BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

ES103: BASIC ELECTRICAL ENGINEERING
CREDITS - 4 (LTP:3,0,1)

Course Objectives:
Electricity is the basic requirement for all citizens of a Country. It is also very important for all sectors of Industry, Engineering and Infrastructure. In view of this, it is desirable for all discipline engineering graduates to know the fundamental concepts of electrical engineering. This subject deals with fundamental circuit analysis and solution methods, introduction to electrical machines, power converters and basics of domestic electrical installations.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory		Practical		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8
2	**AC Circuits**: Representation of sinusoidal waveforms, peak and rms values, phasor representation, 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), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.	8
3	**Transformers:** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	6
4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.	8

Unit No.	Topics	Teaching Hours
5	**Power Converters:** DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.	6
6	**Electrical Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6
	Total	**42**

Suggested Text / Reference Books

1. D.P. Kothari and I. J. Nagrath, "*Basic Electrical Engineering*", Tata McGraw Hill,2010.
2. D.C. Kulshreshtha, "*Basic Electrical Engineering*", McGrawHill,2009.
3. Ritu Sahdev, *Basic Electrical Engineering*, (ISBN: 9789386173492), Khanna Book Publishing Co.
4. B. L. Theraja, "*A Textbook of Electrical Technology*" - Volume I and II, S. Chand Publishers, 2012
5. L.S. Bobrow, "*Fundamentals of Electrical Engineering*", Oxford University Press,2011.
6. E. Hughes, "*Electrical and Electronics Technology*", Pearson,2010.
7. V.D. Toro, "*Electrical Engineering Fundamentals*", Prentice Hall India, 1989.

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments–voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve non-linearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging – slip-ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

9. Demonstration of (a) dc-dc converters (b) dc-ac converters –PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switch-gear.

Course Outcomes

At the end of this course the student will be capable:

1. To understand and analyze basic electric and magnetic circuits
2. To study the working principles of electrical machines and its applications
3. To analyze the performance of power converters
4. To understand and analyze components of low voltage electrical installations
5. To demonstrate and analyze the performance of electrical circuits and machines