**COURSE TITLE : SYNCHRONOUS MACHINES AND FHP MOTORS**
**COURSE CODE : 6033**
**COURSE CATEGORY : A**
**PERIODS/WEEK : 5**
**PERIODS/SEMESTER : 75**
**CREDITS : 5**

## TIME SCHEDULE

| MODULE | TOPICS | PERIODS |
|---|---|---|
| 1 | Principle and construction of synchronous generator | 18 |
| 2 | Characteristics of synchronous generator and parallel operation | 19 |
| 3 | Synchronous motor and single phase induction motors | 19 |
| 4 | FHP motors | 19 |
| **Total** | | **75** |

Course Outcome:

| Sl. | Sub | **On completion of this course the student will be able:** |
|---|---|---|
| 1 | 1 | To comprehend the working principle of alternator |
| | 2 | To understand the construction of alternator |
| 2 | 1 | To analyze the characteristics of synchronous generator. |
| | 2 | To understand the parallel operation of alternators. |
| 3 | 1 | To comprehend the working principle of synchronous motor. |
| | 2 | To understand the working principle of single phase induction motors |
| 4 | 1 | To understand the construction of various types of single phase induction motors |
| | 2 | To understand the construction and working principle of FHP motors. |
| | 3 | To know the field of applications of FHP motors |

Specific Outcome:

**MODULE I Principle and construction of synchronous generator**

1.1.1 To explain the principle of sinusoidal alternating EMF.
1.1.2 To determine the frequency of induced EMF.
1.1.3 To derive EMF equation of alternator.
1.1.4 To solve problems to calculate the EMF generated.

1.2.1 To understand the construction of alternator.
1.2.2 To describe the construction of synchronous generators.
1.2.3 To describe the armature winding and winding factor.
1.2.4 To explain rating of alternators.
1.2.5 To explain leakage reactance.
1.2.6 To describe armature reaction.
1.2.7 To describe synchronous impedance.
1.2.8 To explain alternator on load.
1.2.9 To describe the phasor diagram.
1.2.10 To describe the load characteristics.
1.2.11 To describe equivalent circuit.
1.2.12 To explain the effect of variation of power factor on terminal voltage.

**MODULE II Characteristics of synchronous generator and parallel operation**

2.1.1 To describe the laboratory method for determination of synchronous reactance.
2.1.2 To determine effective resistance of armature.
2.1.3 To describe open circuit and short circuit test.
2.1.4 To determine the short circuit test.
2.1.5 To describe the voltage regulation by synchronous impedance method or EMF method.
2.1.6 To describe the voltage regulation by ampere-turn or MMF method.
2.1.7 To describe the voltage regulation by Potier method or Zero power factor method.
2.1.8 To solve problems to calculate the voltage regulation.
2.1.9 To derive the power developed by synchronous generator.
2.1.10 To describe losses and efficiency of alternator.

2.2.1 To explain the synchronizing of alternators.
2.2.2 To explain the synchronizing torque.
2.2.3 To describe the load sharing between two alternators.

**MODULE III Synchronous motor and single phase induction motors**

3.1.1 To comprehend the working principle of synchronous motor.
3.1.2 To describe the principle of operation of synchronous motors

3.1.3 To describe the load on a synchronous motor
3.1.4 To describe effects of varying excitation on armature current and power factor of synchronous motors
3.1.5 T o explain the equivalent circuit, phasor diagram of synchronous motor
3.1.6 To describe the power developed in a synchronous motor
3.1.7 To describe the power flow in a synchronous motor
3.1.8 To describe the different torques of a synchronous motor
3.1.9 To describe V and inverted V curves of synchronous motor
3.1.10 To describe main characteristics of synchronous motor
3.1.11 To describe synchronous condenser
3.1.12 To describe the starting method of synchronous motors
3.1.13 To explain the application of synchronous motors
3.1.14 To describe the production of two phase rotating magnetic field
3.1.15 To describe the classification of single phase induction motors
3.1.16 To explain why single phase induction motor is not self starting

**MODULE IV FHP motors**

4.1.0 To understand the construction of various types of single phase induction motors.
4.1.1 To describe the starting methods and types of single phase induction motors.
4.1.2 To explain resistance start single phase induction motors.
4.1.3 To describe capacitor start single phase induction motors.
4.1.4 To explain capacitor start capacitor run single phase induction motors.
4.1.5 To describe permanent capacitor single phase induction motors.
4.1.6 To explain the speed control of single phase induction motors.
4.2.0 To understand the construction and working principle of FHP motors.
4.2.1 To explain the working of shaded pole motor.
4.2.2 To describe commutator motors.
4.2.3 To describe series motors.
4.2.4 To explain the working of Universal motors.
4.2.5 To describe Repulsion type motors.
4.2.6 To compare the methods for starting of single phase induction motors.
4.2.7 To describe servo motors.
4.2.8 To describe stepper motors.
4.2.9 To describe switched reluctance motors.
4.2.10 To describe printed circuit board motors.
4.3.0 To know the field of applications of FHP motors.
4.3.1 To explain the applications of FHP motors.

**CONTENT DETAILS**

**MODULE – I**

Alternator - constructional details - generation of sinusoidal EMF – frequency - Armature winding - different types - distribution factor – chording factor – simple problems - E MF equation – problems - rating of alternator - Armature reaction - effect of pf – synchronous impedance - alternator on load- phasor diagrams - problems.

**MODULE – II**

Regulation of alternator – definition - Testing of alternator - open circuit test - short circuit test - predetermination of synchronous reactance - regulation by EMF method – MMF method – ZPF method – problems - Direct load test – regulation – problems - Losses and efficiency - Synchronizing of alternator – characteristics - Synchronizing power and torque - load sharing.

**MODULE –III**

Synchronous motor – construction – principle of operation – method of starting – effect of changing excitation on armature current and power factor – vector diagram synchronous condenser - V- curves and inverted V curves - Power developed - different torques – problems - Applications – comparison between synchronous motor and induction motor.

**MODULE –IV**

Single phase induction motor – double revolving field theory - classification – split phase motor – capacitor start motor – capacitor start and capacitor run – shaded pole motor – speed control of single phase induction motor (voltage control) -Commutator motor – series motor – repulsion motor – servo motors – stepper motors – single phase synchronous motors - Switched reluctance motor – printed circuit board motors.

**REFERENCES:**


1. BL Theraja. Electrical technology. Vol- II: S Chand & co.
2. JB Gupta. Theory and performance of electrical Machines: S. K. Kataria & Sons