22EE420 AC MACHINES

Category	L	T	P	Credit
PCC	2	1	0	3

Preamble

Rotating electrical machines are widely used for the purpose of converting energy from one form to another. Alternating Current (AC) machines are becoming more and more attractive in many applications such as those requiring variable speed and flexible control. Also, AC machines are the most preferred for generation of electric power. AC motors are the commonly used in industry for motive power for applications. There are three families of rotating machines one of which is the synchronous machine commonly in the form of the AC synchronous generator such machines are widely used in power stations for electric power generation. The synchronous motor has limited application. However, an asynchronous machine, the induction motor has wide spread industrial and domestic application such that about 85 % of electric power consumption is due to induction motor loads. Single phase motor has wide spread small power application for example in the home. Due to their low cost and economic advantages, AC motors are widely used in applications requiring a wide range of speeds or precise control of output.

Prerequisite

- 22EE230: Electric Circuit Analysis
- 22EE240: Electromagnetic Fields

Course Outcomes

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

CO NOs	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the construction and working principles of Synchronous machine	TPS2	80	80
CO2	Explain the construction and working principles of Asynchronous machine	TPS2	80	80
CO3	Obtain the performance of AC Generators	TPS3	80	80
CO4	Obtain the performance of AC Motors using equivalent circuit	TPS3	80	80
CO5	Explain the Operation and Control of AC Machines	TPS2	80	80
CO6	Apply the testing procedures for AC Machines as per the standard practice	TPS3	80	80

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L						M		M			M		
CO2	M	L						M		M			M		
CO3	S	M	L	L				M		M			S		
CO4	S	M	L	L				M		M			S		
CO5	M	L						M		M			M		
CO6	S	M	L	L				M		M			S		

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Assignment 1				Assignment 2				Terminal Examination					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6	3	4	5	6	1	2	3	4	5	6
CO1	10	10																			2	5				
CO2							10	15													2	5				
CO3	6	10	35										60								2	5	20			
CO4							8	15	35								60				2		15			
CO5	2	5																			2	5				
CO6	2	5	15				2		15				40				40					5	15			

Syllabus

SYNCHRONOUS MACHINE

Alternator: Types, Construction, working principle, Characteristics, Applications, Performance Analysis, Testing, Parallel operation, Voltage & Frequency control

Synchronous Motor: Starting Methods, Working Principles, Characteristics, Applications, Voltage and Power Factor control.

ASYNCHRONOUS MACHINE

Three Phase Induction Motor: Types, Construction, Working Principle, Characteristics, Applications, Performance Analysis, Types of losses and efficiency calculations, Equivalent Circuit, Circle Diagram, Starting Methods and Speed Control.

Single Phase Induction Motor: Types, Construction, Working principle, Applications, AC Series Motor.

SPECIAL MACHINES

Special Machines: Linear Induction Motor, Hysteresis Motor, Eddy Current Motor,

Brushless DC motor, Stepper motor, Induction Generator.

Text Book

1. H.Wayne Beaty & James. L.Kirtley. Jr "Electric Motor Handbook", McGraw-Hill, USA, 1st Edition, 1998.

Reference Books

1. A.K.Sawhney and A.Chakrabarti, "A course in Electrical Machine Design",6th Edition, Dhanpat Rai & Co (P) Ltd., 2006.
2. P. S. Bimbhra, "Electrical machinery", Seventh Edition, Khanna Publications, 2014.
3. Gupta.J.B,"Theory of Performances of Electrical Machines' Katson, 7th Edition, 1987
4. Stephen J.Chapman, "Electric Machinery Fundamentals', "McGraw Hill Intl. Edition, New Delhi, 6 th Edition, 2012.
5. Vincent Deldoro ," Electromechanical Energy Conversion " PHI III edition,
6. M.G.Say, The Performance and Design of Alternating Current machines, Tata-McGraw Hill.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
	SYNCHRONOUS MACHINE	
1	**Alternator**	
1.1	Types, working principle	2
1.2	Construction, Characteristics, Applications	2
1.3	Performance Analysis: Determination of Voltage	3

Module No.	Topic	No. of Periods
	regulation by EMF, MMF and ZPF	
1.4	Blondel two reaction Theory for salient pole machine, Phasor diagram using Xd, Xq, Testing	3
1.5	Parallel operation, Voltage & Frequency control	2
2	**Synchronous Motor**	
2.1	Working Principles, Starting Methods	2
2.2	Characteristics & Applications	2
2.3	Voltage and Power Factor control	2
ASYNCHRONOUS MACHINE		
3	**Three Phase Induction Motor**	
3.1	Types, working Principle	2
3.2	Construction, Characteristics, Applications	2
3.3	Types of losses and efficiency calculations	1
3.4	Performance Analysis, Equivalent Circuit	3
3.5	Starting Methods, Speed Control	2
4	**Single Phase Induction Motor**	
4.1	Types, Construction, Working principle	2
4.5	Applications, AC Series Motor	2
5	**Special Machines**	
5.1	Linear Induction Motor, Hysteresis Motor	1
5.2	Eddy Current Motor, Stepper Motor	1
5.3	Brushless DC motor, Induction Generator	1
5.4	Testing, Standards, Specifications	1
	Total	36

Course Designer(s):

Dr. S. Latha, Professor, EEE - sleee@tce.edu

Dr. D. Nelson Jayakumar, Assistant Professor, EEE – dnjayakumar@tce.edu