



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Bachelor of Engineering**

**Level: UG**

**Branch: ALL**

**Course / Subject Code: BE01000051**

**Course / Subject Name: Basic Electrical Engineering**

w. e. f. Academic Year:	2024-25
Semester:	I <sup>st</sup> Year
Category of the Course:	ESC

<b>Prerequisite:</b>	NA
<b>Rationale:</b>	Electricity has been the main source of energy for the developing and developed countries. Per capita consumption of electricity of a country can be considered as an indicator of the development of the country. In view of this, it is essential for all engineering graduates to know the basic aspects of electrical engineering. This subject deals with basic circuit solution methods, introduction to electrical machines and basics of domestic electrical installations.

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Apply fundamental electrical laws and circuit theorems to electrical circuits.	Application
02	Analyze single phase and three phase AC circuits.	Analyze
03	Describe operating principle and applications of static and rotating electrical machines.	Understand
04	Understand the wiring methods, electricity billing, and working principles of circuits protective devices and personal safety measures.	Read & Understand
05	Understand the electrical safety and purpose, types and scope of earthing systems	Read & Understand

### Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		Theory		Tutorial / Practical		
			C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

**Course Content:**

Unit No.	Content	No. of Hours	% of Weightage
1.	<b><u>DC Circuits:</u></b> Electrical circuit elements (R, L and C), voltage and current independent sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Star-delta/Delta-Star conversion, Time-domain analysis of first-order RL and RC circuits.	7	15
2.	<b><u>AC Circuits</u></b> Representation of sinusoidal waveforms, peak, RMS and average values of different signals, form factor and peak factor, Phasor representation of AC quantities, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Series and parallel resonances, Three phase balanced circuits, voltage and current relations in star and delta connections, Power measurement in three phase balanced circuits.	9	20
3.	<b><u>Magnetic Circuits &amp; Transformers</u></b> Magnetic effect of electrical current, cross and dot convention, right hand thumb rule and cork screw rule, Concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, Analogy between electric and magnetic circuits, Magnetic Circuits, B-H Curve, Hysteresis Loop, Hysteresis and Eddy current losses, Construction and working principle of single-phase transformers: Construction, principle of working, voltage and current ratios, losses, definition of regulation and efficiency, Ideal and practical transformer.	8	15
4.	<b><u>Fundamentals of Electrical Machines</u></b> Generation of rotating magnetic fields, Construction and working of Single-phase induction motors (Split phase, Capacitor start, Permanent split capacitor, Capacitor start/capacitor run). Single phase induction motor applications: pumps, refrigerators, fans, compressors, and portable drills. Construction and working of brushless DC motors and its application: Electrical Vehicle, washing machines, Blowers, Computers/Laptops	9	20

5.	<p><b><u>Electrical Wiring and Installations</u></b></p> <p>Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB.</p> <p>Types of lamps, fixtures &amp; reflectors, illumination schemes for domestic, industrial &amp; commercial premises, Lumen requirements for different categories.</p> <p>Earthing – Types of earthing and its importance.</p> <p>Safety precautions for electrical appliances.</p> <p>Types of Batteries, Characteristics of Batteries (Voltage, storage capacity, discharge curve, cycle life).</p> <p>Elementary calculations for energy consumption of home appliances and electricity bill.</p> <p>Basic electrical measurements with Ammeter, Voltmeter, Wattmeter and Energy meter (working principle and circuit connection).</p>	12	30
	<b>Total</b>	<b>45</b>	<b>100</b>

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

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	20	20	20	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

**References/Suggested Learning Resources:**

**(a) Books:**

- 1) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
- 2) Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press
- 3) B. L. Theraja, "Electrical Technology – Part I and II", S. Chand and Co. 2012
- 4) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
- 5) J. B. Gupta " Basic Electrical Engineering", S.K. Kataria & Sons,2023.
- 6) A Chakrabarti,S Nath and C K Chanda "Basic Electrical Engineering",TATA McGraw Hill,
- 7) S.L. Uppal "Electrical Wiring Estimating and Costing", Khanna Publisher, 1987
- 8) Irving M. Gottlieb ""Practical Electric Motor Handbook"Newnes,1997
- 9) L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
- 10) E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
- 11) V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

**(b) Open source software and website:**

1. <https://nptel.ac.in/>

**Suggested Course Practical List:**

- 1) Introduction of Resistors, Capacitors and Inductors and usage of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope.
- 2) To verify the Kirchoff's current and Kirchoff's voltage laws.
- 3) To verify the Thevenin's and Norton's theorems.
- 4) To verify Superposition's theorems
- 5) To obtain sinusoidal steady state response of R-L and R-C circuits – impedance calculation and verification phasor relationships between voltage and current and to observe the phase differences between current and voltage phasors
- 6) To obtain steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in DC input voltage (transient may be observed on a Digital Storage Oscilloscope)
- 7) To verify the phasor relationships between currents and voltages for resonances in R-L-C circuits
- 8) To measure the power in three phase balanced circuits using two wattmeter method
- 9) To verify the current phasor and voltage phasor relationships in three phase star and delta connections
- 10) Demonstration of cut-section models and charts of various machines
- 11) Demonstration of domestic switch gears like MCB, ELCB, MCCB etc. of different ratings
- 12) Understanding of various safety precautions for electrical installations
- 13) Demonstration of various types of wires, fuses and cables
- 14) To Calculate energy consumption of various appliances and house hold electricity bills
- 15) To verify the power factor improvement in single phase AC circuit
- 16) Study the different types of domestic wiring
- 17) To obtain Hysteresis loop of a magnetic material on CRO/DSO

**List of Laboratory/Learning Resources Required:**

Ammeters, Voltmeters, Wattmeters, Resistors, Capacitors and Inductors of appropriate rating. Multimeters, Digital storage oscilloscope, Cut section models/charts of various machines, Demo units for MCB, ELCB, MCCB etc, Samples of wires and cables. Charts for earthing and safety precautions.

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