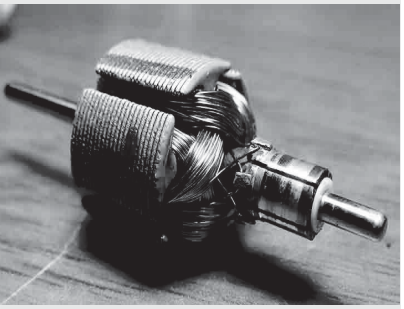

16EE308 SYNCHRONOUS AND SPECIAL MACHINES

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	40	-	8	5	5

Course Description and Objectives:

This course deals with the construction, operation and applications of synchronous machines and special machines such as hysteresis, repulsion, AC series, variable reluctance, permanent magnet and stepper motors. The objective of course is to understand the complete characteristic features of different synchronous machine and special machines in their field of applications.

Course Outcomes:

The student will be able to:

- understand the operational characteristics of alternators.
- analyze power factor correction capability of synchronous motor.
- analyze starting and running characteristics of single phase induction motor.
- understand the suitability of special machines for given application.

SKILLS:

- ✓ *Obtain the voltage regulation of alternator at any given load.*
- ✓ *Synchronize alternator to supply mains.*
- ✓ *Choose a single phase induction motor for the given application.*
- ✓ *Choose an appropriate special machine for given application.*

UNIT - 1 **L-10**

CONSTRUCTIONAL FEATURES OF ALTERNATORS: Construction - Revolving field type, Rotating armature type, Salient pole and non-salient pole field structure, Principle of operation; Relation between speed and frequency of alternator, Methods of cooling.

ARMATURE WINDINGS: Single layer, Double layer, Full and fractional pitch windings, Pitch factor, distribution factor, Expression for induced emf, Harmonics and their reduction.

LOAD CHARACTERISTICS: Voltage regulation, Causes - Effective resistance, Leakage reactance, Armature reaction, Synchronous reactance; Open circuit and short circuit tests, Phasor diagrams.

UNIT - 2 **L-9**

METHODS OF PREDICTING REGULATION : EMF method, MMF method, Potier triangle method and ASA method.

SALIENT POLE GENERATOR : Two reaction theory - Direct and quadrature axes synchronous reactance; Slip test, Phasor diagrams, Regulation.

ALTERNATOR UNDER SHORT CIRCUIT : Armature current oscillograms on sudden short circuit, Determination of sub transient and transient reactances.

UNIT - 3 **L-9**

PARALLEL OPERATION : Methods of synchronization, Circulating current, Synchronizing power, Effect of change in excitation, Effect of change in prime mover torque, Influence of governors on load division between parallel units, Hunting of alternators.

UNIT - 4 **L-9**

SYNCHRONOUS MOTOR : Principle of operation, Phasor diagram, V and inverted V-curves at constant power output, Hunting and damping, Starting methods, Phasor diagrams of salient pole motor.

MATHEMATICAL ANALYSIS: Expression for power developed, Conditions of maxima, Stiffness of coupling.

GRAPHICAL ANALYSIS: Excitation circles, Power circles, Maximum and minimum conditions.

UNIT - 5 **L-8**

SINGLE PHASE INDUCTION MOTOR: Constructional details, Double field revolving theory, Starting methods, Equivalent circuit, Determination of parameters, Performance curves and applications.

SPECIAL MOTORS : A.C. Series motor - Characteristics, Phasor diagram; Repulsion motor, Reluctance motor, Hysteresis motor, Universal motors, Permanent magnet motors, Stepper motors, Applications.

ACTIVITIES:

- *Design of simple armature and measure emf induced.*
- *Study of time to time voltage behavior of alternator.*
- *Determine the suitable voltage regulation method for alternator.*
- *Study the parallel operation of alternators in power generating plants (virtual lab).*
- *Trouble shoot a single phase induction motor.*

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS Total hours: 30

1. Regulation of a three phase alternator by synchronous impedance method.
2. Regulation of a three phase alternator by M.M.F. method.
3. Regulation of three phase alternator by Z.P.F. method.
4. Regulation of three phase alternator by A.S.A method.
5 V and Inverted V curves of a three phase synchronous motor.
6. Equivalent Circuit of a single phase induction motor.
7. Determination of Xd and Xq of a salient pole synchronous machine.
8. Parallel operation of alternator with infinite bus bar.
9. Determination of performance characteristics of single phase induction motor.
10. Load Test on three phase alternator

TEXT BOOKS:

1. P.S. Bimbhra, “Electrical Machinery”, 7th edition, Khanna publishers, 2007.
2. I.J. Nagrath and D.P. Kothari, “Electrical Machines”, 3rd edition, Tata Mc-Graw Hill, 2006.

REFERENCE BOOKS:

1. Alexander S.Langsdorf, “Theory of alternating current machinery”, 2nd edition, Tata Mc-Graw Hill, 2005.
2. M.G. Say, “Performance and design of alternating current machines”, 3rd edition, CBS, 2002.
3. Charles I Hubert, “Electric Machines (Theory, operation, applications, adjustment and control)”, 2nd edition, Pearson India, 2009.