**Semester – I**

**Subject Name: DC Circuits**

**Subject Code: 09EE0101**

**Diploma Branches in which this subject is offered:** Electrical Engineering

**Objective:** To prepare the students to have a basic knowledge in analysis of electrical circuit/network and to estimate value of voltage across or current through component of circuit/network. To solve the given circuit with 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:** 6 Credits

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

1. To identify and differentiate various electrical components like resistor, inductor and capacitor etc.
2. To perceive significance of electrical components.
3. To compute current in different branches and voltage across the component using KVL and KCL theorem.
4. To apply different network theorem for calculation of unknown quantity (current, voltage) of electrical circuits and network.
5. To observe work of charging and discharging circuit for capacitor

**Pre-requisite of course:** Basic knowledge of physics i.e. electrical parameters and materials.

**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 | 0 | 4 | 6 | 50 | 30 | 20 | 25 | 25 | 150 |

**Contents:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit** | **Topics** | **Contact hours** | **Weightage (%)** |
| **1** | **Basic Concepts of Electricity:**  Introduction of electricity   * Nature of electricity   Modern electron theory   * Structure of an atom * Charged body, Unit of charge, Free electrons   Electric potential  Electric current  Electromotive force and potential difference  Resistance   * Laws of resistance, Resistivity, Specific resistance * Conductance, Conductivity * Multiple and submultiple units * 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 * Basic concepts of voltage source and current source   Ohm’s Law  Combination of resistance   * Resistances in series * Resistances in parallel * Short and open circuits * Series-parallel combination of resistance   Star-delta and delta-star transformation | **3** | **11** |
| **2** | **Work, Power and Energy**   * S.I. Units * Definition work, power and energy and it’s units * Electrical and mechanical work, power, energy, and efficiency * Thermal effect of electric current * Laws of electric heating * Thermal efficiency   Relation between various quantities | **2** | **7** |
| **3** | **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-liner, Active and passive network   D.C. network theorems   * Superposition theorem * Thevenin’s theorem * Norton’s theorem * Maximum power transfer theorem * Reciprocity theorem | **9** | **32** |
| **4** | **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, Capacitors in parallel  Capacitors in series parallel  Energy stored in capacitor  Charging and discharging of capacitor  Time constant | **5** | **18** |
| **5** | **Electromagnetism and magnetic Circuits:** Introduction   * Magnet * Important properties of a magnet * Classification of materials * Law of magnetic force   Law’s and definitions   * 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 magnetisation * Susceptibility   Magnetic effect of electric current  Current carrying conductor in a magnetic field  Force between two parallel conductor  Magnetic circuit   * Important terms * Analysis of magnetic circuit * Comparison between magnetic and electric circuit * Composite magnetic circuits * Parallel magnetic circuit, MMF, Air gap * Flux, Leakage flux, Fringing   Ampere turns calculation  Series magnetic circuit and parallel magnetic circuit  Analysis of series-parallel magnetic circuits  B-H curve or magnetization curve   * Magnetic hysteresis and hysteresis loop * Hysteresis loss, magnitude of hysteresis loss * Importance of hysteresis loop | **4** | **14** |
| **6** | **Electromagnetic Induction:**  Introduction  Electromagnetic induction  Faraday’s laws of electromagnetic induction  Direction of induced e.m.f.  Induced E.M.F.   * Dynamically induced e.m.f * Statically induced e.m.f. * Co-efficient of coupling   Self-inductance, mutual inductance  Mutually induced e.m.f.  Expression for self and mutual inductance  Inductances in series and parallel  Energy stored in a magnetic field  Losses in magnetic circuits  Rise and decay of current in an inductive circuit | **5** | **18** |

**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 |
| 20% | 20% | 30% | 15% | 10% | 5% |

**Suggested List of Experiments:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Unit No.** | **Name of Topics** | **Contact**  **Hours** |
| 1 | 1 | To measure various electrical quantities like Voltage, E.M.F, Current, Power and Energy in a given electrical circuit | 2 |
| 2 | 1 | To measure and compute resistance of given material | 2 |
| 3 | 1 | To study of conductors, Semiconductors & Insulators | 2 |
| 4 | 1 | To analyze the effect of temperature on conductivity and resistance of a given material | 2 |
| 5 | 1 | To verify Ohm's Law | 2 |
| 6 | 1 | To connect resistances in parallel and series to measure required effective resistance | 2 |
| 7 | 1 | To perform star to delta and delta to star conversion | 2 |
| 8 | 2 | To study of unit conversion of electrical power and energy to other non-electrical energy and efficiency | 2 |
| 9 | 2 | To observe thermal effect of electrical current | 2 |
| 10 | 3 | To perform an experimental check of Kirchhoff’s Current Law and Kirchhoff’s Voltage Law | 2 |
| 11 | 3 | To perform experiment of Superposition Theorem. | 2 |
| 12 | 3 | To perform experiment of Thevenin’s Theorem. | 2 |
| 13 | 3 | To perform experiment of Norton’s Theorem | 2 |
| 14 | 3 | To perform experiment of Maximum Power Transfer Theorem. | 2 |
| 15 | 4 | To perform experiment of Coulomb’s laws of electrostatics | 2 |
| 16 | 4 | To connect capacitor in series and parallel to measure required effective capacitance. | 2 |
| 17 | 4 | To perform experiment of charging and discharging time constants of capacitor | 2 |
| 18 | 5 | To measure magnetic flux of magnetic circuit | 2 |
| 19 | 5 | To perform experiment of B-H curve or magnetization curve | 2 |
| 20 | 6 | To perform experiment of faraday’s laws of electromagnetic induction | 2 |
| 21 | 6 | To Perform experiment of rise and decay of current in an inductive circuit | 2 |

**Instructional Method:**

1. 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.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

**References:**

1. B. L. Theraja, "*A Text Book of Electrical Technology Vol-I*", S. Chand & Co. Ltd., 2014
2. Tarlok Singh, "*Fundamental of Electrical Engineering*", S. K. Kataria & Sons, 2012
3. J. B. Gupta, "*A Course of Electrical Technology Vol-I*", Kataria & Sons, 2012
4. S.K. Sahdev, "*Fundamentals of Electrical Engineering & Electronics*", Dhanpat Rai & Co. LTD., 2014
5. U. A. Bakshi & V. U. Bakshi, "*Basic Electrical Engineering*", Technical Publication Pune, 2012
6. U. A. Patel, "*Elements of Electrical Engineering*", Atul Prakashan, 2016

Supplementary Resources:

* 1. <http://nptel.ac.in/courses/108108076/>
  2. <http://nptel.ac.in/downloads/108105053/>
  3. [http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-](http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/)

002-circuits-and-electronics-spring-2007/video-lectures/

* 1. <http://www.electrical4u.com/nature-of-electricity/>
  2. <http://vlab.amrita.edu/index.php>