

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: The students understand basic knowledge of Electrical circuit and network. To estimate value of voltage across or current through component of circuit/network. Solve the circuit using various theorems and methods. To design charging and discharging of capacitors for various applications. To analyse magnetic circuit and differentiate magnetic and electric circuits.

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able

1. To understand and apply the fundamental concepts of electricity, including current, voltage, resistance, energy, power, and efficiency.
2. To Apply Ohm's Law, Kirchhoff's Laws, and basic network theorems to solve DC electrical circuits.
3. To analyze the behavior and interrelationship of electrical components (resistors, capacitors, inductors) in various circuit configurations.
4. To understand and apply electrostatics, magnetism, electromagnetic induction, and their practical applications in electrical systems.

Pre-requisite of course: Basic knowledge of physics

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
2	2	2	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours	Weightage (%)
1	Basic Concepts of Electricity: • Introduction of electricity • Nature of electricity • Electric potential • Electric current • Electromotive force and potential difference Definition work, power and energy and it's units • Resistance, Specific resistance, Conductance, Conductivity • Conductors, Semiconductors, and Insulators • Computation of resistance of metallic and composite conductors • Effect of temperature on resistance • Temperature co-efficient of resistance • Effect of temperature on resistivity • Source of electric energy • Dependent and independent sources, its types • Basic concepts of voltage source and current source • Ohm's Law • Combination of resistance; Resistances in series, parallel, power rating of resistor, • Short and open circuits • Series-parallel combination of resistance • Star-delta and delta-star transformation • Electrical and mechanical work, power, energy, and efficiency • Thermal effect of electric current • Laws of electric heating	3	11
2	Electrical Circuit and Network Analysis: • Introduction • Network terminology • Kirchhoff's Law ; Kirchhoff's current law, Kirchhoff's voltage law, Solution of network by Kirchhoff's law • Mesh analysis and nodal analysis of network; • Maxwell's mesh / loop current methods • Types of electric circuits; Linear, Non-linear, Active and passive network • Network theorems; Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Duality in electric circuit	2	7

3	Electrostatics and Capacitance: • Introduction • Static electricity, Electric charge • Laws of electrostatics • Electric field, Electric lines of force, Electric field intensity, Electric flux and flux density • Absolute and relative permittivity • Coulomb's laws of electrostatics • Electric potential, potential difference and gradient, Potential at a Point, Potential due to charge • Dielectric strength • Gauss's theorem, Electrostatic induction Capacitor and capacitance, Permittivity, Capacitance of parallel plate capacitors, Factor affecting capacitors, Capacitance of Multiplate capacitor • Type of capacitors • Capacitors in series, parallel, Capacitors in series - parallel • Energy stored in capacitor • Rise and decay of voltage and current in RC circuit	9	32
4	Electromagnetism and magnetic Circuits: Introduction • Magnet, Important properties of a magnet, Classification of magnetic materials • Terms related to magnetic circuit; Pole Strength, Laws of magnetism, Magnetic field, Magnetic lines of force, Magnetic flux, Magnetic flux density, Magnetic field strength, Magnetic force, Electromagnet, Electromagnetism, Reluctance, Permeance, Permeability, Intensity of magnetization Susceptibility • Rules for magnetic circuit • Magnetic field of solenoid • Current carrying conductor in magnetic field • Force between two parallel conductor • Magnetic circuit; Composite magnetic circuits, Leakage factor, Fringing • Comparison between magnetic and electric circuit • Hysteresis loop; Importance of hysteresis loop	7	25

5	Electromagnetic Induction: • Introduction • Faraday's laws of electromagnetic induction • Induced E.M.F.; dynamically induced e.m.f, statically induced e.m.f., self-induced e.m.f and mutually induced e.m.f. • Fleming's right hand rule and left hand rule • Lenz's law • Self-inductance, mutual inductance • Co-efficient of coupling • Series and parallel connection of Inductor • Types of Inductor • Energy stored in magnetic field • Lifting power of magnet • Rise and decay of current in an inductive circuit	7	25
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Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
40%	40%	10%	10%	0%	0%

Suggested List of Experiments:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	Measure electrical quantities using voltmeter, ammeter, wattmeter and energy meter for given electrical network	2
2	1	Identification the value of given resistor using digital multimeter to confirm with colour code.	2
3	1	Verify Ohm's Law using voltmeter and ammeter.	2
4	1	Connect resistor in series and parallel combination on bread board and measure its value using digital multimeter.	2
5	1	Perform star to delta and delta to star conversion.	2
6	1	Perform Kirchhoff's current and voltage law.	2
7	2	Use voltmeter, ammeter to determine current through the given branch of electric network by applying node and mesh analysis.	2
8	2	Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.	2
9	2	Use voltmeter, ammeter to determine circuit parameter in a given circuit by applying Thevenin's theorem.	2
10	2	Use voltmeter, ammeter to determine circuit parameter in a given circuit by applying Norton's theorem.	2
11	2	Use voltmeter, ammeter to determine circuit parameter in a given circuit by applying Maximum power transfer theorem.	2
12	3	Identification and finding value of capacitor and connect capacitor in series and parallel combination on bread board and measure its value using digital multimeter.	2
13	4	Determine the permeability of magnetic material by plotting its B-H curve using Virtual lab.	2
14	5	Perform experiment of faraday's laws of electromagnetic induction using Virtual lab.	2

Suggested List of Tutorials:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	Tutorial – 1 Tutorial on Basic Concepts of Electricity	3
2	2	Tutorial – 2 Tutorial on Electrical Circuit and Network Analysis	2
3	3	Tutorial – 3 Tutorial on Electrostatics and Capacitance	9
4	4	Tutorial – 4 Tutorial on Electromagnetism and magnetic Circuits	7
5	5	Tutorial – 5 Tutorial on Electromagnetic Induction	7

Instructional Method:

- The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

References:

- B. L. Theraja, "A Text Book of Electrical Technology Vol-I", S. Chand & Co. Ltd., 2014
- Tarlok Singh, "Fundamental of Electrical Engineering", S. K. Kataria & Sons, 2012
- J. B. Gupta, "A Course of Electrical Technology Vol-I", Kataria & Sons, 2012
- S.K. Sahdev, "Fundamentals of Electrical Engineering & Electronics", Dhanpat Rai & Co. LTD., 2014
- U. A. Bakshi & V. U. Bakshi, "Basic Electrical Engineering", Technical Publication Pune, 2012
- R. Jadeja, T. Trivedi & A.Ved, "Elements of Electrical Engineering" Tata-McGraw-Hill, 2018
- U. A. Patel, "Elements of Electrical Engineering", Atul Prakashan, 2016

Supplementary Resources:

- <http://nptel.ac.in/courses/108108076/>
- <http://nptel.ac.in/downloads/108105053/>
- <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/>
- <http://www.electrical4u.com/nature-of-electricity/>