

Course Name : Electrical Engineering Group**Course Code : EE /EP****Semester : Fourth****Subject Title : D. C. Machine and Transformer****Subject Code : 17415****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	50#	--	25@	175

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).

Rationale:

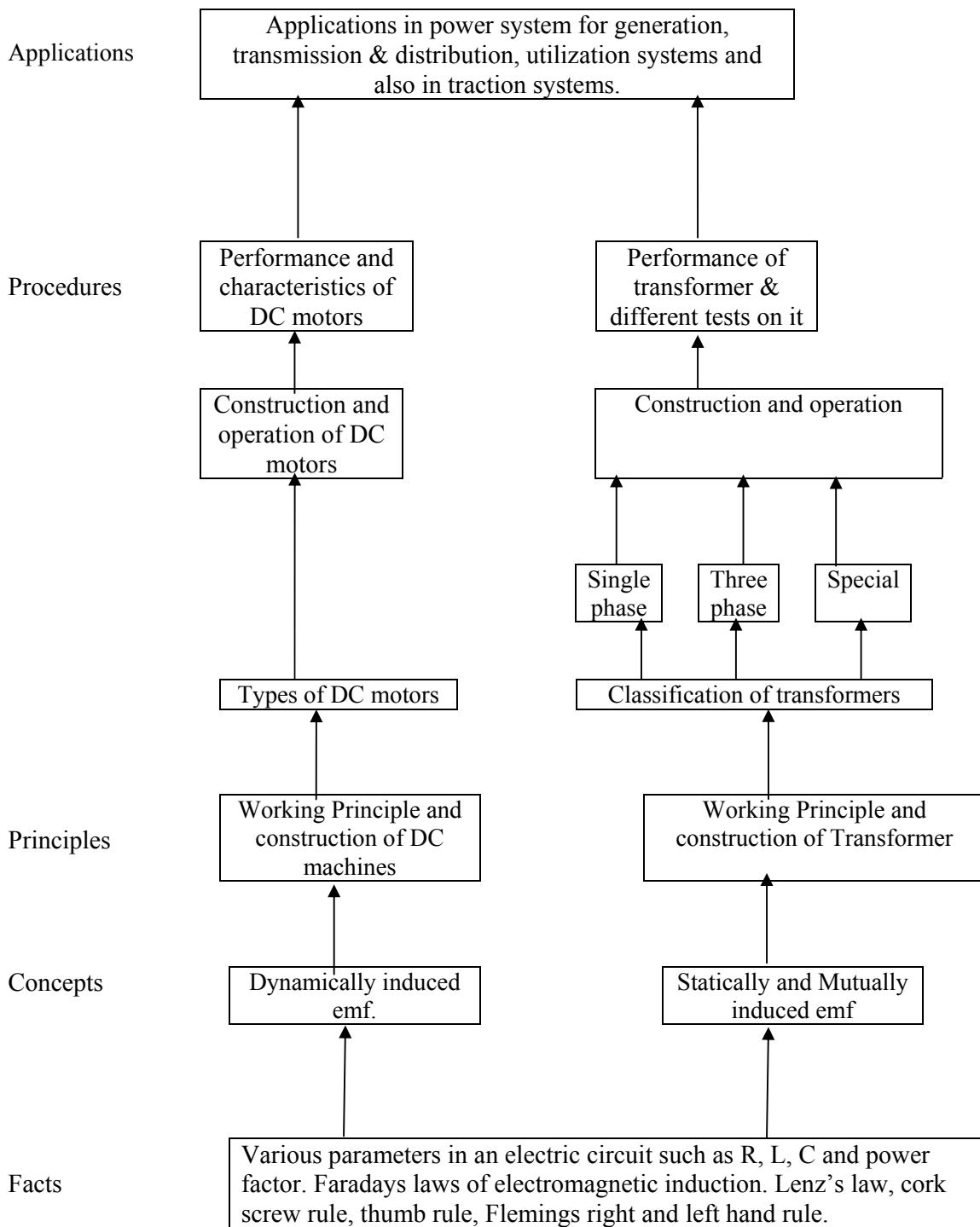
This subject is intended to teach the student facts, concepts, principles and procedures for the operations, testing and maintenance of electric machines such as dc motors, generators and transformers. Students will also be able to analyze characteristics of electric machines and transformers.

These machines are used in power system for generation, transmission & distribution, utilization systems and also in traction systems. Knowledge gained by the students will be used in the study of technological subjects such as power system operation & control, utilization system, switchgear & protection, testing and maintenance of electrical equipment and modern electric traction.

The students will be able to know the use of transformer in measurement, use of CT's and PT's in control circuits, fault locations etc. The knowledge and skill gained by the student will be used while working as technicians in discharging technical functions such as electrical supervisor, testing engineer and procurement engineer.

General Objectives:**Students will be able to-**

1. Understand the laws governing the operation of electrical machines.
2. Understand the working principles of different DC machines and transformer.
3. Know the constructional details of the DC machines and transformer.
4. Know the areas of application of the various dc machines and different types of transformers.

Learning Structure:

Theory:

Topic and Contents	Hours	Marks
Topic 1: DC Generators Specific Objectives: <ul style="list-style-type: none"> ➤ Identify the different parts of DC Machines. ➤ Identify different types of DC generators from connection diagram. Contents: <p>1.1 Introduction</p> <ul style="list-style-type: none"> • Principle of operation of DC generator • Fleming's right hand rule <p>1.2 Construction of DC machine</p> <ul style="list-style-type: none"> • Parts and functions • Different materials used for different parts. <p>1.3 E.m.f. equation of generator (derivation)</p> <ul style="list-style-type: none"> • Numericals on e.m.f. equation <p>1.4 Types of DC generators</p> <ul style="list-style-type: none"> • Connection diagrams of different types of DC generators • Applications of DC generators 	06	08
Topics 2: DC Motors Specific Objectives: <ul style="list-style-type: none"> ➤ Plot different characteristics of DC motors. ➤ Control the speed of DC motors. ➤ Determine the efficiency of DC motor. ➤ Select DC motor for particular industrial applications. Contents: <p>2.1 Introduction</p> <ul style="list-style-type: none"> • Principle of operation of DC motor • Fleming's left hand rule • Back e.m.f. and its significance • Voltage equation and power equation of DC motor • Types of DC motors <p>2.2 DC Motor Torque and Speed</p> <ul style="list-style-type: none"> • Armature torque (derivation) • Shaft torque • Brake horse power • Numericals on torque and speed. <p>2.3 Efficiency of DC Motor</p> <ul style="list-style-type: none"> • Losses in DC motor • Power stages • Efficiency of DC motor • Condition for maximum efficiency • Numericals on efficiency. <p>2.4 DC motor characteristics</p> <ul style="list-style-type: none"> • Torque verses armature current • Speed verses armature current • Speed verses torque • Selection of motors for particular applications. <p>2.5 Speed control of DC series motor</p> <ul style="list-style-type: none"> • Flux control method 	12	18

2.6	<ul style="list-style-type: none"> • Armature resistance control method (No numerical) DC motor starters		
2.7	<ul style="list-style-type: none"> • Necessity of DC motor starters Brushless DC Motor <ul style="list-style-type: none"> • Introduction • Working • Applications 		
Topic 3: Single Phase Transformer. Specific Objectives: <ul style="list-style-type: none"> ➤ Draw phasor diagram of transformer for different load conditions. ➤ Perform various tests on transformers ➤ Evaluate parameters of transformer under different loading conditions. ➤ Determine regulation and efficiency of single-phase transformer. Contents:			
3.1	Introduction <ul style="list-style-type: none"> • Principle of operation • Faradays law of electromagnetic induction. 		
3.2	Construction of single phase transformer. <ul style="list-style-type: none"> • Magnetic circuit • Electric circuit • Dielectric circuit 		
3.3	Types of transformers <ul style="list-style-type: none"> • Shell type and core type- their comparison • Step up and step down transformer • Amorphous Core type Distribution Transformer 		
3.4	EMF equation of transformer <ul style="list-style-type: none"> • Derivation • Voltage transformation ratio • Numericals on above. 	26	42
3.5	Ideal transformer <ul style="list-style-type: none"> • Characteristics of ideal transformer. • Phasor diagram 		
3.6	Practical Transformer <ul style="list-style-type: none"> • Transformer on no load-phasor diagram • Leakage reactance • Transformer on load- phasor diagram • Numericals on above. 		
3.7	Equivalent circuit of transformer <ul style="list-style-type: none"> • Equivalent resistance and reactance • Numericals on above. 		
3.8	Voltage regulation and Efficiency of transformer <ul style="list-style-type: none"> • Why transformer rating is in KVA? • Voltage regulation of transformer • Losses in transformer • Efficiency of transformer • Condition for maximum efficiency • All day efficiency • Numericals on above. 		
3.9	Tests on Single phase Transformer <ul style="list-style-type: none"> • Polarity test 		

<ul style="list-style-type: none"> • Direct loading test • Open circuit test • Short circuit test • Voltage regulation and efficiency based on OC & SC tests. • Numericals on above. 		
<p>3.10 Parallel operation of transformer</p> <ul style="list-style-type: none"> • Advantages of parallel operation of transformer. • Conditions for parallel operation of transformer. • Load sharing with equal turn ratio • Concept of load sharing with unequal turn ratio • Numericals on above. 		
<p>Topic 4: Three Phase Transformer.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ To identify different parts of three-phase transformer. ➤ To identify polarity and phases of three-phase transformer. ➤ To select three-phase transformer for particular applications. <p>Contents:</p> <p>4.1 Introduction</p> <ul style="list-style-type: none"> • Bank of three single phase transformer • Single unit of three phase transformer • Construction, different parts and their functions • Types of transformer cooling • Three phase transformers connections as per IS:2026 (part IV)-1977 • Three phase to two phase conversion (Scott Connection) • Comparison between Distribution transformer and Power transformer <p>4.2 Selection of transformer as per IS: 10028 (Part I)-1985</p> <ul style="list-style-type: none"> • Criteria for selection of distribution transformer • Criteria for selection of power transformer <p>4.3 Parallel operation of three phase transformer</p> <ul style="list-style-type: none"> • Conditions for parallel operation <p>4.4 Specification of three-phase distribution transformer as per IS:1180 (part I)-1989</p> <p>4.5 Tests on Three-phase Transformer</p> <ul style="list-style-type: none"> • Polarity test • Phasing out test <p>4.6 Three- phase auto transformer</p> <ul style="list-style-type: none"> • Construction • Operation • Application 	12	16
<p>Topic 5: Special Transformers.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ To use various special transformers for particular applications.. <p>Contents:</p> <p>5.1 Single phase auto transformer</p> <ul style="list-style-type: none"> • Construction and working • Comparison with two winding transformer • Advantages and disadvantages of auto transformer 	08	16

5.2	<ul style="list-style-type: none"> Applications of auto transformer Instrument Transformers Current transformer- construction, working and applications Potential transformer- construction, working and applications 		
5.3	<ul style="list-style-type: none"> Isolation transformer Features and applications 		
5.4	<ul style="list-style-type: none"> Single phase welding transformer Features and applications. 		
Total		64	100

Practical:**Skills to be developed:****Intellectual Skills:**

1. To understand the concepts of DC machines and transformers.
2. To identify different parts and windings of DC machines and transformers.
3. Ability to test, plot and verify the characteristics.
4. Ability to interpret the test results.

Motor Skills:

1. To draw the circuit diagram.
2. To measure different parameters using different meters.
3. To connect different meters according to circuit diagram.
4. To follow sequence of operations.
5. To measure the values and note down the readings.
6. To operate DC machines and transformers.

List of Practicals:

1. Observe and identify different constructional parts of D. C machine and identify different windings by resistance measurement.
2. Start a D. C shunt motor and reverse its direction of rotation.
3. Control the speed of D.C series motor by flux control and armature resistance control.
4. Perform load test on D. C series motor and plot its performance characteristics.
5. Perform brake test on D. C shunt motor and plot speed – Torque characteristics.
6. Determine transformation ratio, regulation and efficiency of single phase transformer by direct loading.
7. Perform open circuit and short circuit test on single phase transformer and determine equivalent circuit constants, regulation and efficiency.
8. Perform parallel operation of single phase transformer and determine the load sharing.
9. Visit a transformer manufacturing unit /repairing workshop and observe the constructional details of a three phase distribution transformer and identify various parts.
10. Perform polarity test and phasing out test on a three phase transformer.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1.	V. N. Mittle & Arvind Mittal	Basic Electrical Engineering	Tata McGraw Hill Education Pvt. Ltd. New Delhi
2.	D. P. Kothari &	Electrical Machines	Tata McGraw Hill Education Pvt.

	I. J.Nagrath		Ltd. New Delhi
3.	S. K. Bhattacharya	Electrical Machines	Tata McGraw Hill Education Pvt. Ltd. New Delhi
4.	V. K. Mehta & Rohit Mehta,	Principles of Electrical Machines	S.Chand and Co.Ltd., New Delhi
5.	K. Murungesh Kumar	DC Machines and Transformers	Vikas Publishing House Pvt. Ltd. New Delhi.
6.	Tarnekar & Kharabanda.	Laboratory Course in Electrical Engineering	S.Chand and Co.Ltd., New Delhi
7	B. L. Theraja	Electrical Technology	S.Chand and Co.Ltd., New Delhi
8	Edward Hughes	Electrical and Electronics Technology	ELBS Publication.
9	M. N. Bandyopadhyay	Electrical Machines theory and practice	PHI Learning Pvt. Ltd., New Delhi

2. CDs, PPTs, Models, Charts etc.:

Videos-

1. <http://www.youtube.com/watch?v=RAc1RYilugI>
2. <http://www.youtube.com/watch?v=Ue6S8L4On-Y&feature=related>
3. http://www.youtube.com/watch?v=d_aTC0iKO68&feature=related
4. <http://www.youtube.com/watch?v=Xi7o8cMPI0E&feature=related>
5. <http://www.youtube.com/watch?v=VucsoEhB0NA&feature=related>
6. http://www.youtube.com/watch?v=A951LRFRL_M&feature=related

3. IS, BIS and International Codes:

- IS: 2026 (Part IV)-1977 Indian standard specification for power transformers PART IV Terminal markings, tapplings and connections
- IS: 10028 (Part I)-1981 Indian standard code of practice for selection, installation and maintenance of transformers, PART I selection
- IS: 1180 (Part I)-1977 Indian standard specification for power transformer

4. Websites:

- www.standardsbis.in/
- www.bis.org.in/
- www.youtube.com/watch
- www.google.co.in