Program : **Diploma in Electrical and Electronics Engineering**	
Course Code : **5031**	Course Title: **Synchronous Machines and FHP Motors**
Semester : **5**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3 T:1 P:0)**	Periods per semester: **60**

Course Objectives:

- To understand the construction, working principle and characteristics of synchronous machines and FHP motors.
- To understand the parallel operation of alternators.
- To carry out the testing of three phase synchronous machines and single phase motors.
- To select suitable machines based on applications.

Course Prerequisites:

Topic	Course code	Course name	Semester
Basic electrical engineering		Fundamentals of Electrical Circuits	3
DC Machines		DC Machines and Traction Motors	3
Induction machines		Induction Machines	4

Course Outcomes:

On completion of the course, the students will be able to:

COn	Description	Duration (Hours	Cognitive Level
CO1	Develop the EMF equation of a synchronous generator and explain its performances.	15	Applying
CO2	Apply different methods to pre-determine the voltage regulation and illustrate the parallel operation of synchronous generators.	15	Applying

CO3	Illustrate the performance of synchronous motors.	14	Understanding
CO4	Summarize the working and applications of different fractional horsepower motors.	14	Understanding
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	3						
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcome	Description	Duration (Hours)	Cognitive Level
CO1	**Develop the EMF equation of a synchronous generator and explain its performances**		
M1.01	Explain the construction and working principle of synchronous generators.	4	Understanding
M1.02	Develop the emf equation of a synchronous generator.	5	Applying
M1.03	Illustrate the effect of power factors on armature reaction	2	Understanding
M1.04	Explain the concept of synchronous impedance and solve problems	4	Applying

Contents :

Synchronous generators-working principle -production of sinusoidal alternating emf-constructional features - stator - advantages of having stationary armature - types of armature windings(Listing only) - rotor-classifications -salient type-cylindrical type - comparison between salient and cylindrical rotors -damper winding

Relation between rotor speed and frequency of generated emf -definitions - pitch factor - distribution factor- Advantages of short pitched and distributed type windings - -derivation of emf equation-problems

Alternator on load- reasons for variation of terminal voltage- armature resistance - leakage reactance - armature reaction - Effect of power factors (upf,zpf lag and zpf lead) on armature reaction with diagrams

Vector diagrams of a loaded alternator-synchronous reactance -Synchronous impedance- phasor diagrams for various power factors- problems

CO2	**Apply different methods to pre-determine the voltage regulation and illustrate the parallel operation of synchronous generators.**		
M2.01	Select various tests to pre-determine the performance of synchronous generators.	8	Applying
M2.02	Explain power developed in synchronous generators	2	Understanding
M2.03	Explain the parallel operation of alternators.	2	Understanding
M2.04	Illustrate the synchronization of alternators.	3	Understanding
	Series test 1	1	

Contents :

Tests on alternator-Regulation of alternators -definition - testing of alternator -open circuit test - short circuit test -calculation of synchronous impedance and reactance.Pre determination of voltage regulation - methods - EMF method – MMF method – ZPF method - Problems.

Power developed in synchronous generators -Losses and efficiency- power flow diagram.

Parallel operation of alternators -need -Conditions

Synchronization of three phase alternators-methods- dark lamp - bright lamp - synchroscope-Synchronizing current - synchronizing power - synchronizing torque (definitions and equations only)

CO3	**Illustrate the performance of synchronous motors.**		
M3.01	Explain the construction and working of synchronous motors.	3	Understanding
M3.02	Illustrate the performance characteristics of synchronous motors.	5	Understanding
M3.03	Explain the starting of synchronous motors	3	Understanding
M3.04	Compare synchronous and induction motors	3	Understanding

Contents :

Synchronous motor - construction -working principle

Effect of load on synchronous motor - change in load with constant excitation - changing excitation with constant load (phasor diagram approach only)-Power developed by synchronous motor(equation only). Losses and power flow diagram-Effects of varying excitation on armature current and power factor - V and inverted V curves of synchronous motor

Starting of synchronous motors-Different torques in synchronous motors - starting methods of synchronous motors- Hunting in synchronous motors-definition - methods to eliminate hunting.

Comparison between synchronous and induction motors- synchronous condensers(operation with vector diagram)- applications of synchronous motors

CO4	**Summarize the working and applications of different fractional horsepower motors.**		
M4.01	Explain the construction and working of single phase induction motors.	5	Understanding
M4.02	Illustrate the construction and working of commutator motors.	3	Understanding
M4.03	List various special purpose motors and explain their working	4	Understanding
M4.04	Summarize the applications of various fractional horsepower motors.	2	Understanding
	Series test-2	1	

Contents :

Single phase induction motors -Construction -Double field revolving theory - starting - classification- split phase - capacitor start induction run motor -capacitor start capacitor run motor - permanent capacitor motor - shaded pole motor.

Commutator motors - construction and working - AC series motor-universal motor, repulsion motor

Special purpose motors - Construction and working -stepper motor -types- variable reluctance-permanent magnet-hybrid - ac and dc Servomotors - reluctance motor- hysteresis motor-switched reluctance motor

Fractional horsepower motors -Applications

Text / Reference:

T/R	Book Title/Author
T/R	BL Theraja. Electrical technology. Vol- II: S Chand & co.
T/R	JB Gupta. Theory and performance of electrical Machines: S. K. Kataria& Sons
T/R	prithwirajpurkait, Indrayudhbandyopadhyay:Electrical machines: Oxford university press.
T/R	SK Sahdev. Electrical Machines. Cambridge university press

Online resources

Sl.No	Website Link
1	www.nptel.iitm.ac.in electrical engineering
2	http://www.vssut.ac.in/lecture-notes.php?url=electrical-engineering-eee
3	https://www.electrical4u.com/
4	https://www.ee.iitb.ac.in/course/~emlab/lab-manual.html