FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Electrical Engineering)

Semester: VII

Course Code: 202050704

Course Title: Computer Aided Electrical Machine Design

Course Group: Professional Elective Course-III

Course Objectives: 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 & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 09	25 / 09	150 /53

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

Detailed Syllabus:

Sr.	Contents	Hours
1	**Basic Concepts of Electrical Machine Design:** Introduction, Specification, Output Coefficient, Importance of Specific Loadings, Electrical Materials, Magnetic Circuit Calculations, General Procedure for Calculation of Amp-Turns, Thermal considerations, Heat flow, Temperature rise, Rating of machines.	06

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. Flow-chart for computer programming for the overall design of Transformer.	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 polyphase machines, Magnetizing current, short circuit current. Sequential Steps for Design of Each Part and computer programming.	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. Sequential Steps for Design of Each Part and computer programming.	10
5	**Computer Aided Design (CAD) of Electrical Machines:** Limitations and assumptions in traditional designs, need of CAD, analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Analytical design modules, Application of FEM technique for design problems. Use of open-source FEM software for 2D and 3D machine models, analyzing steady state and transient performance of the designs by different software.	06

List of Practicals / Tutorials:

1	Tutorials based on general concepts and constraints in design of electrical machines.
2	Prepare a flowchart and computer program related to problems on general concepts and constraints in design of electrical machines.
3	Design of transformers: design of core and overall dimension of transformer main frame.
4	Prepare a flowchart and computer program related to problems on design of core and overall dimension of transformer main frame.
5	Design of windings, calculations of winding parameters, voltage regulation and efficiency, design of tank and tubes of transformer.
6	Design of Induction Motor: main dimensions of induction motor, stator design of 3-phase induction motor.
7	Prepare a flowchart and computer program for the main dimensions of induction motor, stator design of 3-phase induction motor.
8	Design of rotor of 3-phase squirrel cage and slip-ring induction motor.
9	Operating characteristic of 3-phase induction motor.
10	Design of salient pole synchronous machines: output equation and main dimensions, stator slots, armature mmf, length of air gap.
11	Prepare a flow chart and computer program for the calculation of output equation and main dimensions of synchronous machines.
12	Design of rotor, damper winding, and magnetic circuit calculations of synchronous machines.

Reference Books:

1	A.K. Sawhney – "A Course in Electrical Machine Design" 10th Edition - Dhanpat Rai and sons New Delhi.
2	R. K. Agarwal, "Principles of Electrical Machine Design", S.K. Kataria & Sons, Fifth Edition 2016, New Delhi.
3	M. G. Say –The Performance and Design of A.C. Machines, 3rd Edition, CBS Publishers and distributors, Delhi, Reprint 2002.
4	Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.
5	K.M. Vishnu, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
6	M Ramamurthy, "Computer-Aided Design of Electrical Equipment", John Wiley & Sons.
7	An Introduction to the Finite Element Method – J Reddy, TMH Publication

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;

R	U	A	N	E	C	**N**: Analyzing; **E**: Evaluating; **C**: Creating
20%	30%	20%	10%	10%	10%	

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.

Course Outcomes (CO):

Sr. No.	Course Outcome Statements	%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	Explain the concepts related to computer aided design of electrical equipment.	**20**
CO-4	Formulate and solve the optimum design problems with computers.	**20**

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