NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**V**
Course Code:	**3EE101CC24**
Course Title:	**Rotating AC Machines**
Course Type:	**Core**
Year of Introduction:	**2024 – 25**

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Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. illustrate constructional features and operating principle of induction machine and synchronous machine (BL2)
2. analyse characteristics of induction machine and synchronous machine for different operating conditions (BL4)
3. evaluate performance parameters of induction machine and synchronous machine (BL5)
4. select induction machine and synchronous machine for specific application (BL3)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Polyphase Induction Machines** Construction, rotating magnetic field, principle of operation, torque and power equations, torque/slip characteristics, performance calculations, vector diagram, equivalent circuit, circle diagram, manual and automatic starting methods, speed control – conventional and v/f control, crawling and cogging, modelling of induction motor, applications of induction motor, energy efficient induction motor, operating principle and applications of induction generator.	**16**
Unit-II	**Single-phase AC Motors** Types, double field revolving theory, equivalent circuit, determination of motor parameters, methods of starting, applications, universal motor, repulsion motor.	**05**
Unit-III	**Alternator** Principle of operation, constructional features and types, emf equation, distributed ac windings, distribution and coil span factors, effect of harmonics on emf and its elimination, armature reaction in cylindrical and salient pole machines, two reaction theory, equivalent circuit of cylindrical and salient pole machines, voltage equation, output equations, vector diagrams, voltage regulation by synchronous impedance, MMF and Zero Power Factor (ZPF) method, Short Circuit Ratio (SCR), concept of reactive power control through excitation system, condition for maximum power, synchronizing power and torque, synchronizing conditions and methods, operational aspects of alternators on infinite bus.	**15**

Unit-IV **Synchronous Motor** **09**

Operating principle, voltage equation, phasor diagram, torque and power equations, steady state operating characteristic, 'V' and inverted 'V' curves, starting, hunting, damper windings and its effect, synchronous condenser, working principle of auto synchronous motor

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- E. Fitzgerald, *Electric Machinery*, Tata McGraw-Hill.
- M. G. Say, *Performance and Design of Alternating Current Machines*, CBS Publishers.
- P.S. Bimbhra, *Electrical Machinery*, Khanna Publishers.
- I. J. Nagrath and D. P. Kothari, *Electrical Machines*, Tata McGraw-Hill.
- J B Gupta, *Theory and Performance of Electric Machi*nes, Katson Books.
- Alexander S. Langsdorf, *Theory of Alternating Current Machinery*, Tata McGraw-Hill.
- P.S. Bimbhra, *Generalised Theory of Electrical Machines*, Khanna Publishers.
- Recent relevant standards.
- Recent literature in renowned journals.

Suggested List of Experiments: Laboratory work will be based on the above syllabus with minimum 10 experiments to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

Sr. No.	Name of Experiment	Hours
1.	To plot and analyse the equivalent circuit of a three-phase induction motor from no load and locked rotor test data	2
2.	To evaluate the performance of three-phase induction motor using circle diagram	2
3.	To examine the load characteristics of three- phase induction motor.	2
4.	To plot and analyse the equivalent circuit of a single-phase induction motor from no load and locked rotor test data	2
5.	To evaluate the performance index (regulation) of an alternator by Synchronous impedance method	2
6.	To estimate the percentage regulation of an alternator by MMF method and by zero power factor method	2
7.	To obtain the direct axis and quadrature axis reactance of a salient pole alternator by slip test	2
8.	Comparative study of synchronization of two three - phase alternators by; Dark lamps method, Two lamps bright and one dark lamp method, Synchro scope method	2
9.	To plot and analyse the 'V' curves of a synchronous motor	2
10.	To analyse the repulsion motor behaviour from load test.	2
11.	To model and analyse the three-phase induction motor.	2
12.	To perform transformation from three-phase systems to two-phase systems	2