

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

I Year B. Tech. I Semester

(Common to EEE, EEE (EV))

Course Code:

L T P C

3 0 2 4

Course Outcomes:

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

CO1	Apply fundamental electrical laws and semiconductor concepts to analyze basic Electrical and Electronic circuits.
CO2	Explain the operating principles of AC circuits, Electrical Machines and Electrical Power Systems.
CO3	Understand Electrical Measurements, Analog and digital Electronic Devices.
CO4	Explain the principles of electrical protection and safety engineering practices.
CO5	Explain the fundamental concepts of emerging technologies such as smart grids, electric vehicles, embedded systems, VLSI Technologies.

Note: The syllabus is prepared to give basic concepts of Electrical and Electronics Engineering to First year students. Hence, in the evaluation, problems need to be avoided.

UNIT-I: PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING

10 Lectures

Electrical Fundamentals: Network elements, types of sources, Electrical quantities (SI Units), Voltage, Current, Power and Energy, Ohm's Law, Kirchhoff's Laws, Series and Parallel Circuits, Voltage and Current Division, Star (Wye)-Delta Transformation, source transformation.

Electronics Fundamentals: Conductors, Semiconductors and Insulators with examples, Energy Band Theory, Intrinsic and Extrinsic Semiconductors, operation and applications of the-PN Junction Diode, Zener Diode as a Voltage Regulator, BJT.

Learning Outcomes:

1. Learn network elements, types of sources, basic laws and source transformation (L2)
2. Understand the basic principles of electrical circuits (L3).
3. Understand the basic principles of electronic circuits (L3).

UNIT-II: AC CIRCUITS, ELECTRICAL MACHINES AND POWER SYSTEMS

10 Lectures

AC Fundamentals: Sinusoidal Alternating Quantities, Waveforms, Phase, Phase difference, RMS, Average and Peak Values of periodic functions, Single-phase AC Circuits, Power Factor, Balanced Three-phase Supply (Basic Concepts).

Electrical Machines: Magnetic circuits, Basic Principle of Operation, types and Applications - Transformer, DC Machines, Three-phase Induction Motor, Synchronous Machine, Single-phase Induction Motor.

Power Systems: Block Diagram of Power System Network, Generation of Electricity, Conventional-thermal, hydroelectric, nuclear and Renewable Energy Sources-Solar PV, Wind, Hybrid Energy Systems.

Learning Outcomes:

1. Understand Sinusoidal Quantities. (L3)

2. Understand the principle of operation of Electrical Machines. (L3)
3. Understand the basic structure and operation of a power system network. (L3)

UNIT-III: MEASUREMENTS, ANALOG & DIGITAL ELECTRONICS

10 Lectures

Measurements & Instrumentation: Ammeter, Voltmeter, Wattmeter, Energy Meter, Digital Multimeter, DSO and Function Generator.

Analog Electronics: Introduction, types and applications of Rectifiers, Filters, Transistor as Switch, Transistor as Amplifier, Operational Amplifier.

Digital Electronics: Number Systems, Logic Gates, Boolean Algebra, Universal Gates.

Learning Outcomes:

1. Understand the working principles and applications of electrical and electronic measuring instruments. (L3)
2. Analyze operation and applications of rectifiers, filters, transistors as switches/amplifiers, and operational amplifiers. (L4)
3. Understand number systems, Boolean algebra, logic gates, and universal gates to develop and simplify basic digital logic circuits. (L3)

UNIT-IV: PROTECTION AND SAFETY

10 Lectures

Wiring & Protection: Wiring Diagram (House, Godown and stair case), Fuse, MCB, MCCB, RCCB, Circuit Breakers, Relays.

Electrical Safety: Objectives of safety and security measures, Principles of Electrical Safety, Primary and Secondary Electrical shocks, Prevention of shocks, Safety Precautions, Necessity of Earthing, Fire Safety.

Learning Outcomes:

1. Understand wiring diagrams for house, godown and staircase wiring. (L3)
2. Understand appropriate electrical protection devices (L3)
3. Understand electrical safety and precautions. (L3)

UNIT-V: EMERGING TECHNOLOGIES

10 Lectures

Basic concepts of Smart Grids, Microgrids, Electric Vehicles (EVs), Battery Management Systems (BMS), Embedded Systems, VLSI, Industry 4.0.

Learning Outcomes:

1. Understand the concepts and applications of Smart Grid and Microgrids. (L3)
2. Understand the basics of EV charging and battery management systems. (L3)
3. Understand the applications of Embedded Systems, VLSI and Industry 4.0 in developing automated engineering systems. (L3)

TEXT BOOKS:

1. Vincent Del Toro, "Electrical Engineering Fundamentals", Pearson India, 2nd Edition 2015. (part of Unit-I, Unit-II)
2. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson publishers, 2018. (part of Unit-I, Unit-II & III).
3. S. Rao, Prof. H. L. Saluja, "Electrical safety, fire safety Engineering and safety management", 1st edition Khanna Publishers. New Delhi, 2016 Reprint. (Unit-IV).
4. S. Mohan Krishna, J.L. Febin Daya, Umashankar Subramaniam, Prajof Prabhakaran, and P.V. Brijesh, "Smart Grids and Microgrids: Technology Evolution", Wiley-Scrivener, 1st edition, 2022. (part of Unit-V).

5. J. Vijaychandra, D. Vijaya Kumar, Srinivasa Acharya and Nagalla Sowjanya, “Fundamentals of Electric Vehicles”, 1st Edition, 2026. (part of Unit-V).
6. Raj Kamal, “Embedded Systems- Architecture, Programming and Design”, 3rd Edition, McGraw Hill Education, 2017 (part of Unit-V).
7. Douglas A. Pucknell and Kamran Eshraghian, “Basic VLSI Design”, New Delhi, Prentice-Hall of India, 2003. (part of Unit-V).
8. Rishabh Anand, “Industry 4.0 Technologies”, S Chand and Company Ltd, 2025. (part of Unit-V).

REFERENCE BOOKS:

1. Fundamentals of Electric Circuits, C. K. Alexander and M.N.O. Sadiku, 7th Edition, McGraw-Hill, 2022. (Unit I and II)
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson publications, 11th edition, 2016 (Unit-I&III).

WEB RESOURCES:

1. <https://nptel.ac.in/courses/108105112>
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee175
3. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed85
4. <https://nptel.ac.in/courses/108106170>
5. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee84

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB

Prerequisites: Basic Physics

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

CO1: Identify electrical components, instruments, machines, batteries, wiring systems, used in electrical engineering laboratories.

CO2: Perform electrical measurements and verify Ohm's Law, KCL, KVL, and AC/DC circuit parameters using standard laboratory instruments.

CO3: Analyze the characteristics and applications of semiconductor devices, rectifiers, transistors, logic gates and photovoltaic cells.

CO4: Construct and test electrical wiring circuits and evaluate their operation following standard safety practices.

CO5: Evaluate the performance of electrical systems, batteries, measuring instruments, and renewable energy devices based on experimental results.

LIST OF EXPERIMENTS

(Any EIGHT Experiments shall be conducted)

Demonstration and identification of various electrical components and tools in a laboratory environment.

1. Component testing of elements (R, L, C, Diodes, Transistors)
2. Identification of the value of the given resistor using color code and Verification of Ohm's Law.
3. Verification of Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL).
4. Measurement of Voltage and Current in Series and Parallel DC / AC circuit.
5. Understand the measurement of signal parameters using Digital Storage Oscilloscope.
6. Study of Transformer, DC and AC machines.
7. Measurement of earth resistance by fall of potential method.
8. Determination of Insulation Resistance and Continuity test of wiring installation by using Megger.
9. Measurement of Energy using Energy meter
10. Wiring of lighting circuit using two-way switches for Stair case wiring and Godown Wiring
11. VI Characteristics of PN Junction Diode
12. Voltage Regulation using Zener Diode
13. Realization of Basic logic gates- AND, OR, NOT
14. I-V Characteristics of PV Cell for different irradiance.
15. Study of different types of Batteries
16. Demonstration of Solar, Wind and Hybrid Systems.
17. Demonstration of the Electric Vehicle System.

REFERENCES:

1. D. Jayachandra, “Electrical Engineering Workshop Practice Lab Manual”, Falcon Publications, 2007.
2. Participant Handbook for Assistant Electrician, National skill Development corporation-2023.