

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BASIC ELECTRONICS

1<sup>st</sup> Year

Subject Code: 3110016

**Type of course:** Engineering Science

**Prerequisite:** High School Education & Physics

**Rationale:** Electronics is playing a key role in all engineering applications. All engineers should have basic knowledge of electronics. Purpose of this subject is make students familiar with basic electronics concepts. Students will be able to operate electronic test and measurement equipment like multi-meter, CRO, DC power supply and function generator.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

### Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Diode theory and applications</b> Basic idea about forward bias, reverse bias and VI characteristics, ideal diode, second and third approximation, surface mount diodes, Zener diode, Testing of diode with multi-meter, half wave rectifier, full wave rectifier, bridge rectifier, RC and LC filters, Design of un-regulated DC power supply, Clipping circuit, Clamping circuit, voltage multiplier circuit, Reading datasheet of semiconductor diode.	10	20%
2	<b>Bipolar junction transistors and its biasing</b> BJT operation, BJT voltages and currents, CE, CB and CC characteristics, DC load line and bias point, base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal stability, biasing BJT switching circuits, transistor power dissipation and switching time, Testing of bipolar junction transistor with multi-meter, Reading datasheet of BJT.	10	20%
3	<b>Special purpose diodes and transistors</b> Light emitting diode (LED). Zener diode, Zener diode circuit for voltage regulation, Photo diode, Solar cell, PIN diode, Varactor, Schottky diode, Varistors, Tunnel diode, Seven Segment display, Sixteen segment display, Identify segments on pin using multi-meter, Dot-matrix LED display, Photo	4	10%

	transistor, Opto-coupler, Reading datasheet of opto-electronics devices		
<b>4</b>	<b>AC Analysis of BJT circuits and small signal amplifier</b> Coupling and bypass capacitors, AC load lines, Transistor models and parameters, Common emitter circuit analysis, common base circuit analysis, common collector circuit analysis, Comparison of CE, CB and CC circuits, Transistor as a switch	<b>10</b>	20%
<b>5</b>	<b>Field effect transistors (FET) and its biasing</b> Junction field effect transistors(JFET), Comparison of BJT and FET, JFET characteristics, FET, Biasing in ohmic region and active region, Trans-conductance, amplification and switching, MOSFETs (D-type and E-type MOSFET), CMOS introduction, E-MOSFET amplifier. MOSFET testing, Reading datasheet for FET and MOSFET.	<b>10</b>	20%
<b>6</b>	<b>Digital Circuits</b> Basic gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Building AND, OR Gate with diodes, Digital logic families RTL, DTL, TTL, CMOS, Comparison of logic families	<b>4</b>	10%

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
<b>15 %</b>	<b>15 %</b>	<b>20 %</b>	<b>20%</b>	<b>15 %</b>	<b>15 %</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

- [1] David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth edition
- [2] Albert Malvino & David, "Electronic Principles", Tata McGraw-Hill, Seventh edition
- [3] R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education
- [4] Jaccob Millman, Chritos Halkias, Chetan D Parikh, "Integrated Electronics", Tata McGraw-Hill, Second edition
- [5] Albert Malvino & David, "Problems and Solutions in Basic Electronics, McGraw Hill Education

## Course Outcomes:

After learning the course the students should be able to:

- Obtain VI characteristics of semiconductor diode
- Design and test diode rectifier circuits
- Draw and observe waveforms of clamper and clipper circuits
- Understand transistor characteristics, configuration and biasing methods
- Compare transistor CE, CB and CC circuits
- Design, construct and test transistor amplifier circuit
- Plot characteristics of FET and MOSFET
- Test passive electronic components
- Use multi-meter to measure voltage, current and resistance
- Use CRO to observe waveforms and measure amplitude and frequency
- Use open source software like eSIM for simulation of basic electronics circuits

## List of Experiments:

(General guidelines.. Institute may change list of experiments)

- To measure DC voltage and current, AC voltage and current with multi-meter
- To observe waveforms on oscilloscope, measure basic parameters amplitude and frequency of sine wave and square wave.
- Obtain VI characteristics of semiconductor rectifier diode, LED, Photo-diode
- To observe waveform at the output of half wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To observe waveform at the output of full wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To observe waveform at the output of bridge rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To construct clamper circuits on breadboard and To observe waveforms at the output of clamper circuits
- To construct clipper circuits on breadboard and To observe waveforms at the output of clipper circuits
- Construct AND gate & OR gate with help of diode and verify truth table
- To obtain common emitter characteristics of NPN transistor
- To obtain common base characteristics of NPN transistor
- To obtain common collector characteristics of NPN transistor
- To design common emitter amplifier and construct circuit on breadboard. Measure gain at different frequencies and plot frequency response

- To understand working of transistor as a switch. To draw DC load line for given circuit.
- To observe input-output waveforms of common collector (CC) amplifier. To measure gain of amplifier at different frequencies and plot frequency response
- To obtain characteristics of field effect transistor (FET)
- To measure gain of FET common source (CS) amplifier
- Verify truth table of basic digital logic gates OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR
- To test individual circuit prepared by the student (Get circuit from the faculty, build it, draw circuit diagram and test it in the laboratory. Write test results in this practical)

**Design based Problems (DP)/Open Ended Problem:**

1. Design and test unregulated +12V DC power supply using transformer, bridge rectifier and capacitor filter.
2. Design +5V DC power supply, Current capacity 1A without using transformer
3. Design circuit to obtain +15V out of +5V
4. Design common emitter amplifier circuit to provide gain 20 dB
5. Design and test listening bug
6. Design and test electronic switch using transistor and electromagnetic relay

**Major Equipment:**

1. CRO
2. Function generator
3. DC Power Supply
4. Bread board and discrete electronics components

**List of Open Source Software/learning website:**

- <http://nptel.ac.in/syllabus/117103063/>
- <https://swayam.gov.in/course/3595-basic-electronics>
- eSIM available on FOSSEE website: <https://fossee.in/>