

| <b>Savitribai Phule Pune University</b><br><b>First Year of Engineering (2024 Pattern)</b><br><b>Course Code: ESC-101-ETC Course Name: Basic Electronics Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                |                                                                                     |
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| Teaching Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Credit                                                                         | Examination Scheme                                                                  |
| <b>Theory : 02 Hours/Week</b><br><b>Practical : 02 Hours/Week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>02</b><br><b>01</b>                                                         | <b>CCE : 30 Marks</b><br><b>End – Sem : 70 Marks</b><br><b>Term Work : 25 Marks</b> |
| <b>Prerequisite Courses, if any:</b><br>Basic Physics and Mathematics, Semiconductor Physics, Digital Electronics, Circuit Theory, Analog Electronics, Sensors and Transducers                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                |                                                                                     |
| <b>Companion Course, if any:</b> Laboratory Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                |                                                                                     |
| <b>Course Objectives:</b><br>1. To <b>understand</b> the working principles of PN junction diode and Special purpose diodes.<br>2. To <b>study</b> the operating principle and applications of Bipolar Junction Transistors & MOSFET.<br>3. To <b>learn</b> the concepts of various logic gates, digital circuits, Microprocessor & Controller.<br>4. To <b>understand</b> the concepts of Opamp, its applications and electronic Instruments.<br>5. To <b>know</b> the methods of measurement of physical parameters using sensors and transmission with the help of communication systems.                  |                                                                                |                                                                                     |
| <b>Course Outcomes:</b><br>On completion of the course, learner will be able to:<br><b>CO1: Know</b> about the working of P-N Junction diode and its application as rectifier & switch, basics of LED & Photodiode.<br><b>CO2: Understand</b> the working of BJT & MOSFET, their characteristics & compare.<br><b>CO3: Learn</b> logic gates & realization of the digital circuits.<br><b>CO4: Understand</b> the functioning of Opamp and electronic instruments.<br><b>CO5: Select</b> sensors based on their working principle for specific applications and its implementation with Communication system. |                                                                                |                                                                                     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                |                                                                                     |
| Unit I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Diodes and Applications                                                        | (06 Hours)                                                                          |
| Evolution of Electronics, Current trends in Electronics, Impact of Electronics in industry and society.<br>Introduction to active and passive components.<br><b>P-N Junction Diode:</b> P-N Junction diode construction and its working in forward and reverse bias conditions, V-I characteristics of P-N junction Diode, Diode as a switch, Half wave rectifier, Full wave and Bridge rectifier.<br><b>Special purpose diodes:</b> Light Emitting Diode (LED) and photo diode along with V- I characteristics and their applications.                                                                       |                                                                                |                                                                                     |
| #Exemplar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | LED TV, IR-Remote Controller, Rolling Displays, SMPS, Mobile & Laptop Chargers |                                                                                     |
| Unit II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Transistors and Technology                                                     | (06 Hours)                                                                          |

**Bipolar Junction Transistor:** Construction, type, Operation, V-I Characteristics in common emitter mode, BJT as switch and Common Emitter(CE) amplifier.

**Enhancement Metal Oxide Semiconductor Field Effect Transistors (EMOSFET):** Construction, Types, Operation, V-I characteristics, MOSFET as switch & amplifier. Introduction to VLSI Technology, Feature size/Channel Length, N Well method of VLSI CMOS manufacturing.

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|-----------|----------------------------------------------------------------------------|------------|
| #Exemplar | Audio Amplifier / PA System, CMOS ICs in Cell phone & Laptops, Pen Drives. |            |
| Unit III  | Logic Gates and Digital Circuits                                           | (06 Hours) |

**Number System:** Introduction of Binary, Decimal, Octal, Hexadecimal, Conversion of Binary to Decimal, Decimal to Binary, Binary addition.

**Logic Gates** - AND, OR, NOT, XOR, XNOR. Universal Gates – NAND, NOR. De-Morgan's theorem.

**Logic circuits** - Half & Full adders. SR, JK, T & D Flip Flops.

Introduction to Microprocessor and Microcontroller (Only block diagram and explanation). Digital IC design flow, IC Fabrication process flow.

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| #Exemplar | Memories in Cell Phone, Laptop, Pen drive, ECU in Advanced car, Automation in manufacturing using PLC, Arduino Boards. |            |
| Unit IV   | Operational Amplifier and Electronic Instruments                                                                       | (06 Hours) |

**Operational amplifier:** Functional block diagram of operational amplifier, Ideal & practical values of performance parameters, Op-amp applications: Inverting, Non-inverting amplifier.

**Electronic Instruments:** Block diagram of Digital Multimeter, Function Generator, Digital Storage Oscilloscope (DSO), DC power supply.

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| #Exemplar | Domestic Energy Meter, Battery Charging Station, ICU Monitor in Hospital. |            |
| Unit V    | Sensors and Communication Systems                                         | (06 Hours) |

**Classification of sensors:** Active /Passive Sensors, Selection Criteria/Characteristics of sensor. Motion Sensors (LVDT), Temperature Sensors (Thermocouple, RTD), Mechanical Sensors (Strain Gauge), Biosensors. Block diagram of IoT based Data Acquisition and Automation System.

**Communication Systems:** Block Diagram, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Cellular concept, Block diagram of GSM system.

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| #Exemplar | Digital Thermometer, Weighing Machine, Green House Automation in Agricultural, Home Automation. 4G & 5G Technology, Satellite Communication, Radar/Military Communication |  |
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#### List of Laboratory Experiments (Any 8 experiments from the given list)

|    |                                                                                  |  |
|----|----------------------------------------------------------------------------------|--|
| 1. | Electronic Components:                                                           |  |
|    | Study of Active and Passive components                                           |  |
|    | a) Resistors (Fixed & Variable), Calculation of resistor value using color code. |  |
|    | b) Capacitors (Fixed & Variable)                                                 |  |
|    | c) Inductors, Calculation of inductor value using color code.                    |  |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | d) Devices such as Diode, BJT, MOSFET, various IC packages<br>e) Switches & Relays                                                                                                                                                              |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Measurements using various measuring instruments:<br>a) Setup CRO and function generator for measurement of AC & DC voltages and frequency<br>b) Measure Voltage, Resistance using digital Multimeter. Also use Multimeter to check diode, BJT. |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | V-I characteristics of P-N Junction Diode (Study the datasheet of typical PN junction diode)                                                                                                                                                    |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rectifier circuits: Implement DC Regulated Power Supply using bridge rectifier & diodes.                                                                                                                                                        |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Build and test Common Emitter (CE) BJT Amplifier Circuit.<br>a) Calculate the Gain of CE Amplifier                                                                                                                                              |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Linear applications of Op-amp:<br>Build inverting and non-inverting amplifier using op-amp(Study the data sheet of typical Op-Amp741)                                                                                                           |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Test and verify the truth tables of:<br>a) Basic and Universal Gates (Study the datasheet of respective ICs)<br>b) Half & Full Adder                                                                                                            |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Study of transducers/sensor (Any3)                                                                                                                                                                                                              |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Build and test any circuit using BJT/MOSFET/Op-Amp/Logic Gates using any one sensor.                                                                                                                                                            |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Case Study of any one electronics appliances with block diagram, specification etc.                                                                                                                                                             |
| <p style="text-align: center;"><b><u>Guidelines for Instructor's Manual</u></b></p> <ul style="list-style-type: none"> <li>The instructor's manual is to be developed as a hands-on resource and reference.</li> <li>Copy of Curriculum, Conduction &amp; Assessment guide lines, List of Experiments to be attached.</li> </ul>                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                 |
| <p style="text-align: center;"><b><u>Guidelines for Student's Lab Journal</u></b></p> <p>The students Lab Journal should contain following related to every experiment –</p> <ol style="list-style-type: none"> <li>Title of the experiment</li> <li>Objective</li> <li>Apparatus with their detailed specifications.</li> <li>Brief theory related to the experiment.</li> <li>Connection diagram /circuit diagram.</li> <li>Observation table</li> <li>Sample calculations for one/two reading.</li> <li>Result tabl</li> <li>Graph and Conclusions.</li> </ol> |                                                                                                                                                                                                                                                 |
| <p style="text-align: center;"><b><u>Guidelines for Laboratory Conduction</u></b></p> <ul style="list-style-type: none"> <li>All the experiments (Any Eight) mentioned in the syllabus are compulsory.</li> <li>Use of open source software and recent version is to been courage.</li> </ul>                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                 |

### **Guidelines for Lab/TW Assessment**

- Continuous assessment of laboratory work is to be done based on overall performance.
- Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each laboratory assignment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.

### **Learning Resources**

#### **Text Books:**

1. Electronics Devices by Thomas. L. Floyd, 9th Edition, Pearson
2. Modern Digital Electronics by R. P. Jain, 4th Edition, Tata McGraw Hill
3. Electronic Instrumentation by H. S. Kalsi, 3rd Edition, Tata McGraw Hill
4. Sensors and Transducers by D. Patrnabis, 2nd Edition, PHI
5. Electronic Communication Systems by Kennedy & Davis, 4th Edition, Tata McGraw Hill
6. Mobile Wireless communication by M. Schwartz, Cambridge University Press

#### **Reference Books:**

1. Digital Fundamentals by Thomas. L. Floyd, 11th Edition, Pearson
2. Mobile Communication by J. Schiller, 2nd Edition, Pearson
3. Sensors Handbook, by S. Soloman, 2nd Edition.
4. CMOS Circuit Design, Layout & Simulation, by Baker, 2nd Edition, Wiley IEEE Press

#### **e-Books:**

1. <https://www.pearson.com/en-us/subject-catalog/p/electronic-devices-electron-flow-version/P200000001048>

#### **MOOC / NPTEL/YouTube Links:**

1. <https://nptel.ac.in/courses/117103063>
2. <https://nptel.ac.in/courses/117103064>
3. <https://archive.nptel.ac.in/courses/106/105/106105166/>

| <b>Savitribai Phule Pune University</b><br><b>First Year of Engineering (2024 Pattern)</b><br><b>Course Code: ESE-102-ELE Course Name: Basic Electrical Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                   |                                                                                          |
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| Teaching Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Credit                                                            | Examination Scheme:                                                                      |
| <b>Theory</b> : 02 Hours/Week<br><b>Practical</b> : 02 Hours/Week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>02</b><br><b>01</b>                                            | <b>CCE</b> : 30 Marks<br><b>End - Semester</b> : 70 Marks<br><b>Term Work</b> : 25 Marks |
| <b>Prerequisite Courses, if any:</b> Electric charges and fields, Coulomb's laws, Voltage, Potential, Current, Ohms law, Magnetism, EMF, Faraday's Laws, Alternating current, AC Generator, Power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                   |                                                                                          |
| <b>Companion Course, if any: Laboratory Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |                                                                                          |
| <b>Course Objectives:</b><br>To impart the fundamental knowledge of electrical engineering to all the students of various disciplines and give comprehensive idea about AC and D C circuit analysis, working principles and applications of basic electric machines. The aim is also to familiarize students with different wiring components, wiring schemes and electricity bill.                                                                                                                                                                                                                                                                                                        |                                                                   |                                                                                          |
| <b>Course Outcomes:</b><br><b>On completion of this course, learners will be able to:</b><br><b>CO1: Apply</b> Kirchhoff's Laws, Superposition theorem and network simplification techniques for DC circuit analysis.<br><b>CO2: Analyze</b> the magnetic circuit parameters, self-Inductance, mutual Inductance and Electromotive Forces (EMF's).<br><b>CO3: Calculate</b> AC quantities using mathematical equations, waveforms and phasor diagrams.<br><b>CO4: Compute</b> the voltage, current and power of the given 1-phase and 3-phase AC circuits<br><b>CO5: Understand</b> the working principle of 1-Phase Transformer, Motors (DC, Induction) and their practical applications. |                                                                   |                                                                                          |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                   |                                                                                          |
| Unit I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Elementary Concepts and DC Circuits                               | (06 Hours)                                                                               |
| <b>Elementary concepts:</b> Resistance, EMF, current, potential difference, Ohm's law. Overview of elementary power system showing stages such as Generation, Transmission, and Distribution of electrical energy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                   |                                                                                          |
| <b>DC Circuits:</b> Classification of electrical networks, simplifications of networks using series-parallel combinations and star delta transformation technique, Kirchhoff's Laws and their applications for network solutions using loop analysis, Superposition theorem                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                   |                                                                                          |
| #Exemplar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Electric power system, Electrical Load Distribution box, Robotics |                                                                                          |
| Unit II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Electromagnetism                                                  | (06 Hours)                                                                               |
| <b>Magnetic Circuit:</b> Concept of flux density, field strength, permeability, MMF, reluctance, their units, and relationships. Simple series magnetic circuit, comparison of electric and magnetic circuit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                   |                                                                                          |
| <b>Electromagnetic Induction:</b> Faradays Laws of electromagnetic induction, Fleming's right-hand rule, statically and dynamically induced emf, self and mutual inductance, coefficient of coupling. Energy stored in magnetic field.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                   |                                                                                          |
| #Exemplar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Loudspeaker, Motor, Generator, Transformer                        |                                                                                          |