

## SEMESTER III

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

#### GENERIC ELECTIVE (GE – 4): INTRODUCTION TO ELECTRONICS

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisites
		Lecture	Tutorial	Practical		
INTRODUCTION TO ELECTRONICS  GE – 4	4	2	0	2	Passed 12 <sup>th</sup> Class	NIL

#### LEARNING OBJECTIVES

This paper aims to introduce fundamentals of electronics to students not majoring in physics. Basics of Analog and Digital Electronics are envisioned to be introduced with emphasis on applications of diodes, transistor (BJT), operational amplifier, 555 timer, number systems, basic gates and digital circuits.

#### LEARNING OUTCOMES

At the end of this course, students will be able to imbibe the following learning outcomes:

- This paper aims to describe the concepts of basic electronics in real-life. In this course, students will receive an introduction to the principle, performance and applications of basic electronic components.
- The students will gain an insight on the existence of analog and digital signals and their necessity. Specifically they would know the difference between active and passive electronic components including filters.
- Students will learn about diodes and its uses in rectification (analog) and switching properties thereof (digital). They will gain an insight into working principle of Photodiodes, Solar Cells, LED and Zener Diode as Voltage Regulator.
- They will gain an understanding of construction and working principle of bipolar junction transistors (BJTs). Specifically, they would understand the fundamentals of amplification.
- Students will be able to seamlessly understand and work on different numbers systems including binary, octal, hexadecimal besides decimal.
- They will learn about the existence of digital gates besides their need in electronic decision making thus laying the foundation for basic artificial intelligence.
- Students will learn the fundamentals of operation amplifier and their regular application including those used to sum, subtract and compare two or more signals.
- They will gain an in-depth understanding of working of Cathode Ray Oscilloscope which effectively acts as an electronic stethoscope for analysis of electronic signal in any laboratory.
- This paper will essentially connect the text book knowledge with the most common electronic components available that influence design of technology in a real world.
- The project component included in the practical section is envisaged to impart much

needed hands-on skill sets to the student. Therein he/she gets an experience in correctly choosing components required to build an electronic circuit, identifying the procurement source (online/offline) besides gaining valuable experience in trouble-shooting

## SYLLABUS OF GE - 4

### THEORY COMPONENT

#### **Unit – I (4 Hours)**

Analog and digital signals, Active and passive electronic components, RC integrator and differentiator (use as low pass and high pass filter): Qualitative analysis and frequency response.

#### **Unit – II (6 Hours)**

I-V characteristics of a diode and its applications as rectifier (Half and full wave rectifier configurations), Clipper and Clamper circuits (Qualitative Analysis only). Principle and working of Photodiodes, Solar Cells, LED and Zener Diode as Voltage Regulator.

#### **Unit – III (4 Hours)**

Input and output characteristics of a bipolar junction transistor (BJT) in CB and CE configurations, identifying active, cut-off and saturation regions. Transistor parameters alpha and beta, and relation between them. Application of BJT as a switch and an amplifier in CE configuration (Graphical Analysis)

#### **Unit – IV (6 Hours)**

Review of basic and Universal Logic Gates, Binary to decimal and Decimal to binary conversion, binary addition and subtraction using 2's complement, Half and Full Adder, Half and Full Subtractor using NAND Gates.

#### **Unit – V (6 Hours)**

Operational Amplifier (Black Box Approach): Pinout diagram of IC 741; Characteristics of Op-amp (Voltage Gain, offset voltage, slew rate, CMRR, Bandwidth, Input Impedance and Output Impedance). Open loop configuration and its application as a comparator and zero crossing detector. Closed Loop Configuration and its Applications as Inverting and Non-inverting Amplifier (Voltage gain using concept of virtual ground), Summing Amplifier and Subtractor

#### **Unit – VI (4 Hours)**

Block diagram of CRO, Voltage and frequency measurement. Pin-out diagram of IC 555 and its application as Astable Multivibrator

### **References:**

#### **Essential Readings:**

- 1) Electronic Devices, Thomas L Floyd; Pearsons Education
- 2) Op Amps and Linear Integrated Circuits, Ramakant A Gaekwad, Pearson Education
- 3) Microelectronic circuits, A. S. Sedra, K. C. Smith, A. N. Chandorkar, Oxford University Press
- 4) Electronic Principles, A. Malvino, D. J. Bates, 7<sup>th</sup> Edition, Tata Mc-Graw Hill Education, 2018

- 5) Electronic Devices and circuit theory, R. L. Boylestad and L. D. Nashelsky, Pearson Learning
- 6) Digital Principles and Applications, Donald P Leach, Albert Paul Malvino and Goutam Saha, Pearson Education, Tata Mc-Graw Hill.

**Additional Readings:**

- 1) Electronic Fundamental and Applications, John D Ryder; PHI Learning
- 2) Electronic Devices and Circuits, J. Millman and C. C. Halkias, Tata Mc-Graw Hill.

**PRACTICAL COMPONENT**

**(15 Weeks with 4 hours of laboratory session per week)**

Every student must perform either “04 Experiments and 01 Project” or “At least six experiments”

- 1) Voltage and frequency measurement using CRO
- 2) Study of RC circuits as an Integrator and Differentiator
- 3) IV characteristics for pn junction diode and Zener diode
- 4) Study of Zener diode as voltage regulator circuit
- 5) Study of transistor characteristics in CE configuration
- 6) Half Adder and Full Adder using NAND gates
- 7) Half Subtractor and Full Subtractor using NAND gates
- 8) Design Astable Multivibrator using IC 555
- 9) Study the Frequency Response of Op Amp in Inverting and Non Inverting configurations.
- 10) Study of zero crossing detector using Op amp IC 741
- 11) Addition of two dc voltages using OP Amp in inverting and non-inverting configurations.

**References (for Laboratory Work):**

- 1) An Analog Electronics Companion: Basic Circuit Design for Engineers and Scientists – by Scott Hamilton, Cambridge University Press
- 2) Practical Electronics – by Ralph Morrison, Wiley
- 3) Practical Electronic Design for Experimenters (ELECTRONICS) – by Louis E. Frenzel, McGraw Hill Education
- 4) Practical Electronics for Inventors – by Paul Scherz and Simon Monk, McGraw Hill
- 5) Analog Electronics with Op-amps: A Source Book of Practical Circuits (Electronics Texts for Engineers and Scientists) – by Anthony Peyton and Vincent Walsh, Cambridge University Press