769 Reference Manual (User)

Web LINK:

- https://onlinecourses.nptel.ac.in/noc22_cs93

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–SC4102	FPGA Controller for Power Converters	0:1:2	2

Course Objectives:

- To introduce the fundamentals of FPGA architecture and its role in real-time digital control.
- To develop proficiency in VHDL/Verilog programming for signal processing and control logic.
- To understand the control principles of DC-DC converters, inverters and multi-level inverter using digital platforms.
- To impart practical skills in implementing closed-loop control systems using FPGA.
- To expose students to hardware interfacing, PWM generation, and real-time signal processing.
- To encourage students to design, simulate, and validate FPGA-based converter control projects.

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

1. Describe the structure and functioning of FPGAs for control applications.
2. Write and simulate VHDL/Verilog code for PWM generation and digital control.
3. Develop closed-loop control systems for converters (buck, boost, inverter) using FPGA.
4. Interface ADCs and sensors with FPGA for real-time feedback control.
5. Analyze performance of FPGA-based converter systems using simulation and testing.

Module 1: Introduction to Power Converters and FPGA

- Overview of Power Electronic Converters: DC-DC, DC-AC, AC-DC, AC-AC
- Basic concepts of FPGA: Architecture, CLBs, I/O blocks, LUTs
- FPGA vs Microcontrollers for power electronics

Module 2: FPGA Design Tools and Workflow

- Introduction to VHDL/Verilog
- Xilinx Vivado / Intel Quartus overview
- Simulation & synthesis process
- Test bench creation and waveform analysis

Module 3: PWM Generation using FPGA

- Basics of PWM, SPWM, SVPWM
- VHDL implementation of PWM
- Duty cycle control logic
- Multi-channel PWM for converter applications

Module 4: Closed-Loop Control using FPGA

- Introduction to PI/PID control theory
- Implementing digital control algorithms in VHDL
- Voltage and current feedback loop design
- Real-time data acquisition from sensors via ADCs

Module 5: FPGA Control of DC-DC Converters

- Control of buck, boost, buck-boost converters
- Modeling and simulation of DC-DC converters
- FPGA-based real-time control implementation
- Case study: MPPT for solar using boost converter

Textbooks:

1. Digital Design- Authors: M. Morris Mano and Michael D. Ciletti
2. FPGA Prototyping by VHDL Examples-Author: Pong P. Chu
3. Power Electronics: Converters, Applications, and Design- Author: Ned Mohan, Tore M. Undeland, William P. Robbins
4. Power Electronics: Devices, Circuits, and Applications- Author: Muhammad H. Rashid

Reference Books:

1. Designing with FPGAs and CPLDs- Author: Bob Zeidman
2. Advanced FPGA Design: Architecture, Implementation, and Optimization-Author: Steve Kilts.
3. Xilinx and Intel (Altera) FPGA User Manuals & Application Notes.
4. Digital Control of Electrical Drives with Embedded System-Author: Shaahin Filizadeh

Web Links:

1. https://archive.org/details/digital-design-5th-edition-m-morris-mano-and-michael-d-ciletti
2. https://archive.org/details/fpgabasedsystemd0000wolf
3. https://archive.org/details/fpgabasedsystemd0000wolf
4. https://archive.org/details/powerelectronics0000rash

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-SC4101.3	Photovoltaic System Design	1:0:2	2

Course Objectives:

- To identify solar panel systems, their components and connections for various loads
- To Perform site selection, Installation, maintenance, and safe operation of solar PV systems
- To identify various characteristics of solar battery
- To select various equipment's for solar PV system
- To calculate the losses in Grid-Connected PV System

Course Outcomes (COs): After the completion of the course, students will be able to

1. Demonstrate the ability to identify PV module specifications and experimentally determine their electrical characteristics and operating parameters.
2. Evaluate the performance of photovoltaic modules by determining Maximum Power Point (MPP), Fill Factor (FF), efficiency, and analyzing I–V and P–V characteristics.
3. Design and implement photovoltaic system components, including PV array configurations, charge controllers, and DC–DC converters with MPPT techniques.
4. Compare the performance of different MPPT algorithms and assess the operation of standalone and grid-connected photovoltaic systems through experimentation and simulation.
5. Model, simulate, and interpret the performance of photovoltaic systems using MATLAB/Simulink to support the design and optimization of renewable energy systems.

Any TEN of the following Experiments are to be conducted

1. Study of Solar Photovoltaic (PV) Modules and Their Specifications
2. Determination of Maximum Power Point (MPP), Fill Factor, and Efficiency.
3. Determination of I–V and P–V Characteristics of a Solar PV Module/cell
4. Connection of PV Module (Series and Parallel Circuit)
5. Performance Analysis of PWM and MPPT Charge Controllers.
6. Design of solar PV boost converter using P&O MPPT technique.
7. Performance Comparison of Perturb & Observe (P&O) and Incremental Conductance MPPT Algorithms
8. Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System.
9. Modeling and Simulation of a Solar PV Cell
10. Simulation of Grid-Connected Solar PV System
11. Simulation of Off-Grid Solar PV System with Battery Storage
12. Simulation of a Solar PV System with MPPT Using MATLAB/Simulink.

Open ended experiments:

1. Design and Performance Evaluation of an IoT-Enabled Smart Solar PV System
2. Design and Optimization of a Solar PV System for a Real-World Application

TEXT BOOK:

1. Chetan Singh Solanki ,Solar Photovoltaic Technology and Systems: A Manual for Technicians,Trainers and Engineers, PHI Learning Publications, 3rd Edition, 2015
2. SAM Ver. 2.0 User guide - https://www.nrel.gov/docs/fy08osti/43704.pdf

REFERENCES:

1. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning Publications, 3rd Edition, 2015
2. Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and Francis Group Publications, 3rd Edition, 2010(CRC Press Reprint – 2018)
3. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems, Academic Press, (Elsevier) 2nd edition, 2014.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee71/preview

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-SC4101.4	Electric Vehicle Technology	1:0:2	2

Course objectives:

- Understand the fundamental concepts, architecture, and design calculations of electric vehicles.
- Analyze and simulate power electronic converters and inverter systems used in EV applications.
- Model and evaluate electric drive systems (BLDC/PMSM) and their control strategies using MATLAB/SIMULINK.
- Develop and simulate battery systems, including charging techniques, SoC estimation, and cell balancing methods.
- Design and analyze integrated EV subsystems such as BMS, EV chargers, and grid-interactive systems (V2G/G2V)

Course Outcomes (COs): After the completion of the course, students will be able to

1. Apply fundamental knowledge to perform design calculations and basic modeling of electric vehicle systems
2. Analyze and simulate power converters and inverter-based systems for EV applications.
3. Design and implement control strategies for electric drives (BLDC/PMSM) in simulation environment.
4. Evaluate battery performance, SoC, and implement charging/discharging and cell balancing techniques.
5. Develop and simulate integrated EV systems such as BMS, EV chargers, and bidirectional power flow (V2G/G2V).

Pre-requisites:

Introduction, components of electric vehicles, classification of electric vehicles, fundamentals of batteries and their design calculations for EV, PWM techniques, converters, inverters, state-of-charge for battery, battery management system, motors in electric vehicles, charging technologies-V2G, G2V.

Any 10 of the following Experiments are to be conducted:

1. Introduction to electric vehicle technology, fundamentals and the design calculations for EV.
2. Simulation of three – phase VSI with SPWM technique for grid integration in EV using MATLAB/SIMULINK.
3. Design of bidirectional battery circuit using Buck / Boost converter using MATLAB/SIMULINK.
4. Modeling and Simulation to calculate electric vehicle speed from motor torque
6. Speed control of electric vehicle using BLDC or PMSM in MATLAB/SIMULINK.
7. Simulation of regenerative braking system in PMSM for EV in MATLAB/SIMULINK.
8. Battery Charging from Solar PV using Buck Converter with MPPT /MATLAB Simulation.
9. Battery controller based on SoC for charging and discharging of battery in EV using MATLAB/SIMULINK.

10. Modeling and Simulation of passive cell balancing for lithium-ion batteries using MATLAB/SIMULINK.
11. Simulation of active cell balancing using fly back converter for Lithium Ion battery in MATLAB/SIMULINK for EV.
12. Modeling and Simulation of Battery Management System (BMS) using MATLAB/SIMULINK.
13. Modeling and Simulation of EV Charger (Battery Charger) using MATLAB/SIMULINK.
14. Simulation of bidirectional V2G, G2V Operation in Electric Vehicle charger using single phase model.

Open-ended Experiments:

1. Optimization of Electric Vehicle Powertrain Performance using MATLAB/Simulink
2. Design and Performance Analysis of an Electric Vehicle under Different Driving Cycles using MATLAB/Simulink

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-SC4101.5	PCB Design	1:0:2	2

Course Objectives:

- To design and fabricate PCB for prototyping as well as in Industrial Production environment.
- To learn the Power Supply Modules
- To study the different types of Rectifiers to design the circuit
- To know the Security Systems
- To Know the Design of an electronic printed circuit board for a specific application

Course Outcomes (COs): After the completion of the course, students will be able to

1. Understand the Proteus and other EDA tools for schematic creation, circuit simulation, and PCB layout design.
2. Design power supply modules (±5V, ±9V, ±12V, ±15V) with appropriate components, ensuring voltage, current, and safety requirements using Proteus for schematic and PCB layout design.
3. analyze half-wave and full-wave rectifiers, low-pass filters, and CE amplifiers, evaluating their performance using simulations.
4. Design the functional circuits like seven-segment displays, water level indicators, laser light security alarms, and proximity-based touchless doorbells.
5. Design circuits such as temperature detectors and time delay generators using NE555 timers, showcasing the ability to integrate components for specific applications.

Any 10 of the following Experiments are to be conducted:

1. Introduction to Proteus and EDA Tool Software
2. Design of a ±5V, ±9V, ±12V, and ±15V Power supply
3. Design and simulation of a Half and Full Wave Rectifier
4. Design of a PCB layout of Low pass filter
5. Design of a PCB layout of CE Amplifier
6. Design and Simulation of Simple 7 Segment Circuit
7. Design of simple water level indicator
8. Design of a Laser Light Security Alarm
9. Design of touch less doorbell using proximity sensor
10. Design of simple over temperate detector
11. Design of time delay generator using NE555
12. Gate driver circuit for MOSFET
13. Design led strip for 9-watt capacity

Open-ended Experiments:

1. Schematic Creation and simulation of an electronic circuit
2. Design of traffic light control for 4 way using Arduino

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,
2. Analysis and PCB Design", 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/
3. PCB Fabrication at home(video): https://www.youtube.com/watch?v=mv7Y0A9YeUc,
4. https://www.youtube.com/watch?v=imQTCW1yWkg

Course Code	Course Title	Hrs./Week L: T: P	Credits
R23EEE-SC4101.6	CAD for Electrical Engineering	1:0:2	2

Course Objectives:

- Develop proficiency in engineering drawing techniques using drawing instruments and CAD tools for electrical engineering applications.
- Understand and represent standard electrical symbols, wiring layouts, machine windings, substations, and power system components accurately.
- Interpret and prepare electrical engineering drawings as per standard practices and specifications.
- Enhance visualization, drafting, and design skills required for electrical installations, machines, and power system networks.
- Apply engineering drawing principles to communicate technical information effectively in electrical engineering projects.

Course Outcomes (COs): After the completion of the course, students will be able to

1. Draw basic geometrical shapes, curves, and standard electrical symbols using engineering drawing conventions.
2. Prepare electrical wiring diagrams, layouts, and control circuits for domestic and industrial applications.
3. Draw and interpret electrical machine constructional details, winding diagrams, and starter circuits.
4. Illustrate transmission towers, power system single-line diagrams, and substation layouts accurately.
5. Apply drafting standards and visualization skills to communicate electrical engineering designs effectively.

Any 10 of the following Experiments are to be conducted:

1. To draw the Basic shapes like lines, arcs, curves, shape filling.
2. To draw the Basic Electrical symbols.
3. To draw house wiring diagram and layout.
4. To draw the Electrical machine winding diagram.
5. To draw Transmission tower.
6. To draw construction feature of D.C motor.
7. To draw 3-point and 4-point D.C starters.
8. To draw lamps used in illumination.
9. To draw single line diagram of power system.
10. To draw Simple power and control circuit diagrams.
11. To draw the single line diagram of 33kV/11kV substation.
12. To draw the single line diagram of 11kV/415V substation.
13. To draw the transmission tower diagram for the given dimensions.

Open-ended Experiments:

1. Design and Simulation of a DC Power Supply
2. Smart Home Electrical Wiring
3. Design an illumination plan for a classroom or office or laboratory.

Text Book:

1. K. V. Natarajan, A Textbook of Electrical Engineering Drawing, Dhanpat Rai Publications.
2. Surjit Singh, Electrical Engineering Drawing, Dhanpat Rai & Co.
3. S. K. Bhattacharya, Electrical Engineering Drawing and Design, New Central Book Agency.
4. P. S. Gill, Electrical Drawing and Estimating, S. K. Kataria & Sons.
5. N. D. Bhatt, Engineering Drawing, Charotar Publishing House.

References:

1. Warren J. Luzadder and Jon M. Duff, Fundamentals of Engineering Drawing.
2. Thomas E. French and Charles J. Vierck, Engineering Drawing and Graphic Technology.
3. N. D. Bhatt and V. M. Panchal, Engineering Drawing.
4. Bureau of Indian Standards (BIS) – Electrical Symbols Standards.
5. National Electrical Code (NEC) – Electrical Drawing Symbols and Wiring Practices.

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23BSH-MC4101	Technical Paper Writing & IPR	2:0:0	0

Course Objectives:

- To build the knowledge on principles and characteristics of technical writing, including clarity, conciseness, and precision
- To formulate clear and focused research objectives and research proposal
- To outline the significance of Intellectual Property Rights
- To provide knowledge of Copyright and patent law, registration process and grants, protects in India and abroad
- To assess and maintain the protection of trademark and trade secret in the organization and also emerging trends in cyber security

Course Outcomes:

1. Develop the technical writing skills, evaluate sources and properly cite references using appropriate citation styles (L3)
2. Construct clear and focused research proposal that address a specific gap in the advancement of knowledge in their field of study (L2)
3. Assess needful elements, agencies responsible for Registration of Intellectual Property elements (L2)
4. Analyze Copyright subject matters, Patent requirements, Infringement and Litigation (L3)
5. Outline the registration Processes of Trade Mark and Legal procedures to prevent cyber-crimes (L2)

UNIT-I

Introduction to Technical Paper Writing:

Technical paper writing- Objectives- Components -Pre-requisites of good technical report- Format of technical report and its applicability- Significance of technical report and its applicability to end users-Types of technical writing.

Application: Apply while preparing user manual, technical reports, proposals, online help documentations, and scientific articles.

UNIT-II

Information and Communication of Technical paper writing:

7 C's of technical writing- Difference between technical writer and technical editor-Legal and ethical communication and its description in technical paper-Usage of contemporary technologies in technical paper writing.

Application: Analyze accurate information for ethical decision making process.

UNIT-III

Introduction to Intellectual Property Rights:

Introduction to Intellectual Property Rights – International Instruments and IPR - WIPO - TRIPS -Laws Relating to IPR - IPR Tool Kit - Agencies for IPR Registration – Emerging trends in IPR.

Application: Applicability and relativity between elements of Intellectual property rights and Creating innovative ideas.

UNIT-IV

Copyrights and Patents:

Introduction to Copyrights – Principles of Copyright Protection – Copy Registration Process - Subject Matters of Copyright – Right to Copy rights – Copyright Infringement - Patents – Patent Search - Patent Registration and Granting of Patent - Infringement of Patent — Patent Cooperation Treaty – New developments in Patents.

Application: Practice of copyrights case and Identification of the infringement, checking the eligibility for several patents and suggest remedies for problems through casestudy.

UNIT-V

Trademarks, Trade secrets and Cyber-crimes:

Introduction to Trademarks – Trade Mark Registration – Transfer of rights - Trademarks Claims and Infringement – Remedies- Trade Secrets – Physical Security – Employee Confidentiality Agreements – Breach of Contract – Trade Secret Litigation. Introduction to Cyber Law -Cyber Crimes - Prevention and Punishment.

Application: Compare and contrast different trademarks and know how to register trademark, Identify the physical protection of trade secret.

Contemporary Practices: E-filing Applications, Digital Piracy.

Text Books:

1. Fundamentals of IPR for Engineers- Kompal Bansal &Parishit Bansal, B. S. Publications,2013
2. Research Methodology-C.R. Kothari, Gaurav Garg, NEW AGE International Publishers,2019
   Intellectual Property -Deborah E.Bouchoux ,Cengage Learning, New Delhi.,2012

References Books:

1. Intellectual property rights- Prabuddha Ganuli., Tata Mcgraw hill, 2012.
2. Intellectual property rights M.Ashokkumar and Mohd.Iqbal Ali:, Serials Publications, 2015
3. Developing Research Proposals -English, Paperback, Denicolo Pam ,Sage South Asia edition,2012
4. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi,2015
5. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
6. Intellectual Property- Richard Stim, Cengage Learning, New Delhi, 2012.

Web links:

1. http://www.ipindia.gov.in/patents.htm
2. http://www.ipindia.gov.in/trade-marks.htm
3. https://copyright.gov.in/
4. http://www.wipo.int/portal/en/index.html
5. https://indiankanoon.org/

Course Code	Course Title	Hrs./Week L:T:P	Credits
R23EEE–MC4101	Power Systems & Simulation Lab	0:0:3	0

Course Objectives:

- To evaluate the Sequence Impedance of Transformer and Alternator.
- To determine ABCD Parameters of Transmission line.
- To analyze Load Flow Studies of Power System Network.
- To analyze performance characteristics of relays
- To detect the fault locations in underground cables

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

1. Determine the Sequence Impedance of Alternator and Transformer
2. Determine the Transmission Line Parameters
3. Design & Simulation of Load Flow Studies of Power System Network
4. Analyze performance characteristics of relays
5. Detect the fault locations in underground cables

Any 10 of the following Experiments are to be conducted:

1. Sequence Impedances of 3 Phase Transformer.
2. Sequence Impedances of 3 Phase Alternator by Fault Analysis.
3. Sequence Impedances of 3 Phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-Seidel method
6. Load Flow Studies using N-R method.
7. Determination of equivalent circuit of 3-winding Transformer.
8. Identification of fault locations in underground cables using Varley loop test.
9. Transient analysis of Single Machine Connected to Infinite Bus (SMIB).
10. Study of Bucholz relay for major and minor faults.
11. Study of IDMT Electro mechanical over current relay.
12. Study of Under voltage and over voltage Numerical relay.