GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170909
Semester – VII
Subject Name: AC Machine Design

Type of course: Professional Elective Course

Prerequisite:

Rationale:

Electrical machines serve as the backbone for the electrical power sector. The knowledge of electrical machines design is essential for manufacturing as well as the pre-installation performance analysis. The design is also essential for the practicing engineers in the research and development field. This subject deals with design of electrical machines including basics of computer aided design.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction** Major considerations in electrical machine design, Electrical engineering materials, Space factor, Choice of specific electrical and magnetic loadings, Thermal considerations, Heat flow, Temperature rise, Rating of machines.	05
2	**Design of transformers** Sizing of a transformer, Main dimensions, kVA output for single- and three-phase transformers, Window space factor, Overall dimensions, Operating characteristics, Voltage regulation, No load current, Temperature rise in transformers, Design of cooling tank, Methods for cooling of transformers.	10
3	**Design of induction motors** Sizing of an induction motor, Main dimensions, Length of air gap, Rules for selecting rotor slots of squirrel cage machines, Design of rotor bars & slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, Leakage reactance of poly phase machines, Magnetizing current, Short circuit current, Circle diagram, Operating characteristics.	10
4	**Design of synchronous machines** Sizing of a synchronous machine, Main dimensions, Design of salient pole machines, Short circuit ratio and its significance, Shape of pole face, Armature design, Armature parameters, Estimation of air gap length, Design of rotor, Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turbo alternators.	10
5	**Computer aided design** Need for CAD analysis, Synthesis and hybrid methods, Design optimization methods, Variables, Constraints and objective function, Problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines- Permanent Magnet Synchronous Machines, Brushless DC Machines and Switched	10

	Reluctance Machines.	

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	30	25	10	-

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

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.

Reference Books:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 2010
2. R. K. Agarwal, "Principles of Electrical Machine Design", S. K. Kataria and Sons, 2009
3. M.G. Say, "Theory & Performance & Design of A.C. Machines", CBS Publishers, 2005
4. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
5. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2015.
6. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Course Outcomes:

After completing the course, students will be able to;

Sr. No.	CO statement	Marks % weightage
CO-1	Select appropriate design parameters according to applications and rating of electrical machines	20
CO-2	Design the AC machines as per the given specifications	40
CO-3	Evaluate the performance parameters of electrical machines using design parameters	20
CO-4	Formulate the optimum design problem and solve it with computer aided tools	20

List of Experiments:

This is a suggestive list only:

1. Electrical machine design problems should be given for practice to the students. At least 8-10 design problems with different ratings should be practiced by the students
2. Computer aided design problems 1-2 should be practiced by the students

3. 3D visualization of various electrical machine components should be demonstrated to students during lab sessions using open source softwares.

Major Equipment:

Charts and cut section models of various electrical machines, CAD softwares like ANSYS etc..

List of Open Source Software/learning website:

- E-materials available at the website of NPTEL- http://nptel.ac.in/