FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **V**

Course Code: **202050502**

Course Title: **Electrical Machines-II**

Course Group: **Professional Core Course-VIII**

Course Objectives: Electrical power sector is the backbone of industries, agriculture, irrigation, urban development and almost all the segments of society. In view of this, the rotating electrical machines play a vital role for society. This subject deals with the theory and performance analysis of various rotating electrical machines.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
4	0	2	5	50 / 18	50 / 17	25/9	25/9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Induction Machines:** Revision of the concept of rotating magnetic field. Construction, working and types of induction motor (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. No-load & blocked rotor test, Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Induction generator operation. Self-excitation of an induction generator. Double cage induction motor. Circle diagram of induction motor. Effect of harmonics, Cogging & Crawling, Effect of unbalanced voltages on performance of motor.	16

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2	**Single-phase induction motors:** Constructional features double revolving field theory, equivalent circuit, Determination of parameters. Split-phase starting methods and applications. Universal motor. Repulsion motor. Shaded pole single phase motor.	**08**
3	**Alternator:** Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Methods to find voltage regulation: Synchronous impedance method, MMF method, ZPF method. Operating characteristics of synchronous machines, Salient pole machine – two reaction theory, power angle characteristics. Parallel operation of alternators - synchronization and load division.	**16**
4	**Synchronous Motor:** Principle of reversibility, 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.	**08**
5	**Special machines:** Magnetic levitation principle, advantages and applications of linear induction motor. Introduction to axial flux machines. Construction, working and applications of Permanent magnet brushless DC motor, Stepper motor and Switched reluctance motor.	**08**

List of Practicals / Tutorials:

1	Direct Load Test on Three-Phase Induction Motor.
2	To perform no load and blocked rotor test on three phase induction motor to obtain the parameters of equivalent circuit.
3	To perform no load and blocked rotor test on three phase induction motor to evaluate the performance parameters using circle diagram.
4	To perform no load and blocked rotor test on single phase induction motor to obtain the parameters of equivalent circuit.
5	To perform the Speed control of a 3-Phase Induction motor using v/f method.
6	To find out the voltage regulation of three phase alternator using direct load test.
7	To perform open circuit, short circuit and resistance measurement tests on alternator to find out its voltage regulation using synchronous impedance method and MMF methods.
8	To perform open circuit, short circuit, zero power factor and resistance measurement tests on alternator to find out its voltage regulation using ZPF method.
9	To perform synchronization of alternator using dark lamp method, two bright one dark lamp method and synchroscope.
10	To obtain direct axis and quadrature axis reactance of salient pole synchronous machine using slip test.
11	To obtain the v-curves of a synchronous motor.

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12	To study the construction and working of special electric machines like stepper motor, permanent brushless DC motor and switched reluctance motor.

Reference Books:

1	B L Theraja, "Electrical Technology – Part II", S Chand Publications, 2011.
2	J B Gupta, "Theory and Performance of Electrical Machines", Katson Publication, 2009.
3	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4	I J Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010
5	E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
6	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
7	G.C. Garg, "Electrical Machines- II", Khanna Publishers.
8	E G Janardanan, "Special Electrical Machines ", PHI Learning Pvt Ltd.

Supplementary learning Material:	
1	https://electrical-engineering-portal.com/
2	https://www.electrical4u.com/
3	www.nptel.ac.in
4	https://interestingengineering.com/electrical-engineering-salaries-worldwide

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	20%	20%	20%	20%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Describe the construction, working principle and applications of induction machines and synchronous machines	**30**
CO-2	Analyze the performance of rotating electrical machines using the tools like equivalent circuit, phasor diagram and circle diagram	**30**
CO-3	Evaluate the performance parameters of rotating machines with different operating conditions	**30**
CO-4	Illustrate the construction, working, applications and advantages of special machines	**10**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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