Syllabus: B Tech III Semester

Fourier series, Matrices & Differential Equations: 13242101

Course Objective:

- To expose the concept of Fourier series, matrices and their properties, Eigen values and eigenvectors
- To expose the concept of ordinary and partial differential equations

Unit 1: Fourier Series: Introduction, Periodic functions: Even & Odd functions: Properties, Euler's Formulae for Fourier Series, Fourier Series for arbitrary and periodic functions, Dirichlet's conditions, Half Range Fourier Series, Harmonic analysis

Unit 2:Matrices-I: Types of Matrix, Hermitian and skew Harmition matrix, unitary matrix, Matrix Rank of a matrix by Echelon Form and Normal Form, Inverse of Non-singular matrix by elementary transformation, solution of system of Homogeneous and non-homogeneous equations by elementary transformation, Consistency of equation.

Unit 3:Matrices-II: Linear dependence of vectors,Eigen values and Eigenvectors with their properties, Cayley Hamilton theorem and its application to finding inverse of matrix, Diagonalization of a matrix.

Unit 4: Differential Equation: Ordinary differential equations of first and higher order, Linear higher order differential equation with constant coefficients, Homogeneous linear differential equation and Simultaneous differential equations.

Unit 5:Partial Differential equation: Linear and Non-Linear Partial differential equations of first and second order with constant coefficients, Separation of variable method, Application in solution of wave and heat conduction equations (one-dimensional).

Recommended Books:

1. E. A. Coddington:An Introduction to Ordinary Differential Equations, DoverPublications, (2006)
2. S. L. Ross: Differential Equations, Third Edition, Wiley, (2007)
3. I. N. Sneddon:Elements of partial differential equations, Dover Publications, (2006)
4. A. K. Nandakumaran and P. S. Datti: Partial Differential Equations, Classical Theory with a Modern Touch, Cambridge Presss, (2020).
5. Phoolan Prasad and RenukaRavindran: Partial Differential Equations, New Age International Publication (2011)

Course Outcomes

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

CO1. **Apply** Fourier series concepts to represent periodic functions and perform harmonic analysis**.**
CO2. **Solve** systems of linear equations using matrix operations and elementary transformations**.**
CO3. **Determine** eigenvalues, eigenvectors, and use the Cayley-Hamilton theorem for matrix diagonalization**.**
CO4. **Solve** ordinary differential equations of various orders and types including simultaneous equations.
CO5. **Solve** partial differential equations and model physical systems such as wave and heat conduction

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	1	1	3	3	1
CO2	3	3	2	2	2	1	1	1	1	1	1	3	3	1
CO3	3	3	2	2	2	1	1	1	1	1	1	3	3	1
CO4	3	3	3	2	2	1	1	1	1	1	1	3	2	1
CO5	3	3	3	3	3	1	1	1	1	1	1	3	2	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Data Structures :13242102

Course Objectives:

- To familiar the students with the use of data structures as the foundational base for computer solutions to problems,
- To familiar the students with various techniques of searching and sorting and basic concepts about stacks, queues, lists, trees and graphs.

Unit 1: Introduction to Data Structures: Algorithms & their Characteristics, Asymptotic Notations and complexity analysis, Array: Representations of Array, Index to Address Translation, Linked List: Introduction, Implementation of Linked List, Operations, and types.

Unit 2: Stack: Concepts and implementation of Stacks, Operations on Stack, Applications of Stack, Conversion of Infix to Postfix Notation, Evaluation of Postfix Expression, Recursion. Queue: Concepts and Implementation, Operations on Queues, Dequeue, Priority Queues, Circular Queues.

Unit 3: Trees: Types, Terminology, Binary Tree -Representations, Traversal, Threaded Binary Tree, Binary Search Tree, Height Balanced Tree-AVL Tree. Graph: Terminologies, Representation of Graphs-Sequential & Linked Representation, Graph Traversals- BFS, DFS, Spanning Trees.

Unit 4: Searching: Linear Search, Binary Search, Hashing and Collision Resolution Techniques; Sorting: Bubble Sort, Selection Sort, Insertion Sort.

Unit 5: Introduction to Advanced Data Structures: Real-world Applications (Big Data, AI, Cloud Computing, etc.), Hashing for Large-Scale Systems, Graph-Based Data Structures in Industry, Introduction to Concurrent and Distributed Data Structures etc.

Recommended Books

1. Data Structures, Algorithms and Applications in C++, SartajSahni, 2nd Edition.
2. An Introduction to Data Structures with Applications, Jean-Paul Tremblay, Mcgraw hill.
3. Data Structures & Algorithms, Aho, Hopcroft & Ullman, original edition, Pearson Publication.

Course Outcomes

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

CO1. **Analyze** algorithms using asymptotic notations and perform operations on arrays and linked lists.
CO2. **Construct** stacks and queues and use them to solve real world problems.
CO3. **Differentiate** between various tree structures and apply graph traversal techniques for problem solving
CO4. **Compare** various searching, sorting and hashing techniques.
CO5. **Identify** the applications of data structure in emerging areas and real world

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	1	1	1	1	1	2	-	2
CO2	3	2	3	2	2	1	1	2	1	1	2	2	-	2
CO3	3	2	2	2	2	1	1	1	1	1	1	2	-	2
CO4	3	2	1	2	2	1	1	1	1	1	1	2	-	2
CO5	3	2	2	2	2	1	1	2	1	1	2	2	1	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Electromagnetic Field Theory:13242103

Course Objectives:

- To provide the knowledge of electromagnetic fields and its use in understanding the working principles of various power apparatus and machines and to provide the basic concepts of vectors and fields, electrostatics, electric current flow, magnetic fields, Maxwell's equations, and electromagnetic wave propagation.

Unit 1: Overview of Coordinate System and Vector Calculus: Scalar and vector fields, overview of coordinate system, calculus of scalar and vector fields in Cartesian and curvilinear coordinates, Review of the concepts of gradient, divergence and curl.

Unit 2: Electrostatics-I: Coulomb's law, Electrical filed intensity, electric flux density, electric field due to point, line, sheet, spherical charge distributions, Gauss' law and its applications, Divergence and curl of electrostatic field, Energy expended in moving a charge in an electric field.

Unit 3: Electrostatics-I:: Electric potential, potential due to point, line, spherical charge distributions, potential gradient, Poisson's and Laplace' equations, Uniqueness theorem, Electric dipole, Dipole moment, potential and electric field due to an electric dipole, Torque on an Electric dipole in an electric field, resistance, capacitance, Dielectrics, Energy in electrostatic field, boundary conditions.

Unit 4: Magnetostatics: Biot-Savart's law, magnetic flux density, magnetic field intensity, magnetic field due to straight wire, surface, solenoid, toroid carrying steady current Ampere's Law and its applications, Divergence and curl of Magnetic field, Comparison of magnetostatics and electrostatics, Magnetic scalar and vector potentials, Lorentz force, inductance, self and mutual inductance of solenoid, toroidal and other simple configurations, energy in magneto static fields, boundary conditions.

Unit 5: Time Varying Fields: Equation of continuity, Faraday's law, Lenz's law, transformer emf and motional emf, inconsistency of Ampere's law, displacement current, electromagnetic waves and Maxwell's equations, Poynting theorem, energy in electro-magnetic fields.

Recommended Books:

1. Electromagnetic Fields by P.V. Gupta, Dhanpat Rai.
2. Element of Engineering Electromagnetic by N.N. Rao, PHI.
3. Engineering Electromagnetic by William H. Hayt; TMH.
4. Electromagnetic by John D. Kraus, TMH.
5. Electromagnetic wave & Radiating System by Jordan Balmian, PHI.
6. Electromagnetic Field by S.P. Seth, Dhanpat Rai & Sons

Course Outcomes

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

- **CO 1.** **Compute** gradient, divergence, and curl in various coordinate systems for scalar and vector fields.
- **CO 2.** **Analyze** electric field intensity, flux density, and field lines for point, line, and surface charges.
- **CO 3.** **Analyze** electric potential, dipole behavior, and energy storage in electrostatic fields using Poisson's and Laplace's equations.
- **CO 4.** **Determine** magnetic field intensity and inductance using Biot-Savart's and Ampere's laws for various current configurations.
- **CO 5.** **Apply** Maxwell's equations to solve problems involving time-varying electromagnetic fields, and evaluate energy flow using Poynting's theorem.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	2	1	1	1	1	1	3	1
CO2	3	3	2	2	1	1	2	1	1	1	1	1	3	1
CO3	3	3	2	2	1	1	2	1	1	1	1	2	3	1
CO4	3	3	2	2	2	1	2	1	1	1	1	2	3	2
CO5	3	3	2	2	2	1	2	1	1	1	1	3	3	3

Electrical Machines-I : 13242104

Course Objectives:

- To develop basic concepts of DC machines, their constructional details and working principles and applications.
- To familiarize the students with the single phase & three phase transformers

Unit 1: Single-Phase Transformers: Construction, principle of operation, E.M.F. equation, phasor diagrams; Equivalent circuit, determination of equivalent circuit parameters. Losses, separation of no-load losses, calculation of efficiency and regulation by direct and indirect methods, conditions for maximum efficiency. Concept of all-day efficiency. Parallel operation of transformers and Load sharing. Auto transformer: Principle of operation, saving of copper compared to two-winding transformer and applications.

Unit 2: D.C. Machines: Constructional features, parts of DC machines, Simplex and multiplex lap and wave windings; Methods of excitation, characteristics of saturated and un-saturated series, shunt, cumulatively and differentially compound excited machines operating as motors and generators, applications of DC machines; Armature reaction, demagnetizing and cross magnetizing ampere-turns, compensating windings, commutation process and methods of commutation, role of inter poles and compensating winding.

Unit 3: Speed Control of DC Motors: Speed control of shunt & series motors, losses in DC machines and calculation of efficiency. Need for starters and Starters for DC series shunt and compound motors. Testing of DC Motors: No-load test, load tests and regenerative tests such as Swinburne's Test, Direct load test, Hopkinson's test, Field's test and Retardation test. Calculation of efficiency based on all the above tests**.**

Unit 4: Three-Phase Transformers: Merits of three phase Transformers over three phase transformer bank Type of connections such as Delta-Delta, Delta-Star, Star-Delta, Delta-Star, V-V connection and T-T Connections. Relation between line and phase voltages and currents, Vector Groups, use of tertiary winding. Three phase to Two phase connections and vice-versa.

Unit 5: Special Machines: Energy Efficient Machines: Construction, Basic Concepts, losses minimization and efficiency calculations of Energy efficient AC machines. Super Conducting Machines: Construction, Principle of operation and basic concepts of superconducting AC machines.

Recommended Books:

1. Electric Machines by D.P. Kothari &I.J. Nagrath, Tata McGraw Hill
2. Electric Machines by Ashfaq Hussain, Dhanpat Rai & Company
3. Electric Machinery by A.E Fitzerald, Kingsley and S.D. Umans, McGraw Hill.
4. Electrical Machinery by P.S. Bimbhra, Khanna Publisher
5. Generalized Theory of Electrical Machines by P.S. Bimbhra, Khanna Publishers
6. Alternating Current Machines by M.G.Say, Pitman & Sons

Course Outcome (CO)

CO1. Explain the construction, working, and performance of single-phase and auto transformers, including efficiency and regulation**.**

CO2. Describe the construction, types, and characteristics of DC machines and their applications.

CO3. Analyze starting & speed control methods of DC motor and efficiency of dc machines using different test methods.

CO4. Identify different three-phase transformer connections and explain their operation and uses**.**

CO5. Compare the features and efficiency of energy-efficient and superconducting machines with conventional machine.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	1	2	2	-
CO2	3	3	3	3	2	3	2	2	1	1	2	2	2	-
CO3	3	3	3	3	2	2	1	1	1	1	1	2	2	-
CO4	3	3	3	3	2	2	1	1	1	1	1	2	2	-
CO5	3	3	3	3	2	3	2	2	1	1	2	2	2	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Generation, Transmission & Distribution of Electric Power: 13242105

Course Objectives:

- To expose the students with Transmission and distribution system, line parameters, performance of transmission lines, power plant economics and different types of tariffs.

Unit 1: Energy Resources and Electrical Power Generation: Introduction to Conventional and non-conventional energy resources; National and International energy trends; Global warming and greenhouse effects. Generation of electrical power, overview of conventional power generation: Hydro, Thermal, Nuclear and Gas Power; Renewable energy generation.

Unit 2: Transmission and Distribution Systems: Introduction, electrical supply system, comparison of AC and DC systems : conductor volume etc., overhead versus underground systems, choice of working voltages for transmission and distribution, transmission and distribution systems, Overhead line insulators, types of insulators pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings. Corona.

Unit 3: Line Parameters: Types of conductor, Inductance of a conductor due to internal flux, Inductance of a single phase & three phase transmission line, Self & mutual G.M.D., Inductance of three phase symmetrical and unsymmetrical spaced lines, transposed lines. Bundle conductors, skin effect, capacitance of single & three phase transmission line, effect of earth and charging current, transmission line communication and line interference.

Unit 4: Performance of Overhead Transmission Line: Single line diagram of power system, ABCD constant and equivalent circuits of short, medium and long transmission line, regulation and efficiency of short, medium, transmission line, Ferranti effect, surge impedance loading. Long transmission line, Generalized circuit equation relation between generalized circuit constant for simple network

Unit 5 Power plants Economics and Tariff: Size and number of generating units. Effect of load factor on cost of generation, Load curves, Maximum demand, Load factor, diversity factor, Plant capacity and plant use factor, type of tariffs and economics of power factor improvements.

Recommended Books:

1. Electric Power Generation, Transmission and Distribution by S.N. Singh, Prentice Hall of India, 2nd Edition.
2. Power system Analysis by A. Husain A, CBS Pub & Distributor.
3. Power System Analysis by B.R. Gupta B.R, S Chand & Co.
4. Electrical Power by S.L. Uppal, Khanna Publishers Limited, New Delhi.
5. Electrical Power Systems by C.L.Wadhwa, New Age International Publishers Ltd., New Delhi

Course Outcomes

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

- **CO 1.** **Analyze** various methods of electrical power generation
- **CO 2.** **Explain** the structure of transmission and distribution systems including the performance of insulators and corona phenomena
- **CO 3.** **Evaluate** the inductance and capacitance of transmission lines considering conductor configuration and spacing**.**
- **CO 4.** **Analyze** the performance of short, medium, and long transmission lines using ABCD constants including efficiency, regulation, and surge impedance loading.
- **CO 5.** **Analyze** power plant performance parameters and electricity tariff structures with respect to their economic implications**.**

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	1	2	3	2
CO2	3	3	3	3	2	3	2	2	1	1	2	2	3	2
CO3	3	3	3	3	2	2	1	1	1	1	1	2	3	2
CO4	3	3	3	3	2	2	1	1	1	1	1	2	3	1
CO5	3	3	3	3	2	3	2	2	1	1	2	2	3	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Cyber Security: 13242111
(Mandatory Audit Course)

Course Objectives

- To introduce the basic concepts of cybersecurity.
- To make students aware of various types of cyber threats, vulnerabilities, security policies and cybersecurity tools and to build basic skills for protecting information systems.

Unit 1: Introduction to Cyber Security: Overview of Cyber Security, Goals of Cyber Security (Confidentiality, Integrity, Availability), Types of cyber-attacks: Phishing, Malware, Ransomware, Social Engineering, Malicious Software. Hacker and its types. Real-world incidents and their impact, Cyber Ethics and Legal Aspects.

Unit 2: Basics of Networking: Internetworking devices, Topologies OSI and TCP/IP models, IP address, DNS, TCP, IP, HTTP, HTTPS, Web Browser, Web Server.

Unit 3: Security Mechanisms: Firewalls, Anti-virus, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS), Encryption and Decryption: Symmetric and Asymmetric, Cryptanalysis, Digital Signature, Authentication: Passwords, Biometrics, Multi-Factor Authentication.

Unit 4: System and Application Security: Operating System security basics. Securing mobile devices and apps. Web application vulnerabilities: SQL Injection, XSS, CSRF. Secure coding practices.

Cybercrime, Forensics, and Incident Response: Types of cybercrimes: Identity Theft, Financial Fraud, Cyberbullying. Basics of digital forensics. Cyber law and IT Act (India) overview. Incident response lifecycle and reporting.

Unit 5: Cyber Hygiene and Best Practices: Cyber hygiene: Safe browsing, regular updates, backups. Strong password creation and management. Social media safety. **Application of Cyber Security in Substations, Power Distribution Network, Electrical Power Market and Industries**, Power Grids: Challenges and **Opportunities**

Recommended Books

1. Raef Meeuwisse, Cybersecurity for Beginners, Wiley.
2. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India.
3. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, Pearson.
4. Chwan-Hwa (John) Wu and J. David Irwin, Introduction to Cyber Security, CRC Press.
5. Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short, Cybersecurity Essentials, Wiley.

Course Outcomes

After completion of the course students will be able to:

CO1. **Describe** the goals of cyber security, various types of cyber-attacks, categories of hackers, and ethical and legal frameworks with reference to real-world incidents.

CO2. **Explain** networking concepts such as OSI and TCP/IP models, internetworking devices, addressing schemes, and web communication protocols.

CO3. **Analyze** the use of firewalls, IDS/IPS, encryption techniques, and authentication mechanisms to secure data and systems

CO4. **Analyze** common system and application vulnerabilities and recommend secure coding and protection techniques against cyber threats.

CO5. **Apply** cyber hygiene best practices and security measures for individuals and organizations to prevent cyber threats and ensure safe digital behavior.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		2	1	2		3		2		2	1	1
CO2	3	2			2							1	1	1
CO3	3	2	2		3	1	1					2	1	1
CO4	3	3		3	3	2	1	2		1		2	1	1
CO5	2	1		2	2	3	2	3	2	2	1	3	1	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Annexure -2:
List of Experiments
&
List of Macro Project-I
(B. Tech III Semester)

Electrical Machines-I Lab: 13242106

LIST OF EXPERIMENTS

1. To Perform direct load test on single phase transformer
2. To perform parallel operation on two single phase transformers
3. To obtain magnetization characteristics of DC shunt generator
4. To obtain internal and external characteristics of DC shunt generator
5. To control the speed of DC shunt motor(Armature and Field Control)
6. To perform load test on DC shunt motor (Mechanically loaded)
7. To perform load test on DC compound motor (Electrically loaded)
8. To perform Scott connection ontwo1-phase transformer connections
9. To perform Y-Δ connection on three phase transformer
10. A virtual lab simulation of conventional electrical machines.

Course Outcomes:

At the end of the Laboratory work the students will be able to:

CO1. Conduct investigations through systematic performance of experiments.

CO2. Demonstrate ethical behavior and communicate effectively during viva sessions

CO3. Acquire teamwork skills for working effectively in groups

CO4. Prepare technical report on experiments conducted in the lab.

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2		2			1	1	2	3	-
CO2	3	3	3					3	2	3	1	2	3	-
CO3	3	3	3						3	2	1	2	3	-
CO4.	3	3	3			2				3	2	2	3	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Generation, Transmission & Distribution of Electric Power Lab: 13242107

List of Experiments

1. Study of EHV AC Transmission line simulation panel.
2. Measurement of resistance of EHV AC Transmission line simulation panel.
3. Measurement of inductance of EHV AC Transmission line simulation panel.
4. Measurement of capacitance of EHV AC Transmission line simulation panel.
5. Study of Insulators and line supports used in transmission anddistribution system.
6. Study of Cables used in transmission and distribution system.
7. A visit and study of 33 KV Substation.
8. Determination of 'Corona Loss' using MATLA/Python.
9. Performance computation of 'String Efficiency' using MATLAB/Python.
10. Performance Evaluation' of transmission lines using MATLAB /Python.
11. Hands on training on DIgSILENT Power Factory Software (for Education).

Course Outcomes:

At the end of the Laboratory work the students will be able to

CO1. Conduct investigations through systematic performance of experiments.

CO2. Demonstrate ethical behaviour and communicate effectively during viva sessions

CO3. Acquire teamwork skills for working effectively in groups

CO4. Prepare technical report on experiments conducted in the lab.

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2		2			1	1	2	3	-
CO2	3	3	3					3	2	3	1	2	3	-
CO3	3	3	3						3	2	1	2	3	-
CO4.	3	3	3			2				3	2	2	3	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Macro Project-I: 13242109

Tentative Macro Project List for the Upcoming Semester

S.No	Title	Type of Project	Applications
1	Smart Microgrid Design with Renewable Integration	Hardware and Software	Smart grids, Rural electrification, Research labs
2	Automated Solar Tracking System with IoT Monitoring	Hardware and Software	Solar farms, Energy optimization, Academic projects
3	Design and Optimization of a Home Energy Management System	Hardware and Software	Smart homes, Energy efficiency
4	Hybrid Energy System Using Solar and Wind for Rural Electrification	Hardware	Remote areas, Community power supply
5	Load Forecasting using Machine Learning for Smart Grids	Software	Utility companies, Research
6	Design of an Electric Vehicle Charging Station with Grid Feedback	Hardware and Software	Urban EV infrastructure, Smart cities
7	Battery Energy Storage System (BESS) for Smart Homes	Hardware	Home backup systems, Renewable energy
8	Power Quality Monitoring and Improvement Using FACTS Devices	Hardware	Power systems, Substations
9	Techno-Economic Analysis of Grid-Connected vs. Off-Grid Solar Systems	Case Study	Policy making, Project feasibility studies
10	Smart Transformer with Fault Detection and Self-Healing Capabilities	Hardware and Software	Smart grids, Substation automation
11	SCADA-based Automation System for a Manufacturing Plant	Hardware and Software	Industrial automation, Process control
12	Design of PLC-Controlled Conveyor Belt System	Hardware and Software	Factories, Material handling
13	Energy-Efficient Industrial Motor Control using VFDs	Hardware	Factories, HVAC systems
14	IoT-based Predictive Maintenance System for Motors	Hardware and Software	Industries, Smart maintenance
15	Design of a Smart Factory Using Industrial IoT (IIoT)	Hardware and Software	Industry 4.0, Automation
16	Wireless Sensor Network for Smart Agriculture	Hardware and Software	Precision farming, Environmental monitoring
17	LoRa-based Monitoring System for Remote Electrical Equipment	Hardware and Software	Remote monitoring, Utility management
18	IoT-based Smart Meter with Billing and Tamper Detection	Hardware and Software	Smart grid, Energy billing
19	AI-based Load Control System using Smart Switches	Hardware and Software	Home automation, Energy efficiency
20	Development of an Energy Dashboard for Smart Cities	Software	Smart city projects, Energy analytics
21	Thermal Management System for EV Battery Packs	Hardware	Electric vehicles, Battery safety
22	Wireless Charging System for Electric Two-Wheelers	Hardware	EV infrastructure, Charging innovation
23	EV Range Prediction using Real-Time Load and Terrain Data	Software	EV manufacturers, Navigation systems
24	Design of a Regenerative Braking System	Hardware	EVs, Transportation
25	Bidirectional Converter for Vehicle-to-	Hardware and	Smart grid, EVs

	Grid (V2G) Applications	Software	
26	Fault Detection in Power Systems using Deep Learning	Software	Power utilities, Grid automation
27	AI-Powered Load Shedding and Management System	Hardware and Software	Smart grid, Load management
28	Smart Energy Consumption Prediction using Time-Series Forecasting	Software	Utilities, Energy analytics
29	Image Processing-Based Automatic Electrical Meter Reading	Hardware and Software	Smart metering, Utilities
30	Machine Learning Model for Classifying Electrical Faults	Software	Grid protection, Fault diagnosis

Course Outcomes:

At the end of the Laboratory work the students will be able to:

CO1. **Identify** a real-world problem through literature review and requirement analysis.
CO2. **Apply** appropriate engineering principles and domain knowledge to propose a
CO3. **Develop** a functional prototype or working system using suitable tools and
CO4. **Collaborate** effectively within a team to accomplish project tasks and manage responsibilities.
CO5. **Demonstrate** professional ethics and effective communication through reports and presentations.
CO6. **Reflect** on the project outcomes to evaluate learning gaps and plan future improvements.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	1	1	2	2	2	2	2	2
CO2	3	3	3	2	3	2	2	1	2	2	3	2	2	2
CO3	3	2	3	3	3	1	2	1	2	2	3	2	2	2
CO4	2	2	2	1	2	1	1	1	3	3	3	2	2	2
CO5	1	1	2	2	2	2	1	3	2	3	2	2	2	2
CO6	2	2	2	2	2	1	1	1	2	2	2	3	2	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Annexure -3:

The list of courses for Self-learning/Presentation to be offered from SWAYAM/NPTEL/MOOC

(B. Tech III Semester)

Department of Electrical Engineering

The list of courses for Self-learning/Presentation to be offered from SWAYAM/NPTEL/MOOC

Course Name	Offered By	Duration of the course	Start date	End date	Url
Design and Simulation of Power Conversion using Open Source Tools	IISc Bangalore	4 Weeks	July 21, 2025	August 15, 2025	https://onlinecourses.nptel.ac.in/noc25_ee167/preview
Fundamentals of Electronic Device Fabrication	IIT Madras	4 Weeks	July 21, 2025	August 15, 2025	https://onlinecourses.nptel.ac.in/noc25_mm41/preview
Intelligent Feedback and Control	IIT Bombay	4 Weeks	August 18, 2025	September 12, 2025	https://onlinecourses.nptel.ac.in/noc25_ge57/preview
Python for Data Science	IIT Madras	4 Weeks	August 15, 2025	September 20, 2025	https://onlinecourses.nptel.ac.in/noc25_cs104/preview
C Programming and Assembly Language	IIT Madras	4 Weeks	July 21, 2025	August 15, 2025	https://onlinecourses.nptel.ac.in/noc25_cs114/preview
Strategic Communication for Sustainable Development	IIT Kharagpur	4 Weeks	July 21, 2025	August 15, 2025	https://onlinecourses.nptel.ac.in/noc25_mg140/preview
Gender Justice and Workplace Security	IIT Kharagpur	4 Weeks	August 18, 2025	September 12, 2025	https://onlinecourses.nptel.ac.in/noc25_mg131/preview
Water, Society and Sustainability	IIT Kharagpur	4 Weeks	July 21, 2025	August 15, 2025	https://onlinecourses.nptel.ac.in/noc25_hs144/preview

Annexure -4

List of Professional Certification Course (Platforms)

List of Professional Certification Course (Platforms)

S. No	Course Name	Duration (weeks/month/ hours)	Platform	Web Link
1.	Mathematics for Machine Learning and Data Science Specialization (3-course series)	4 months (93 Hours)	Coursera	https://www.coursera.org/specializations/mathematics-for-machine-learning-and-data-science
	• Linear algebra for Machine Learning	34hours		
	• Calculus for Machine Learning and Data Science	26 Hours		
	• Statistics for Machine Learning & Data Science	33 Hours		
2.	Algorithms for Battery Management Systems Specialization (5-course series)	**122 Hours**		https://www.coursera.org/specializations/algorithms-for-battery-management-systems
	• Introduction to battery-management systems	24Hours		
	• Equivalent Circuit Cell Model Simulation	27Hours		
	• Battery State-of-Charge (SOC) Estimation	27Hours		
	• Battery State-of-Health (SOH) Estimation	22Hours		
	• Battery Pack Balancing and Power Estimation	22Hours		
3.	Hands-on Internet of Things (4-course series)	**61 Hours**		https://www.coursera.org/specializations/uiuc-iot#courses
	• IoT Devices	12Hours		
	• IoT Communications	11Hours		
	• IoT Networking	20Hours		
	• IoT Cloud	18Hours		
4.	Introduction to Programming the Internet of Things (IOT)	3 Weeks 30 Hours		https://www.coursera.org/specializations/iot
5.	IoT Systems and Industrial Applications with Design Thinking	4 Weeks (40 Hours)		https://www.coursera.org/specializations/iot-systems-and-industrial-applications-with-design-thinking
6.	Certificate Course in Data Science using Python	60 Hours	NIELIT	https://www.nielit.gov.in/sites/default/files/PDF/Training/Short_Term_Courses/60%20hr%20Data%20Science.pdf
7.	Certificate Course in Machine Learning and AI Applications using Python	80 Hours		https://www.nielit.gov.in/sites/default/files/PDF/Training/Short_Term_Courses/80%20Hrs%20Machine%20learniing-01.pdf
8.	Introduction to Machine Learning (Joint Certification with Intel)	64 Hours		https://www.nielit.gov.in/delhi/sites

				/default/files/PDF/Training/Short_Term_Courses/Summer%20Training%20ADVT.%20JUNE%202025_rev4.pdf
9.	Data Analytics Essentials with Excel and Power Bi	60 Hours		https://www.nielit.gov.in/sites/default/files/PDF/Training/Short_Term_Courses/Advance%20Excel%20Power%20BI%2060%20Hrs..pdf
10.	JavaScript Essentials	40 Hours	Cisco Networking Academy	https://www.netacad.com/courses/javascript-essentials-1?courseLang=en-US
11.	Ethical Hacker	40 Hours		https://www.netacad.com/courses/ethical-hacker?courseLang=en-US