4109 – D.C. MACHINES

Teaching Schedule Per Week			Progressive Assessment		Examination Schedule (Marks)			
					Theory		Practical Ex.	Total
Lectures	Practical	Credits						
3	2	5	25	25	3 hrs	100	-	150

Pre-requisite	Source
1005	ELL

Semester	Theory	Test	Total	TW	PR	Gr Total
	75	25	100	25	–	125

Rationale: This subject enables a student to understand the working principle, parts of construction and performance characteristics of D.C. machine. The students get acquainted with the skill of testing each of the D.C. machine before putting them into service. The students also get familiarised with the various types of defects, Commonly occurring in D.C. machine as well as the necessary remedies to eliminate them.

COURSE CONTENTS	Hrs	Mks
1. CONSTRUCTION Working of a simple loop generator, various parts of D.C. machine & their functions & materials used, Armature winding- a) Calculation of pole pitch, front pitch, back pitch, resultant pitch, commutator pitch, b) Concept of lap winding, wave winding, single layer and double layer winding comparison of lap and wave winding w.r.t. various pitch & use, Method for positioning of the brushes.	6	12
2. D. C GENERATORS Equation of e.m.f. generated, polarity and factors on which it depends, Classification of generator w.r.t.a) Excitation system, b)Connection of field and armature winding. Current and voltage equation for various types of generators, Voltage build up in shunt, series, and compound generator, effect of field and load resistance on voltage build up. Critical field and load resistance. Cause of failure, Characteristics - O.C. and external characteristics of various generator, Losses and efficiency	12	22
3. SPECIAL GENERATOR D.C. Welding Generator – Bipolar and third brush Generator – Its construction and characteristics. Current controller.	4	8
4. PARALLEL OPERATIONS Condition for parallel operation. Essential and necessary, Connection of shunt and Compound Generator in parallel, Analysis of load sharing , shifting of load in case of D.C. shunt and compound generators.	6	8
5. D.C. MOTORS Principle of operation and working of DC Motor, Importance of back e.m.f. and its equation. Development of torque, Armature torque, shaft torque, Classification of motor based on connection. Voltage and speed equation. Method of speed control - Armature control, field control, ward leonard method, field diverter, (tapped field, series-parallel field coils). Characteristics – torque-current, torque-speed characteristics of series, shunt and compound motors, Comparison of shunt, series and compound motors w.r.t starting torque, application conditions of operation and speed variation, Starting of motor – Necessary of starter, types of starter for shunt and compound motors. Various components of starters and their functions. Starting of series motor with drum controller. Classification of various losses in DC motor as per IS and separation of various losses. Calculation of Mechanical efficiency. Electrical efficiency and overall efficiency.	16	36

6. ARMATURE REACTION & COMMUTATION Concept of armature reaction and its component, Effect of armature reaction and its component, effect of armature reaction on the performance of D.C. machine and method to reduce the effect, Principle of commutation, cause of poor commutation, method of improving commutation, resistance commutation, electromagnetic field commutation (interlope, shifting of brushes)	4	12
Total	48	98

LIST OF PRACTICAL:

1. To plot O.C. characteristics of a D.C machine and to find the value of critical field resistance.
2. To plot external characteristics of DC shunt generator.
3. To plot external characteristics of DC series generator.
4. To plot external characteristics of DC compound generator.
5. Speed control of DC shunt motor above and below normal.
6. To plot speed torque characteristics of DC shunt motor
7. Starting of DC motor with the help of a starter and a reversal of direction of rotation.
8. Checking the field system of DC machine for open circuit, inter turns short circuit, and polarity of the field pole.
9. Detection of open circuit, short circuit and ground fault in armature winding.
10. To perform O.C. and load characteristics of d. c. welding generator.

REFERENCE BOOKS

1. Electrical Engineering Vol I (Direct current) by C.I. Dawes, Mc Graw Hill.
2. Performance and design of DC machines, by clayton and Hancock.
3. AC/DC Machines, by J.B. Gupta.
4. Electrical Machines, by S.K. Bhattacharya.
5. Electrical Technology (Vol II) by B.L. Theresa.