

Kadi Sarva Vishvavidyalaya, Gandhinagar
Bachelor of Engineering (Electrical Engineering Syllabus)

ELECTRICAL MACHINE-II
B.E. SEM-IV SUBJECT CODE: EE-403

A. Course Objective:

To identify & formulate solutions to problems relevant to synchronous machine.

To identify & formulate solutions to problems relevant to Induction motor.

To study and design various types of AC winding.

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Examination Scheme					Total Mark s
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EE-403	ELECTRICAL MACHINE-II	3+1*	0	2	6	4	3	70	30	20	30	150

*Non Credit Lecture

AC Armature Winding:

Number of Phases & Phase spread, Concentric winding, Mush winding, Double layer winding, Integral slot lap & wave winding, Fractional Slot winding, Concentrated & Distributed winding in machines

Three Phase Induction Motor:

Classification of AC motors, working principle, Synchronous Speed, speed of rotor field, slip, starting & running torque, torque-slip characteristics, Starting & maximum torque, Rotor emf, effect of change in voltage & frequency on torque, speed & slip, Measurement of Slip, No-load & blocked rotor test, equivalent circuit, Phasor diagram, Circle diagram, Effect of rotor resistance on performance of induction motor, Double cage squirrel cage I.M. and its equivalent circuit,

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Synchronous Machines:

Alternator:

Introduction, Stationary armature, rotor, Armature winding, Distribution factor, Emf equation, Alternator on load, Synchronous reactance, Voltage regulation, Methods of Voltage regulation i.e. EMF method, MMF method, Potier Triangle method, Torque, Operations, Machine efficiency, Armature reaction and its compensation, Short circuit ratio, Effect of increase in excitation, Effect of change in torque and speed, Determination of Synchronous reactance, AIEE methods, Synchronizing & load shadding between two machines Operating characteristics, Load angle and Power flow equations, Capability curves, Two reaction model of Salient pole machines, Effect of unequal voltages & percentage impedance, Short circuit transients, single phase generators, Slip test for measurement of X_d and X_q , Sudden short circuit of Synchronous machine.

Synchronous Motor:

Methods of starting of synchronous motors, Different torques in Synchronous motor, Synchronous motor with different excitation, Stability, Power developed by synchronous motor, Synchronous condenser, Synchronous phase modifiers, V-curves and O-curves of Synchronous motors, hunting of synchronous machines and its prevention

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures, practical's and Tutorial which carries 05 Marks.
- At regular intervals assignments is given. In all, a student should submit all assignments of 05 marks each.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries 05 Marks.
- Viva Voce will be conducted at the end of the semester of 05 Marks.
- One internal exam of 30 marks is conducted as a part of mid semester evaluation.
- Experiments shall be performed in the laboratory related to course contents.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

C. Lesson Planning

SR No.	Lectures (Hours)	Weightage in % in Exam	Topic
1	08	15	Number of Phases & Phase spread, Concentric winding, Mush winding, Double layer winding, Integral slot lap & wave winding, Fractional Slot winding, Concentrated & Distributed winding in machines

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2	06	35	Introduction, working principle, Classification of AC motors, Synchronous Speed, speed of rotor field, slip, starting & running torque, torque-slip characteristics, maximum torque
3	12		Rotor emf, effect of change in voltage & frequency on torque, speed & slip, Measurement of Slip, No-load & blocked rotor test, equivalent circuit, Phasor diagram, Circle diagram, Effect of rotor resistance on performance of induction motor, Double cage squirrel cage I.M. and its equivalent circuit
6	04	50	Introduction, Stationary armature, rotor, Armature winding, Distribution factor, Emf equation, Alternator on load, Synchronous reactance, Voltage regulation
7	08		Methods of Voltage regulation i.e. EMF method, MMF method, Potier Triangle method, Torque, Operations, Machine efficiency
8	12		Armature reaction and it's compensation, Short circuit ratio, Effect of increase in excitation, Effect of change in torque and speed, Determination of Synchronous reactance, AIEE methods, Synchronizing & load shading between two machines Operating characteristics, Load angle and Power flow equations, Capability curves, Two reaction model of Salient pole machines, Effect of unequal voltages & percentage impedance, Short circuit transients, single phase generators, Slip test for measurement of X_d and X_q , Sudden short circuit of Synchronous machine.
10	08		Different torques in Synchronous motor, Stability, Synchronous condenser, Synchronous phase modifiers, V-curves and O-curves of Synchronous motors., hunting of synchronous machines and its prevention.
	60	100	

D. Instructional Method & Pedagogy

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.

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- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

- **Suggested List of Experiments:**

1. Direct Load test on Alternator
2. Voltage Regulation of an Alternator by Synchronous Impedance Method
3. Voltage Regulation of an Alternator by Ampere-turn or mmf method
4. Voltage Regulation of an Alternator by Zero Power Factor (ZPF) Method
5. Short Circuit Ratio(SCR) of a Synchronous machine
6. Slip test on Synchronous machine
7. Synchronization of an alternator
8. Construction and Study of Synchronous Motor
9. V-curves of Synchronous Machine
10. Direct load test on 3-Phase Induction Motors.
11. No-load test and Blocked rotor test on 3-phase I.M.

Students Learning Outcomes

On successful completion of the course

- The students will be able to effectively employ electrical systems and lead the exploration of new applications and techniques for their use.

Suggested Books:

1. Electrical Machines, by Nagarath & Kothari Tata Macgraw hill Pub.
2. Electrical Machines by J. B. Gupta, (S.K.Kataria& Sons).
3. Electrical Technology Vol II. B. L. Theraja. S chand publication.
4. Electrical Machines by P S Bhimbra, Khanna Pub.
5. Performance and Design of A.C. machines by M. G. Say,CBS pub.
6. Electrical machine Drives and Power System by Wildi ,6th Edition, Pearson Publications.