SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B.Tech. – I Year Semester II

Subject Name: Electrical Machines II **Subject Code: BTEL13282**

Type of course: **Professional Core Course**
Prerequisite: **Basic Electrical Engineering, Electrical Machines-I**
Rationale: Electrical power sector is the foundation of industries, agriculture, irrigation, urban development and almost all the segments of society. In view of this, the rotating electrical machines play a significant role for the society. This subject deals with the theory, applications and performance analysis of various electrical machines.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks		Practical Marks		Total
L	T	P	C	TEE	CAT	TEP	CAP	150
4	0	2	5	60	40	30	20	

CAT: Continuous Assessment (assignments/projects/open book tests/closed book tests **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CAP:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
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 induction generator. Double cage induction motor. Circle diagram of induction motor. Effect of harmonics, Cogging & Crawling, Effect of unbalanced voltages on performance of motor. Routine and Type test of Induction motor. induction motor faults and troubleshooting.	19	30
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.	07	15
3.	**SYNCHRONOUS MACHINES** 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,	15	30

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	ZPF method. Operating characteristics of synchronous machines, Salient pole machine, two reaction theory, power angle characteristics. Parallel operation of alternators - synchronization and load division.		
4.	**SYNCHRONOUS MOTORS** Working principle of synchronous motor Methods of starting of synchronous motors, Different torques in Synchronous motor, Stability, Synchronous condenser, Synchronous phase modifiers, V-curves of Synchronous motors. Auto synchronous motor. Routine and Type test of Synchronous Machine.	**11**	**15**
5.	**SPECIAL MACHINES** Magnetic levitation principle, advantages and applications of linear induction motor. Construction, working and applications of Permanent magnet brushless DC motor, Stepper motor and Switched reluctance motor.	**08**	**10**

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**20**	**20**	**20**	**20**	**00**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

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

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Describe the construction, working principle and application of 3-phase induction motor and induction generator	15
CO-2	Describe the construction, working principle and application of 3-phase synchronous generator and 3 -phase synchronous motor	15
CO-3	Analysis the performance of rotating electrical machines using the tools like equivalent circuit, phasor diagram, circle diagram.	30
CO-4	Evaluate the performance parameters of rotating machines with different percentage of full load loading conditions and overload condition.	30
CO-5	Describe the construction, working principle and application of special machines	10

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Mapping with POs:

	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
CO-1	2	1	1	1	2					1			1	1	
CO-2	2	1	1	1	2					1			1	1	
CO-3	2	3	3	3	2		1	1	2	2	1	1	2	3	2
CO-4	2	3	3	3	2	1			2	2	1		2	3	2
CO-5	2	1	1	1	2					1			1	1	2

List of experiments

1. Equivalent circuit and circle diagram of 3-phase induction motor.
2. Load test on 3-phase induction motor
3. Speed control of 3-phase induction motor.
4. Equivalent circuit of single-phase induction motor.
5. To study about the starters of 3-phase induction motor.
6. Zero power factor method for finding out voltage regulation of an alternator.
7. Synchronous impedance method for finding out voltage regulation of an alternator
8. Measurement of Xd and Xq of synchronous machine.
9. 'V' and inverted 'V' curves of synchronous motor.
10. To study the synchronization of two three phase alternators or one alternator with grid using different methods.

Reference Text Books:

1. Nagrath and Kothari, "Electric Machines", TMH, New Delhi, 2005.
2. M. G. Say, The perfonnance and design of alternating cmTent machines, CBS Publishers and Distributors, Delhi, 1983.
3. P. K. Mukherjee and S. Chakravorty, Electrical Machines, Dhanpat Rai Pub., New Delhi, 2005.
4. Fitzgerald, Kingsley and Umans, Electric Machinery, Tata McGraw Hill,New Delhi, 2003
5. J B Gupta, "Theory and Performance of Electrical Machines", Katson Publication, 2009.
6. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Major Equipments:

Required number of machines, panels, meters, accessories and instruments etc… to be provided to conduct the above experiments in a group of maximum 6 students. Charts and cut section models of various machines should be provided for better understanding.

List of Open Source/learning website:

- https://nptel.ac.in/courses/108/102/108102146/
- https://nptel.ac.in/courses/108/105/108105131/
- https://nptel.ac.in/courses/108/106/108106072/
- http://www.scilab.org/
- http://www.gnu.org/software/octave/
- http://www.vlab.co.in
- http://www.femm.inf

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