DC	13242201	Electrical Machines-II	3-0-0

Course Objective:

- To develop basic concepts about AC machines, their constructional details and working principles and to understand the practical applications and operational issues of three phase transformer and other rotating machines

Unit I Three Phase Induction Motor-I: Constructional details. Principle of operation, Slip. Production of torque. Phasor diagram, equivalent circuit. Power flow diagram and Torque speed characteristics.

Unit II Three Phase Induction Motor-II: Starting methods, cogging and crawling losses, Efficiency, Double cage induction motor, Speed control, Rotor resistance control, pole changing method, Frequency control, Induction generator.

Unit III Three Phase Synchronous Machine-I: Constructional Features of Salient Pole and Non-Salient Pole Machines, Operation of Synchronous generator, Field Winding Arrangement Synchronous Reactance, Load Characteristics, Zero Power Factor Characteristics, Voltage Regulation by different methods, Power Angle Characteristics.

Unit IV Three Phase Synchronous Machine-II: Principle of operation of salient pole machines: Two reaction theory analysis, Slip test, regulation of salient pole synchronous generator, power-angle characteristics, synchronization and synchronizing power. Parallel operation and load sharing– effect of change in excitation, effect of change in power factor.

Unit V Synchronous Motor: Constructional features, Phasor Diagram, Torque and Power Relations in Non-Salient Pole and Salient Pole Motors, V-Curves, Various Types of Excitation, Methods of Starting using solid state devices, Synchronizing torque, power analysis under fault condition, Short circuit ratio, Synchronous Condenser, Applications of synchronous motor.

Text and Reference Books:

1. Theory of Alternating Current Machinery by Alexender S Langsdorf.
2. The performance and design of AC machines by M.G. Say,CBS Publication.
3. Electric machine by Nagrath and Khotari. TMH.
4. Electrical machines by P.S. Bimbhra, Khanna publication
5. The Performance and Design of AC Commutator Machines by Openshaw Taylor. CBS Publication

Course Outcomes:

After completion of this course, students will be able to:

CO1. **Explain** the constructional details and working principle of the three phase Induction Machine.
CO2. **Analyze** the performance of 3-phase induction and synchronous machines using equivalent circuits & phasor diagrams under different loading conditions.
CO3. **Calculate** voltage regulation of three phase synchronous machines
CO4. **Determine** time constant, various sequence reactance and equivalent circuit parameters under transient conditions for synchronous machines.
CO5. **Analyze** the effects of excitation and mechanical input on the operation of synchronous machines.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	2	2	-
CO2	3	3	3	3	2	3	2	2	1	1	2	2	-
CO3	3	3	3	3	2	2	1	1	1	1	2	2	-
CO4	3	3	3	3	2	2	1	1	1	1	2	2	-
CO5	3	3	3	3	2	3	2	2	1	1	2	2	-

DC	13242202	Power System Analysis	3-0-0

Course Objectives:

- To expose the students to the concepts of Load Flow Studies, Symmetrical and Unsymmetrical Faults, Power System Stability, Power System Control, Underground Cables and HVDC Transmission System.
- To enable the students to solve problems related to Load Flow Studies, Fault analysis, Power System Stability, Power System Control and Underground Cables.

Unit I System Representation and Load Flow Analysis: Single line representation, Per unit system, Network Model formulation, Formulation of YBUS, Formation of static load flow equations, solution of load flow problem by Gauss-Seidel, Newton-Raphson (polar and rectangular) and fast decoupled load flow methods. Impact of renewable integration on load flow analysis

Unit II Symmetrical and Unsymmetrical Fault: Review of symmetrical components, sequence networks, symmetrical fault analysis, unsymmetrical fault analysis, analysis of open conductor fault, fault calculations for symmetrical and unsymmetrical faults. Real-world fault scenarios in modern grids

Unit III Power System Stability: Basic concepts of steady state, dynamic and transient stability, power angle equation, synchronizing power coefficient, equal area criterion, critical clearing angle, Swing equation, Concept of multi-machine transient stability studies with classical machine representation, factor affecting stability and methods of its improvement. Effect of renewable energy sources on system stability, Stability enhancement techniques (Power System Stabilizer, FACTS)

Unit IV Power System Control: Elementary idea of load-frequency control, automatic generation control, reactive power and voltage control. Series and shunt compensation techniques, tap changing transformers, phase shifting transformers, Induction regulator, Economic limit of VAR control.

Unit V Modern Distribution Networks: Constructions, classification and applications, advantages and disadvantages of cable and HVDC Systems. Real time case study of distribution network: Feeders, Distributors, Load Scenario and critical areas etc., Basics of Geographic Information System (GIS), Real time case study of GIS for understanding its operations, advantages etc. (Dynamic Content; Dec. 2025)

Text and Reference Books:

1. Advanced Power System Analysis and Dynamics, L.P. Singh, Wiley Eastern Ltd, 6th Ed. 2017.
2. Modern Power System Analysis, Nagrath & Kothari, TMH Publishers, 4th Ed. 2016.
3. Elements of Power System Analysis, W.D. Stevenson, McGraw-Hill, 4th Ed. 2017.
4. Power system operation and control, A.J. Wood & Woollenberg, 2nd Ed. 2010.
5. HVDC Power Transmission Systems: Technology and System Interactions, K. R. Padiyar, New Age International, 3rd Ed. 2017.

Course Outcomes

After the completion of this course, students will be able to:

CO 1. **Apply** different load flow techniques to solve load flow problem.

CO 2. **Compute** the fault calculations for symmetrical and unsymmetrical faults.

CO 3. **Analyze** the theoretical and practical aspects of Power System Stability and its enhancement.

CO 4. **Explain** the automatic generation control reactive power, voltage control, series and shunt compensation.

CO 5. **Determine** the insulation resistance, capacitance of various types of cables and the need of HVDC transmission.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	3	3	-
CO2	3	3	3	3	2	1	1	1	1	1	3	3	-
CO3	3	3	3	3	2	1	1	1	1	1	3	3	-
CO4	3	3	2	3	3	1	1	1	1	1	3	3	-
CO5	3	3	2	2	2	1	1	1	1	1	3	3	-

DC	13242203	Power Electronics	3-0-0

Course Objective:

To provide fundamental knowledge of power semiconductor devices, passive components, and power conversion circuits (AC-DC, DC-DC, DC-AC), along with their applications. The course also introduces soft switching techniques and EMI considerations for advanced study in power electronics.

Unit I Power Semiconductor Devices: Classification of Power electronic switches, Power diodes, Transistors, Power MOSFET, IGBT, Thyristor TRIAC and GTO, Thyristor static and dynamic characteristics, two transistor equivalent model, Turn on and turn-off. Design of Firing circuits and protection, Series and parallel operation.

Unit II Controlled Rectifiers: Principle of phase-controlled converter operation, Single phase half wave, full wave and semi converters. Three phase half wave, full wave and semi converters and inverters, Power factor improvement, Symmetrical angle control. Pulse width modulation control.

Unit III Chopper: Principles of single quadrant, Two quadrant, four quadrant chopper, Control strategies, Pulse width modulation, Frequency modulation, Thyristor commutation schemes. **Inverter circuits:** Principle of operation of voltage source inverter, Single phase and three phase inverters, Voltage control using PWM technique, Current source inverters, Inverter applications.

Unit IV AC Voltage Controller: Principle of AC phase control, Single and three phase ac voltage controllers, **Cyclo-converter** circuits, Single phase to single phase, three phase to single phase, three phase to three phase output voltage control circuit, Cyclo-converter, Dual converters.

Unit V Recent Trends in Power Electronics: Bidirectional / Smart Grids & Grid-Interactive Converters, Power Electronics for Hydrogen Systems, Hybrid Energy Storage Integration, Power Electronics for Data Centers. (Dynamic Content; Dec. 2025)

Text and Reference Books:

1. Power Electronics by P.S. Bimbhra, Khanna Publishers,5th Ed., 2012
2. Power Electronics: Circuits, Devices & Applications by MH Rashid, Pearson, 5th Ed. 2012
3. Power Electronics by Cyril W. Lander, McGraw-Hill; 2ndEd.,1987
4. Power Electronics Principles and Applications by Josheph Vidyathil, TMH,2010
5. Bose, B.K., Handbook of Power Electronics, IEEE Publications.

Course Outcomes:

After completing this course, the student will be able to:

CO 1. **Explain** the structure, characteristics, and switching behavior of power semiconductor devices and their use in firing circuits and protection schemes.

CO 2. **Analyze** single-phase and three-phase controlled rectifier circuits and assess their performance under various load and control conditions.

CO 3. **Evaluate** chopper & inverter circuits, including their modes of operation, control strategies, and applications in switched-mode power supplies.

CO 4. **Compare** AC voltage controllers and cyclo-converters for various phase configurations and types, including dual converter operation.

CO 5. **Develop** simulations of grid-interactive systems and assess their stability under various grid scenarios.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	1	1	2	1	1	2	2	-
CO2	3	3	3	3	3	1	1	2	2	2	2	2	-
CO3	3	3	3	3	3	1	1	2	1	1	3	2	-
CO4	3	3	3	2	3	1	1	2	2	2	2	2	-
CO5	2	2	2	3	3	1	1	2	2	2	2	2	-

DC	13242204	Signals & Systems	3-0-0

Course Objectives

- To develop a thorough understanding of the fundamental characteristics of continuous-time and discrete-time signals and systems.
- To introduce time-domain, frequency-domain, and complex-domain analysis methods.
- To build the mathematical skills required to analyze and solve problems involving convolution, system modeling, filtering, modulation, sampling, and transform-domain techniques.

Unit I Dynamic Representation of Signals and Systems: Classification and Representation of Signals, Standard and Special Signals, System Characteristics and Attributes, Linear Time-Invariant (LTI) Systems, Convolution and System Response, Discrete-Time Special Functions, Realization of LTI Systems (differential and difference equations).

Unit II Fourier Analysis (Continuous-Time and Discrete-Time): Continuous-Time Analysis: Representation and properties of Continuous-Time Fourier Series (CTFS) and Continuous-Time Fourier Transform (CTFT), Parseval's Theorem. Discrete-Time Analysis: Representation and properties of Discrete-Time Fourier Series (DTFS) and Discrete-Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT).

Unit III Laplace Transform: Fundamentals of Laplace Transform, Region of Convergence (ROC), Properties of Laplace Transform, Inverse Laplace Transform, Poles, Zeros, and System Behavior, Application to Continuous-Time LTI Systems, Stability Analysis Using Laplace Transform.

Unit IV Z-Transform: Fundamentals of Z-Transform, Region of Convergence (ROC), Properties of Z-Transform, Inverse Z-Transform Methods, Poles, Zeros, and System Significance, Application to Discrete-Time LTI Systems, Stability Analysis Using Z-Transform.

Unit V Sampling and Wavelet Transform: A/D converters & D/A converters, Sampling Theorem, Sampling of Continuous-Time Signals, Signal reconstruction from samples, sampling in the frequency domain, sampling of discrete-time signals. Introduction and classification of Wavelet Transform, Motivation for time–frequency analysis. (Dynamic Content; Dec. 2025)

Text and Reference Books:

1. A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, Signals and Systems, Pearson Education, 2nd Edition, 1997.
2. Hwei P. Hsu, Signals and Systems, Schaum's Outlines, McGraw-Hill Education, 3rd Edition, 2014.
3. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson Education, 4th Edition, 2007.
4. Michael J. Roberts, Fundamentals of Signals & Systems, McGraw-Hill Education, 2nd Edition, 2010.
5. S.K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill Education, 4th Edition, 2011.
6. Stéphane Mallat, A Wavelet Tour of Signal Processing: The Sparse Way, Academic Press (Elsevier), 3rd Edition, 2008.
7. W.D. Stanley, Ray Dougherty, and Gary R. Dougherty, Digital Signal Processing, Prentice-Hall, 2nd Edition, 1983.

Course Outcomes:
After the completion of this course students will be able to:

CO 1. **Classify** continuous-time and discrete-time signals and system attributes for representing and modeling LTI systems.
CO 2. **Analyze** the spectral characteristics of periodic and aperiodic signals using Fourier series and Fourier transforms.
CO 3. **Apply** Laplace transform concepts to evaluate and interpret the behavior of continuous-time LTI systems.
CO 4. **Apply** Z-transform techniques to analyze discrete-time LTI systems and determine system stability.
CO 5. **Explain** the principles of sampling, A/D and D/A conversion, and basic wavelet concepts for signal processing applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	1	1	1	2	1
CO2	3	3	2	2	1	1	1	1	1	2	1	2	1
CO3	3	2	2	1	2	1	1	1	1	2	2	3	1
CO4	3	2	2	1	2	1	1	1	1	2	2	3	2
CO5	2	2	1	1	1	2	2	1	1	1	2	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

DC	13242205	Microprocessor & Microcontroller	3-0-0

Course Objectives

- To understand, compare, and analyze the architecture, instruction set, addressing modes, and operational concepts of microprocessors and microcontrollers.
- To apply, interpret, and design programming and interfacing solutions for developing real-time embedded applications using microprocessors, microcontrollers, and peripheral ICs.

Unit I 8085 Microprocessor : Architecture of 8085 Microprocessor, Pin Diagram and Pin Functions, Instruction Format and Types of Instructions, Addressing Modes of 8085, Instruction Set Classification (Data Transfer, Arithmetic, Logical, Branch, Stack & I/O Control), Timing Diagrams (Opcode Fetch, Memory Read/Write, I/O Read/Write, Machine Cycles & T-states), Assembly Language Programming:Simple arithmetic programs,Logical operations

Unit II 8086 Microprocessor: Architecture of 8086 (Internal structure, BIU & EU Data flow and execution unit functions) , Pin Diagram and Pin Functions (Minimum mode and maximum mode signals), Addressing Modes of 8086**,** Register Organization, Memory Segmentation, Interrupts of 8086 (Hardware and software interrupts ,Interrupt vector table,Priority and interrupt handling mechanism)

Unit III Interfacing ICS: Architecture and functional features of 8255 PPI, 8251USART, 8279 Keyboard display controller and 8253/8254 Timer/Counter, Interfacing with 8085, A/D and D/A converter interfacing.

Unit IV 8051 Microcontroller: Overview of 8051 architecture and internal components, Pin Diagram and Pin Functions, Addressing modes, Timers/Counters, Serial communication, Programming & Interfacing (Temperature control system, stepper motor control).

Unit V Advanced Trends in Microprocessors and Microcontrollers: High-Performance Microcontrollers, Serial & Wireless Communication Interfaces, Embedded System Integration, Real-Time Operating Systems (RTOS) Basics, Introduction to RISC-V Architecture. (Dynamic Content; Dec. 2025)

Text and Reference Books:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The PIC Micro Controller and Embedded Systems'.
4. A. K. Ray and K.M. Bhurchandani , 'Advanced Microprocessors and Peripherals', MHE.
5. Joseph Yiu – The Definitive Guide to ARM Cortex-M Processors (latest ARM topics).
6. P. P. Chu – Embedded Microcontrollers and Systems.
7. David Patterson & John Hennessy – Computer Organization and Design – RISC-V Edition (for modern trends).
8. Microcontrollers: Principles and Applications – Raj Kamal.
9. Embedded Systems: Real-Time Interfacing – Jonathan Valvano (for RTOS & IoT).
10. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.
11. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
12. Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009.
13. Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004.

Course Outcomes

After successful completion of the course, the students will be able to:

CO1. Explain the architecture, instruction set, and addressing modes of the 8085 microprocessor, and demonstrate basic assembly language programming.

CO2. Analyze the architecture, memory segmentation, and instruction formats of the 8086 microprocessor, and develop assembly programs using appropriate addressing modes.

CO3. Apply the concepts of peripheral interfacing by configuring and testing ICs such as 8255, 8251, 8279, and 8253/8254 with microprocessors.

CO4. Explains the architecture, timers, interrupts, and serial communication features of the 8051 microcontroller, and implement real-time control programs.

CO5. Analyze the architectures and interfacing techniques of microprocessors and microcontrollers in order to evaluate their suitability for various embedded system applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	1	2	1	3	1
CO2	3	2	2	1	1	1	1	1	1	2	1	3	1
CO3	3	3	2	2	2	1	1	1	1	1	2	3	2
CO4	3	3	3	2	2	1	1	1	1	1	2	3	2
CO5	3	3	3	2	2	1	1	1	1	1	3	3	3

1 - Slightly; 2 - Moderately; 3 – Substantially

MAC	13242211	Project Management, Economics & Financing	0-2-0

Course Objectives:

To provide knowledge about project attributes and planning essentials, develop project networks, make rational decisions for project completion, utilize resources effectively, and understand the basics of project finances and management.

Unit I Project Planning: Introduction to Project Management, Difference between Project and Production, Attributes of a Project: Time, Cost, Quality and Safety. Stakeholders of a Project, Project life cycle. Project Planning: Types of Project Plans and feasibility.

Unit II Project Network logic: Project Networking and work flows, Activity duration and methods of estimating activity duration – One time estimate three time estimates, Duration estimation procedure. Use of Bar Charts, Mile stone charts and networks, Network representation schemes: Activity on Arrow and Activity on Node Networks (A-o-A & A-o-N), Logic behind developing project network and simple network calculations, Critical paths and floats.

Unit III Decision making through networks: CPM, PERT & PDM: Use of network in Decision Making: Importance of critical path, Monitoring the progress and updating the project plan. Use of floats in Resource smoothening, Introduction to Precedence Diagramming Method (PDM), Different lag and lead relations in terms of SS(Start to Start), SF(Start to Finish), Finish to Start(FS), and Finish to Finish(FF) and composite relations.

Unit IV Project Cost Control: Breakeven analysis in planning stage, Direct and indirect cost, slope of direct cost curve, Total project cost and optimum duration, contracting the network for cost optimization. Escalation & Variation in prices.

Unit V Projects Financing: Introduction to project financing; Role of governments in financing projects, Funder and Concessionaire: Economic multiplier effects of Projects; Means of financing-public finance and private finance, Granting authority: World Bank Group, IMF,ADB, Micro and Small Enterprises Funding Scheme (MSME), Elementary understanding of Procurement of infrastructure projects through Public Private Partnership (PPP) route, Build Operate Transfer (BOT), Build Operate Own & Transfer (BOOT); Stakeholders' perspectives, Lifecycle of PPP projects, Micro & Macro economics concepts and its application in Project Financing.

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

CO 1. **Know** the attributes of project and its different phases.
CO 2. **Develop** the project network based on work breakdown structure and estimation of activity durations.
CO 3. **Analyze** the project network and make decide the various alternates.
CO 4. **Evaluate** the optimum cost of project for assigned deadlines.
CO 5. **Understand** the different options to arrange the finances to complete it within stipulated time.

Text and Reference Books:

1. Project Management Scheduling PERT and CPM by Dr. B.C. Punmia, K.K. Khandelawal
2. PERT & CPM Principles and Applications by L.S. Srinath, Affiliated EWP Pvt. Ltd.
3. Project Planning and Control by Albert Lester, Fourth Edition Elsevier Butterworth-Heinemann.
4. A Management Guide to PERT/CPM With GERT/PDM/DCPM and Other networks by Jerome D. Wiest, Ferdinand K. Levy, Prentice Hall.
5. Project Management with CPM and PERT by Joseph J . Moder, Cecil R . Phillips, Van Nostrand Reinhold Company

DLC	**13242206**	**Electrical Machines-II Lab**	**0-0-2**

List of Experiments

1. To conduct No Load & Blocked Rotor test on Three-Phase squirrel Cage Induction Motor and plot circle diagram.
2. To conduct a Load Test on Three-Phase Squirrel Cage Induction Motor and plot performance curve.
3. To conduct No Load & Blocked Rotor Test on Three-Ph Slip Ring Induction Motor and plot performance curve.
4. To conduct Load Test on Three-Phase Slip Ring Induction Motor and plot performance curve.
5. To perform the cascaded connection of two Three-Phase Slip Ring induction motor.
6. To find out OCC and SCC of an Alternator and its regulation using synchronous impedance method.
7. To compute voltage regulation of Alternator using Zero Power Factor (ZPF) method.
8. To draw V Curves of Synchronous motor.
9. To perform Synchronization of Alternators.
10. To determine the Xd & Xq of an alternator using Slip Test.
11. Virtual lab simulation of Conventional Electrical Machines.

Course Outcomes:

After the completion of the lab, the student will be able to –

CO 1. **Demonstrate** the ability to operate Electrical Machines and instruments relevant to the electrical engineering field

CO 2. **Collect** experimental data accurately and effectively

CO 3. **Integrate** theoretical knowledge from coursework into practical applications and experiments

CO 4. **Communicate** experimental results effectively through oral presentations and written documentation

CO 5. **Demonstrate** responsibility and professionalism in the completion of lab tasks and assignments

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	2	2	-
CO2	3	3	3	3	2	1	1	2	1	2	2	2	-
CO3	3	3	3	3	3	1	2	1	1	1	2	2	-
CO4	3	3	3	3	3	1	1	2	1	2	2	2	-
CO5	3	3	3	3	3	1	1	1	1	1	2	2	-

DLC	13242207	Power System Analysis Lab	0-0-2

List of Experiments

1. To calculate generalised circuit constants for short, medium, and long transmission lines.
2. To design and develop a small distribution network model and perform load flow case study using DIgSILENT PowerFactory.
3. To perform and analyze bus voltage profiles and line power flows under different loading conditions using DIgSILENT PowerFactory.
4. To determine the transient stability of a power system by observing the generator swing curve obtained from PowerFactory simulation.
5. Performance of Generator Capacity Planning and Peak Load Sensitivity Analysis Using Homer Grid Software.
6. To perform Techno-Economic Feasibility of Distributed Solar for Gwalior Feeder Stress Reduction.
7. To perform Simulation of Grid Outages for System Reliability Assessment using Homer Pro.
8. To perform seasonal and sensitivity load analysis for the power generation station.
9. Performance Evaluation and Comparison of Load Following, Cycle Charging, and Predictive Dispatch Algorithms using HOMER Pro.
10. A visit and study of 132kV Substation.

Course Outcomes:

After the completion of the lab, the student will be able to –

CO1. **Demonstrate** the ability to operate lab equipment and instruments relevant to the electrical engineering field

CO2. **Collect** experimental data accurately and effectively

CO3. **Integrate** theoretical knowledge from coursework into practical applications and experiments

CO4. **Communicate** experimental results effectively through oral presentations and written documentation

CO5. **Demonstrate** responsibility and professionalism in the completion of lab tasks and assignments

CO6. **Show** willingness to learn new techniques, tools, or methods to enhance practical engineering skills.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	1	1	3	1	1	1	1	2	3	2	2
CO2	1	1	1	1	3	1	1	1	2	1	3	2	2
CO3	1	1	1	1	3	1	1	1	2	1	3	2	2
CO4	3	3	3	3	3	1	1	2	1	2	2	2	1
CO5	3	3	3	3	3	1	1	1	1	1	2	2	2
CO6	3	3	3	3	3	1	1	2	1	2	2	2	2

DLC	13242208	Power Electronics & Drives Lab

List of Experiments

1. To observe the performance of SCR using R & RC triggering circuit.
2. To perform TRIAC triggering with series transistor-controlled ramp based on UJT/PUT
3. To determine the dv/dt capacity of SCR using Snubber Circuits.
4. To observe the performance of Half controlled bridge rectifier (semi converter) under different loading conditions
5. To observe the performance of a fully controlled bridge converter operates under rectification & inverter mode.
6. To perform the operation of an AC phase controller using R and RL load.
7. To observe the performance of a MOSFET based Buck Boost converter in open and closed loop.
8. To perform the operation of a single phase full wave controlled rectifier with DC motor load.
9. To perform the V/f control of three phase Induction Motor using Voltage Source Inverter (VSI).
10. Perform and analyze the Open loop speed control of DC Motor using chopper in all four quadrants.

Course Outcomes:

After completing the LAB course, the students will be able to

CO1. **Demonstrate** the ability to operate lab equipment and instruments relevant to the electrical engineering
CO2. **Collect** experimental data accurately and effectively in ethical manner
CO3. **Integrate** theoretical knowledge from coursework into practical applications and experiments
CO4. **Communicate** experimental results effectively through oral presentations and written documentation
CO5. **Demonstrate** responsibility and professionalism in the completion of lab tasks and assignments
CO6. **Show** willingness to learn new techniques, tools, or methods to enhance practical engineering skills

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	2	2	-
CO2	3	3	3	3	2	1	1	2	1	2	2	2	-
CO3	3	3	3	3	3	1	2	1	1	1	2	2	-
CO4	3	3	3	3	3	1	1	2	1	2	2	2	-
CO5	3	3	3	3	3	1	1	1	1	1	2	2	-
CO6	3	3	3	3	3	1	1	1	1	1	3	2	-

List of Macro Project-II

S.No.	Project Title	CO	Type	Short Description	Employability Skill Gained
1	Digital Thermometer Using LM35	CO1	Hardware	Measures temperature using LM35 + ADC.	Sensor interfacing, calibration basics
2	Error Calculation Toolkit	CO2	Software	Computes absolute, relative & percentage errors in measurements.	Data analysis, precision measurement
3	PMMC vs MI Performance Comparison	CO2	Hardware	Compare accuracy, torque & scale differences of meters.	Testing of electromechanical instruments
4	Wheatstone Bridge on Breadboard	CO2	Hardware	Measures unknown resistance using precision bridge method.	Precision measurement skills
5	Kelvin Double Bridge Simulator	CO3	Software	Virtual tool for low-resistance measurement.	Calibration & virtual measurement
6	3-Phase Power Measurement Display	CO3	Hardware	Measures real and reactive power in a 3-phase system.	Power system measurement
7	Arduino-based Voltmeter	CO3	Hardware	Simple digital voltmeter built using Arduino + LCD.	Embedded measurement development
8	PC-based Mini-Oscilloscope	CO4	Software	Uses PC sound card to visualize low-frequency signals.	Signal processing, waveform analysis
9	RTD Temperature Measurement	CO4	Hardware	Measures temperature using PT100 + signal conditioning.	Industrial temperature measurement
10	Strain Gauge Load Cell Demo	CO4	Hardware	Demonstrates strain measurement with Wheatstone bridge.	Mechanical sensing & bridges
11	LVDT Simulation in	CO5	Software	Models	Transducer modeling

	MATLAB			displacement vs induced voltage.	& simulation
12	Smart Energy Meter Prototype	CO5	Hardware	Energy monitoring with current sensor + microcontroller.	Smart metering & IoT integration
13	Frequency Measurement App	CO5	Software	Calculates frequency of periodic signals.	Signal frequency estimation
14	Harmonic Analyzer using FFT	CO5	Software	Computes THD and harmonic content.	Power quality & FFT analysis
15	Calibration Bench Setup	CO5	Hardware	Calibrates one instrument using another as reference.	Metrology & standards
16	Ohm’s Law Verification Kit	CO1	Hardware	Simple R-V-I measurement to verify Ohm’s law.	Electrical lab & testing skills
17	Series & Parallel Calculator	CO1	Software	Computes equivalent resistance for any combination.	Electrical computation & coding
18	Nodal Analysis Solver	CO1	Software	Solves node voltages automatically for user input.	Algorithmic circuit analysis
19	Mesh Analysis Demonstrator	CO1	Software	GUI-based mesh current solver.	Network analysis automation
20	Thevenin/Norton Equivalent Generator	CO1	Software	Calculates Vth, Rth and converts to Norton.	Circuit simplification & modeling
21	RLC Resonance Demonstration	CO2	Hardware	Shows resonance and bandwidth using RLC circuit.	AC signal interpretation
22	Mutual Inductance Demo	CO2	Hardware	Measures M using coupled coils.	Magnetic circuit understanding
23	Phasor Diagram Plotter	CO2	Software	Visualizes phase angles and RMS values.	Power systems visualization

24	RLC Transient Visualizer	CO3	Software	Shows step, impulse response of RLC circuit.	Transient system modeling
25	Pole–Zero Plotter for RLC Network	CO3	Software	Identifies poles/zeros for stability analysis.	Control & systems understanding
26	Two-Port Parameter Calculator	CO3	Software	Computes Z, Y, H, ABCD parameters.	Network parameter analysis
27	Unbalanced 3-Phase Load Analyzer	CO4	Software	Computes neutral shift, phase currents, line voltages.	Industrial 3-phase load analysis
28	Network Graph Generator	CO4	Software	Builds incidence, cut-set & tie-set matrices.	Graph theory application
29	Breadboard RLC Test Bench	CO2	Hardware	Build RL/RC/RLC circuits to study impedance.	Practical circuit assembly
30	AC Transient Measurement using DSO	CO5	Hardware	Observe sinusoidal startup response.	Oscilloscope handling
31	Binary Addition Calculator	CO1	Software	Adds binary numbers & shows step-by-step solution.	Logic & number system skills
32	Number System Converter App	CO1	Software	Converts decimal, binary, octal, hex.	Digital logic & coding
33	Logic Gate Truth Table Generator	CO2	Software	Generates truth tables for all logic gates.	Boolean logic automation
34	K-Map Minimizer	CO2	Software	Minimizes SOP/POS expressions using K-Maps.	Digital simplification techniques
35	LED-based Logic Gate Trainer	CO2	Hardware	Implement AND/OR/XOR using LEDs.	Hands-on digital electronics
36	4-bit Adder/Subtractor	CO3	Hardware	Add/subtract using logic ICs.	Combinational circuit design
37	7-Segment Display	CO3	Hardware	Convert binary to	Digital display

	Decoder			7-segment display output.	interfacing
38	Multiplexer/Demultiplexer Demo	CO3	Hardware	Shows 74153/74139 IC-based mux/demux.	Communication logic circuits
39	Encoder/Decoder Kit	CO3	Hardware	Encodes digital data & decodes back.	Data communication basics
40	SR/JK Flip-Flop Implementation	CO4	Hardware	Demonstrates memory element behavior.	Sequential circuit design
41	Mod-10 Counter	CO4	Hardware	Build a decade counter using 7490 IC.	Counter design & timing
42	Shift Registers (SISO/SIPO)	CO4	Hardware	Data shifting demonstration.	Sequential data handling
43	Basic Digital Clock	CO4	Hardware	Uses counters + 7-seg display.	Timing & clock circuits
44	TTL vs CMOS Comparison	CO5	Hardware	Measures propagation delay & power.	Logic family comparison
45	Verilog-based 4-bit ALU	CO5	Software	Implements ALU operations (AND/OR/ADD).	HDL programming & FPGA skills

CO Achievement Mapping by Subject & Project Range

Subject	Project Numbers	COs Achieved (Across All Projects in Group)	Remarks
Measurement & Instrumentation	1 – 15	CO1, CO2, CO3, CO4, CO5	All 5 COs are fully achieved through hardware & software projects.
Network Analysis	16 – 30	CO1, CO2, CO3, CO4,CO5	CO1–CO5 achieved through analysis, simulation & 3-phase projects.
Switching Theory and Logic Design (STLD)	31 – 45	CO1, CO2, CO3, CO4, CO5	Covers CO1–CO5 through combinational, sequential & Verilog projects.

Annexure-VII

Department of Electrical Engineering

List of the Courses to be opted for B. Tech. with Honors (Electrical Engineering)

(For students of the host department: Electrical Engineering)

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform**

Honours*(*to be opted by students of Parent Department*)		
Specialization 1: Control & Instrumentation	**Specialization 2: Power System & Energy**	**Specialization 3: Internet of Things (IoT)**
Programming, Data Structures and Algorithms using Python (08 Weeks)	Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems (12 Weeks)	Introduction to Internet of Things (12 Weeks)
Industrial Automation and Control (12 Weeks)	Power System Engineering (12 Weeks)	Programming, Data Structures and Algorithms using Python (08 Weeks)
Industry 4.0 and Industrial Internet of Things (12 Weeks)	Smart Grid: Basics to Advanced Technologies (12 Weeks)	Industry 4.0 and Industrial Internet of Things (12 Weeks)

Note: Permitted to opt for maximum two additional courses for the award of Honours or Minor Degree

List of the Courses to be opted for B. Tech. with Minor Specialization (Electrical Engineering)

(For students of the other department except Electrical Engineering)

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform**

Minor specialization * *(to be opted by students of Other Department)*	
Course Code	**Course Name**
	Fundamental of Power Electronics (12 Weeks)
	Measurement & Instrumentation (12 Weeks)
	Principles of Signals and Systems (12 Weeks)
	Sensors and Actuators (12 Weeks)
	Power System Engineering (12 Weeks)
	Network Analysis (12 Weeks)
	Control Engineering (12 Weeks)

Annexure-VIII

List of professional certification platforms

S.No	Course Name	Duration	Platform	Web Link	Employability Skill Gained
1	Introduction to Electronics	4 weeks	Coursera	https://www.coursera.org/learn/electronics	Foundation of electronic components & circuits
2	Basic Electronics	4 weeks	Coursera	https://www.coursera.org/learn/basic-electronics-odc	Analog circuit troubleshooting skills
3	Linear Circuits – DC Analysis	5 weeks	Coursera	https://www.coursera.org/learn/linear-circuits-dcanalysis	Circuit analysis capability (industry basic requirement)
4	Linear Circuits – AC Analysis	5 weeks	Coursera	https://www.coursera.org/learn/linear-circuits-ac-analysis	Power systems & AC signal understanding
5	Introduction to Power Electronics	6 weeks	Coursera	https://www.coursera.org/learn/power-electronics	Converter design & analysis skills
6	Converter Circuits	5 weeks	Coursera	https://www.coursera.org/learn/converter-circuits	SMPS & power converter design competence
7	Electric Power Systems	4 weeks	Coursera	https://www.coursera.org/learn/electric-power-systems	Utility grid operations & protection basics
8	Motors and Motor Control Circuits	6 weeks	Coursera	https://www.coursera.org/learn/motors-and-motor-control-circuits	Drives & motor control industry skills
9	Semiconductor Devices Specialization	3–4 months	Coursera	https://www.coursera.org/specializations/semiconductor-devices	Semiconductor industry fundamentals
10	FPGA Design for Embedded Systems	3 months	Coursera	https://www.coursera.org/specializations/fpga-design-embedded-systems	Digital logic & embedded hardware design
11	Tinkering Fundamentals – Circuits	3 weeks	Coursera	https://www.coursera.org/learn/tinkering-fundamentals-circuits	Hands-on electronics prototyping

12	Power Electronics Specialization	4–5 months	Coursera	https://www.coursera.org/specializations/power-electronics	Power converter simulation & design skills
14	Introduction to Power Semiconductor Switches	20 hours	Coursera	https://www.coursera.org/learn/introduction-to-power-semiconductor-switches	Power switch selection & design
15	Mathematics for Machine Learning	4 months	Coursera	https://www.coursera.org/specializations/mathematics-for-machine-learning-and-data-science	ML/AI foundation for engineering modeling
16	Battery Management Systems (BMS) Algorithms	122 hours	Coursera	https://www.coursera.org/specializations/algorithms-for-battery-management-systems	EV battery SOC/SOH estimation skills
17	Hands-on Internet of Things (IoT)	61 hours	Coursera	https://www.coursera.org/specializations/uiuc-iot	IoT hardware interfacing & communication
18	Programming the Internet of Things	30 hours	Coursera	https://www.coursera.org/specializations/iot	IoT firmware development
19	IoT Systems & Industrial Applications	40 hours	Coursera	https://www.coursera.org/specializations/iot-systems-and-industrial-applications-with-design-thinking	Industry 4.0 implementation skills
20	Data Science with Python	60 hours	NIELIT	https://www.nielit.gov.in/...	Data analytics for power & energy domain
21	Machine Learning Using Python	80 hours	NIELIT	https://www.nielit.gov.in/...	ML for signal & equipment monitoring
22	Introduction to Machine Learning (Intel)	64 hours	NIELIT	https://www.nielit.gov.in/...	Predictive maintenance skills
24	JavaScript Essentials (NetAcad)	40 hours	Cisco Networking Academy	https://www.netacad.com/courses/javascript-essentials-1	Web dashboards for IoT/AMI
25	Ethical Hacking Essentials	40 hours	Cisco Networking Academy	https://www.netacad.com/courses/ethical-hacker	Cybersecurity for smart grid

26	Ultimate Electrical Machines for Electrical Engineering	48 Hours	Udemy	https://www.udemy.com/courses/search/?src=ukw&q=electrical+engineering+8+week+courses	Various electrical machines
27	Ultimate Electrical Design and Fundamentals	48 Hours	Udemy	https://www.udemy.com/course/complete-electrical-theory-design-calculations/?couponCode=CP251118BG1	Practical Calculations and Guides for Electrical Installation Design
28	Electric and Conventional Vehicles	7 weeks	edX	https://www.edx.org/learn/engineering/chalmers-university-of-technology-electric-and-conventional-vehicles	Electric and conventional power trains work
29	Battery Electric Vehicles and Hybrid Vehicles	4 months	edX	https://www.edx.org/certificates/professional-certificate/chalmersx-battery-electric-vehicles-and-hybrid-vehicles	Calculating the performance and energy consumption of power trains
30	Circuits and Electronics 2: Amplification, Speed, and Delay	5 weeks	edX	https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and-electronics-2-amplification-speed-and-delay	Speed up digital circuits and build amplifiers in the design of microchips used in smart phones
31	Industrial Automation With PLC	17 Hours	Learn Vern	https://www.learnvern.com/industrial-automation-with-plc	Industrial automation with PLC programming
32	HVAC Course	17 Hours	Learn Vern	https://www.learnvern.com/course/hvac-course	HVAC system
33	Data Analysis with Excel for Complete Beginners	10 weeks	Future Learn	https://www.futurelearn.com/experttracks/data-analysis-fundamentals-with-excel	Data analysis from scratch, including an introduction to essential maths and Microsoft Excel
34	Fundamentals of Matlab and Simulink	4 weeks	Future Learn	https://www.futurelearn.com/courses/fundamentals-of-matlab-and-simulink	Matlab programming and Simulink modeling skills