



SILVER OAK UNIVERSITY
College of Technology (01)
Diploma in Electrical Engineering
Subject Name: DC Machines and Transformers
Subject Code: 1010082220
Semester: 3rd

Prerequisite: Fundamentals of Electrical and Electronics Engineering

Objective: Transformer is the heart of the electrical power sector and most important apparatus for Industrial, agriculture, irrigation and for the development of the nation. As Electricity is the primary requirement for the growth of Nation it becomes necessary to get detailed knowledge about static and rotating machines. The syllabus of this subject deals with basic principles of electromechanical energy conversion and electromechanical devices such as DC machines and Transformers.

Teaching and Examination Scheme:

| Teaching Scheme | | | | | Evaluation Scheme | | | | Total Marks |
|-----------------|---|---|---------------|---------|-------------------|----------|-----------|----------|-------------|
| L | T | P | Contact Hours | Credits | Theory | | Practical | | |
| | | | | | CIE (TH) | ESE (TH) | CIE (PR) | ESE (PR) | |
| 3 | 0 | 2 | 6 | 5 | 40 | 60 | 20 | 30 | 150 |

Content:

| Unit No. | Course Contents | Teaching Hours | Weightage % |
|----------|---|----------------|-------------|
| 1 | Principles of Electromechanical Energy Conversion Conservation of Energy, Energy stored in Magnetic Field, Singly Excited System and Doubly Excited System, Basic Structure of Rotating Electric Machines, Rotating Magnetic Field, Generated Voltage in AC Machines | 06 | 10 |
| 2 | D.C. Generators Construction of D.C. Machines, Types of D.C. Machines, Working principle of D.C. Generators, EMF Equation of DC Generator, Lap and Wave Windings, Armature Reaction in D.C. Generators, Commutation and Methods of Improving Commutation, Characteristics of D.C. Generators, Separately Excited DC Generator, Voltage Build-up in Self-Excited Generator, D.C. Shunt, D.C. Series and D.C. Compound Generator Characteristics, Power Flow in D.C. Generator, Losses and Efficiency in D.C. Generator and Their Examples. | 14 | 25 |
| 3 | D.C. Motors Overview of Construction, Working principle of Motor, Back E.M.F. and its equations, Types of DC Motors, Torque of DC Motor, Armature Reaction in DC Motor, Characteristics of a DC Shunt Motor, Characteristics of a DC Series Motor, Characteristics of a DC Compound Motor, Need of DC Motor Starter, Starting of DC Motors, Three Point and Four Point Starter with its advantages and disadvantages, Speed of a DC Machine, Speed Control of DC Motors, | 14 | 25 |

| | | | |
|----------|--|-----------|-----------|
| | Losses in DC Machines, Power Flow Diagram, Testing of DC Machines, Swinburne's Test, Break and Pulley Test, Field Test and Hopkinson's Test. | | |
| 4 | <p>Transformer Construction of Transformers with materials and its advantages, Working Principle of Transformers, Core Type and Shell Type Transformers with its applications, EMF Equation of Transformers, Phasor diagram of Ideal transformer and practical transformers with different loading conditions such as Resistive Load, Inductive Load and Capacitive Load, Voltage Regulation of a Transformer, Losses in Transformers, Transformer Efficiency, Condition for Maximum Efficiency, All Day Efficiency, Application of Transformer.</p> <p>Single Phase Auto Transformer, Volt-ampere Relations, Step-up Auto transformers, Auto Transformer Efficiency, Saving in Copper material, Conversion of Two winding Transformer to an Auto Transformer, Advantages and Disadvantages of Auto Transformer, Applications of Auto Transformers.</p> | 14 | 25 |
| 5 | <p>Testing of Transformers Direct Load Test of Transformer, Open Circuit and Short Circuit Tests, Sumpner's Test, Polarity Test and labelling, Parallel operation of Transformers with reasons and necessary conditions, Turns ratio Test, Voltage ratio Test.</p> | 08 | 15 |

Course Outcome:

| Sr. No. | CO statement | Unit No |
|----------------|---|----------------|
| CO-1 | Understanding of Principles of Magnetic Circuits and Electromechanical Energy Conversion. | 01 |
| CO-2 | Understanding of Working Principle, Operation, Control and Applications of Generators. Analytical skill development with testing of DC Generators for performance analysis. Evaluation of different operating conditions with various loading parameters. | 02 |
| CO-3 | Understanding of working Principle, Operation, Control and Applications of DC Motors. Analytical skill development with testing of DC Motors for performance analysis. Evaluation of different operating conditions with various loading parameters. | 03 |
| CO-4 | Understanding of working Principle, Operation, Control and Applications of Transformer. | 04 |
| CO-5 | Analytical skill development with testing for performance analysis. Evaluation of different operating conditions with various loading parameters. | 05 |

Teaching & Learning Methodology:

Lectures with discussions, question and answer sessions, informal quizzes, video sessions where students have an opportunity to clear concepts and doubts. E – Resources and E-Learning for the virtual learning environment to prepare the students ready for each and every circumstance. Practical sessions along with virtual laboratory practice for developing skills which are required in occupation. Occasional Flipped classroom exercise for students for development of presentation skills.

- **List of Experiments/Tutorials:**

1. To study Different Components and Parts of DC Machines along with its applications along with identification.
2. To perform and analyze the Internal & External Characteristics of Self Excited DC Shunt Generator, Series Generator and Compound Generator and obtain the critical field resistance of the machine from magnetizing Characteristics.
3. To conduct direct load test on a D.C. compound generator with a) Shunt field alone b) Cumulative and differential compounding for short and long shunt connections.
4. To determine the efficiency and losses of two similar shunt machines by regenerative method. (Hopkinson's Test.)
5. To perform field tests on identical sets of Two D.C. series machines.
6. To perform Swinburne's test on a DC shunt motor to find out its efficiency.
7. To perform Speed control of DC Shunt Motor using a) Armature control and b) field control methods.
8. To study the construction and working of Transformers and its parts with their applications along with identification.
9. To conduct open circuit and short circuit tests on a three phase transformer and determine the equivalent circuit parameters with line and Phase voltage quantity.
10. To perform Direct Load Test on Transformer for Calculating Efficiency and Voltage Regulation for Different Loading Conditions.
11. To perform a polarity Test on Two Single Phase Transformers for understanding Additive and Subtractive Polarity of Transformers.
12. To operate two single phase transformers of different KVA ratings in parallel and plot the variation of currents shared by each transformer versus load current.
13. To conduct Sumpner test on two identical single phase transformers and determine their efficiency at various loads.

- **Major Equipment/ Instrument:**

- DC Shunt Motor Generator Set
- DC Series Motor Generator Set
- DC Shunt Motor Coupled to DC Compound Generator
- DC Shunt Motor with Break and Pulley
- Single Phase Transformers,
- Control Panel with Set of Single Phase Transformers for Parallel Operation as well as for vector group connection.

- **Books Recommended:**

1. Electrical Technology Part - II by B. L. Theraja, S. Chand Publication
2. Electrical Machines by M. V. Deshpande, PHI Learning
3. Electrical Machines by Ashfaq Hussain, Dhanpat Rai and Co.
4. Electrical Technology by S. L. Uppal, Khanna Publication
5. Electric Machinery by E. Fitzgerald and C. Kingsley, McGraw Hill Education
6. Electric Machines by I. J. Nagrath and D. P. Kothari, McGraw Hill Education
7. Theory and Performance of Electrical Machines by J. B. Gupta, Katson Publication
8. Performance and Design of A.C. Machines by M. G. Say, CBS Publishers
9. Electrical Machinery by P. S. Bhimbhra, Khanna Publishers

- **List of Open Source Software/learning website:**

1. <https://www.vlab.co.in/>
2. <https://www.femm.info/wiki/HomePage>
3. <https://www.scilab.org/>