GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: ALL
Course / Subject Code: BE01R00051
Course / Subject Name: Basic Electrical Engineering

w. e. f. Academic Year:	2024-25
Semester:	Ist Year
Category of the Course:	ESC

Prerequisite:	NA
Rationale:	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 / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

**** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**DC Circuits:** 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.	**AC Circuits** 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.	**Magnetic Circuits & Transformers** 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.	**Fundamentals of Electrical Machines** 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.	**Electrical Wiring and Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB. Types of lamps, fixtures & reflectors, illumination schemes for domestic, industrial & commercial premises, Lumen requirements for different categories. Earthing – Types of earthing and its importance. Safety precautions for electrical appliances. Types of Batteries, Characteristics of Batteries (Voltage, storage capacity, discharge curve, cycle life). Elementary calculations for energy consumption of home appliances and electricity bill. Basic electrical measurements with Ammeter, Voltmeter, Wattmeter and Energy meter (working principle and circuit connection).	12	30
	Total	**45**	**100**

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.

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.

- **List of suggested activities for Problem Based Learning:**

No.	Activity Name	Units Mapped	Hours	Brief Description	Evaluation Criteria/Remarks
1	Technical Video-Based Learning	Unit 1, 2, 3	10 (5+5)	Watch curated videos (e.g., NPTEL/MIT OCW) on DC circuits, AC power, Transformers. Submit a reflective report.	Report + Oral Presentation

2	Numerical Assignment Writing	Unit 1, 2, 3	10 (5 × 2h)	Solve 5 numerical assignments covering Theorems, Power factor, AC analysis, and Transformer calculations.	Correctness, method, clarity
3	Simulation & Problem Solving Using Software (Scilab, Tinkercad, LTSpice)	Unit 1, 2, 3	10 (5 × 2h)	Simulate basic circuits (RLC, transformer equivalent), transient analysis, and AC load behavior.	Report + Screenshot + Output sheet
4	Case Study: Domestic Wiring & Electricity Billing	Unit 5	5 (2.5+2.5)	Study household wiring layout and energy bills. Estimate load, usage, and suggest efficiency improvements.	Report + Practical Recommendations
5	Poster / PPT Preparation	Unit 4, 5	4	Topic examples: “BLDC Motor in EV”, “Earthing Methods”, “Difference between MCB & MCCB”	Technical clarity + Visual appeal + Presentation
6	Group Discussion / Seminar on Electrical Safety & Earthing	Unit 5	2	Discuss safety norms, role of protective devices, and earthing types.	Technical depth, articulation
7	Online Technical Quiz / Interactive Simulation (Electrical4U / vlab.co.in)	Unit 1 to 5	2	Attempt at least 3 online quizzes with screenshot of scores and a 100-word learning reflection.	Quiz scores + Reflection Note
8	Maintenance / Troubleshooting Logbook (Lab Based)	Unit 1, 2, 4, 5	2	Record at least 5 issues encountered during lab sessions and how they were resolved.	Clarity of issue, resolution steps
9	Annotated Concept Video (Optional – Higher Bloom’s level)	Unit 2, 3	Extra (Optional 5)	Make a 5–6 minute video explaining topics like phasor relationships or transformer working.	Clarity, technical accuracy, originality

10	Mini Project	Unit 1		1.Design & build a small DC lighting circuit for a room with switches & fuses, calculate load & test functionality. 2. Create a Portable Power Supply 3. Star-Delta Conversion Demonstration Board	1)Students design and wire a small DC circuit with multiple switches and a fuse. 2)Measure total current & voltage at different load configurations. 3) Document calculations & measurements 1)Design and build a small DC power supply (e.g., 6V/12V) using batteries, resistors, and regulators. 2)Test output voltage under varying loads. Mini-Project:Star-Delta Conversion Demonstration Board
11	Mini Project	Unit 2		Construct & test a power factor correction circuit using capacitors for a given inductive load	1) Build a circuit with inductive loads and capacitors to improve the power factor. 2) Measure before and after power factor.
12	Mini Project	Unit 4		Prepare a report on motors used in a household	Identify and document the types

				appliance (e.g., washing machine) and demonstrate working with a model or simulation	& ratings of motors used in 5–6 household appliances. 2)Suggest improvements for energy efficiency.
13	Mini Project	Unit 5		Design a safe, energy-efficient wiring layout for a small house/shop including earthing & protective devices	1.House Wiring Model Design and build a functional model of electrical wiring for a 1-room house with proper earthing & protection devices. 2.Energy Audit & Bill Calculation Measure energy consumption of typical home appliances and calculate monthly electricity bill. Suggest ways to reduce the bill. 3.Safety Demo Board Create a board demonstrating MCB, ELCB, MCCB operation with faulty & safe scenarios.

Unit-Wise Mapping

Unit	Topic	Relevant Activities
1	DC Circuits	Activities 1, 2, 3, 7, 8, 10
2	AC Circuits	Activities 1, 2, 3, 7, 8, 9, 11
3	Magnetic Circuits & Transformers	Activities 1, 2, 3, 9,

4	Electrical Machines	Activities 1, 5, 8,12
5	Electrical Wiring, Safety & Billing	Activities 4, 5, 6, 7, 8,13

Note:

- **All the suggested activity should be related to the subject.**
- **The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.**
- **Rubrics for the evaluation can be prepared by the faculty.**
- **All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.**
- **Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.**

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