4113 – A.C. MACHINES

Teaching Schedule Per Week			Progressive Assessment		Examination Schedule (Marks)			
					Theory		Practical Ex.	Total
Lectures	Practical	Credits						
4	2	6	25	25	3 Hrs	100	50	200

Pre-requisite	Source
4104	ELL

Semester	Theory	Test	Total	TW	PR	Gr Total
	75	25	100	25	50	175

Rationale: This course enables a learner to understand the working principle, parts of construction, performance characteristics of different types of A.C. machines as well as acquaint himself with the various methods of starting these machines. A learner of this course will be acquainted with the knowledge regarding analysis of various parameters of these machines. The power and control circuits of different starters used in A.C. motors are also studied.

COURSE CONTENTS	Hrs	Mks
1. THREE PHASE INDUCTION MOTOR Fundamental principles of rotating machines:- Production of rotating magnetic field in three phase winding. Derivation of equation for resultant flux. Working principle of three phase induction Motor. Constructional details of three phase induction motor – slip ring and squirrel cage (single and double cage), concept of slip, rotor frequency, rotor emf and rotor current under stand still and running condition.	4	8
2. PERFORMANCE Development of phasor diagram of induction motor at standstill and full load condition. Equivalent circuit and calculation of performance parameters. Power flow and calculation of efficiency in Induction motor. Torque equation (starting and running). Condition of maximum torque (starting and running). Pull up and pull out torque. Effect of variation of supply voltage, frequency and open delta condition on torque and speed. Development of circle diagram from approximate equivalent circuit, torque – slip characteristics of induction motor on load. Relationship between starting torque and full load torque, starting torque and maximum torque. Terminal marking for three phase Induction motor.	14	24
3. STARTERS Methods of starting squirrel cage and slip ring induction motors, type & need of (Squirrel cage) :Direct on line starter, star/Delta starter, Auto transformer starter, Rotor resistance starters (for slip ring induction motor). Concept of soft starter and its advantages, Power & control circuit, working of various starters including safety circuit & protection.	6	8
4. SINGLE PHASE INDUCTION MOTORS Construction, Principles of operation – Rotating field theory. Torque –speed characteristics. Classification of single phase motor based on methods of starting – Resistance split phase (capacitor start, capacitor start and run, capacitor start and capacitor run, shaded pole), Reluctance start.	6	12
5. ALTERNATOR Classification – Construction-Component and functions of salient pole, cylindrical pole and brush type, Frequency of inducted emf and factors on which it depends, EMF equation – Full pitched coil, Fractional pitched coil, Coil span factor and coil distribution factor, effect of these factors on generated emf , Hunting and use of damper winding for circuit control.	6	8
6. OPERATION Armature reaction of three phase alternator and effect of load p.f. on it, operating	10	16

parameters – Armature resistance, leakage reactance, Synchronous reactance and impedance, Phasor diagram of alternator under no load and on load condition, Regulation of alternator and calculation by synchronous Impedance method and by direct loading. Open circuit and short circuit test and calculation of synchronous Impedance, Operating characteristics of Alternator, Rating and specification for procurement		
7. PARALLEL OPERATION Conditions for parallel operation, Methods of synchronising of Alternators (lamp method & synchroscope method), Analysis of load sharing, effect of change of excitation on power factor, effect of change in the input power to one of the machines.	8	8
8. SYNCHRONOUS MOTOR Principles of operation and special features of synchronous motor. Definition of load angle, Torque and power equation, effect on current and power factor under, Variable load, constant excitation, variable excitation constant load, Concept of synchronous condenser.	6	8
9. CONSTRUCTION, PRINCIPLE OF OPERATION & APPLICATION OF Single phase motor, Hysteresis motor, Universal motor, Repulsion motor	4	8
Total	64	100

LIST OF PRACTICALS:

1. To perform no load and Blocked rotor test on a three phase Induction motor and A) determine the equivalent circuit parameters, testal losses and efficiency of three phase induction motor. B) Plot the circle diagram to determine total losses and efficiency.
2. To perform load test and determine the efficiency, variation of speed, power factor and voltage with load, for a 3 phase Induction motor.
3. Identification of parts, function (operational and protectional) in the following starters and their specifications(2 turns).
   D.O.L. Starter, Auto transformer starter, star delta starter, Rotor rheostat starter.
4. Starting and reversal of direction of rotation or 3 phase & single phase Induction motor.
5. To perform No load and blocked rotor test on a single phase induction motor and determine its efficiency.
6. To perform O.C. & S.C. test on Alternator to calculate its synchronous Impendance & regulation.
7. To determine the excitation required to maintain constant voltage in an alternator under varying load conditions.
8. To plot 'V' curves for synchronous motor.
9. To perform parallel operation of Alternator and load sharing.
10. To study the performance of special motors w.r.t. current drawn, power consumed, sparking at the brushes and noise level.

REFERENCE BOOKS

1. Performance and design of A.C. Machines by M.G. Say.
2. A.C. Machines by J. B. Gupta.
3. Electrical machinery by P. S. Bhimbra
4. A.C. Machines by Langsdorf.
5. Electrical Machines by S.K. Bhattcharya.
6. Electrical Technology (vol II) by B. L. Theraja.
7. Performance&Design of A.C. commutator motor by Taylor.