

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09)

COMPUTER AIDED ANALYSIS AND DESIGN FOR ELECTRICAL ENGG.

SUBJECT CODE:2160911

B.E. 6th SEMESTER

Type of course: Engineering Science (Electrical)

Prerequisite: Elements of Electrical Engineering, DC Machines and Transformer, Elements of Electrical Design

Rationale: The design of most of the electrical equipments (machines) is an iterative process. The final objective is to design the most efficient equipment, with minimum size, weight and cost. There are number of constraints in the actual design process. In this scenario, the application of computers for design is a very powerful alternative and is being used by the researchers. This subject focuses on application of computer for design of various electrical equipments.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1.	CONCEPT OF COMPUTER-AIDED DESIGN AND OPTIMIZATION Introduction; Computer Aided Design; Explanation of details of flow chart; Input data to be fed into the program; Applicable constraints Max or Minimum permissible limits; Output data to be printed after execution of program; Various objective parameters for optimization in an electrical machine; Selection of optimal design; Explanation of lowest cost and significance of "Kg/KVA"; Flowcharts.	8	12
2.	BASIC CONCEPTS OF DESIGN Introduction; Specification; Output coefficient; Importance of specific loadings; Electrical Materials: Conducting Materials, Insulating Materials and Magnetic Materials; Magnetic circuit calculations; General procedure for calculation of Amp-Turns; Heating and Cooling; Modes of heat dissipation; Standard ratings of Electrical machines; Ventilation schemes in static machines (Transformers) and in rotating machines; Quantity of cooling medium; Types of enclosures; General design procedure; Steps to get optimal design.	6	12
3.	APPLICATION OF FINITE ELEMENT METHOD IN DESIGN: Introduction; Basics of Finite element, Shape functions, Single element computation. Assembly of elemental coefficient matrix, Global coefficient matrix, Application of FEM technique for design problems. Use of open source FEM software for 2D design. Computation of Capacitance of capacitor, cable, multi dielectric cable through FEM, Computation of electrostatic field for	8	16

	various geometry, skin and proximity effect in conductors		
4.	COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS: Introduction; Flowcharts and programs for computer aided design of Starters, field regulators, small transformers, choke coils. 2D FEM open source software based electrical apparatus design	4	10
5.	COMPUTER AIDED DESIGN OF DC MACHINES: Introduction; Flowcharts and programs for computer aided design of DC machines. 2D FEM open source software based DC machine part design	8	25
6.	COMPUTER AIDED DESIGN OF TRANSFORMERS: Introduction; Flowcharts and programs for computer aided design of transformers. 2D FEM open source software based transformer part design	8	25

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	10	10	20	0

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. Computer aided design of electrical machines - K M Vishnu Murthy, B S Publications
2. Computer aided design of electrical machines – Maurya, Jallan, Shukla, Kataria publication
3. An Introduction to the Finite Element Method – J Reddy, TMH Publication

Course Outcome:

After learning the course the students should be able to:

1. Explain the concepts related to computer aided design of electrical equipments.
2. Formulate and solve the optimum design problems with computers.

List of Experiments: (This is a suggestive list only)

During the laboratory hours, the design problems based on the syllabus should be assigned to the students. Students should develop the constraint based design problems and solve them using suitable computer programs. Minimum ten computer programs must be prepared and evaluated at the end of the term.

Design based Problems (DP)/Open Ended Problem:

- (1) Prepare a flow chart and computer program for optimum design of a small transformer with given specifications and constraints. Use of GUI (Graphical User Interface) may be a better choice.
- (2) Prepare a flow chart and computer program for optimum design of starter for a DC motor with given specifications and constraints. Use of GUI may be a better choice.
- (3) Prepare a flow chart and computer program for optimum design of field regulator for a DC motor with given specifications and constraints. Use of GUI may be a better choice.

- (4) Prepare a flow chart and computer program for optimum design of a choke coil with given specifications and constraints. Use of GUI may be a better choice.
- (5) Prepare a flow chart and computer program for optimum design of a distribution transformer with given specifications and constraints. Use of GUI may be a better choice.
- (6) Prepare a flow chart and computer program for optimum design of a power transformer with given specifications and constraints. Use of GUI may be a better choice.
- (7) Prepare a flow chart and computer program for optimum design of a DC motor to be used for industrial applications with given specifications and constraints. Use of GUI may be a better choice.
- (8) Prepare a flow chart and computer program for optimum design of a small DC motor to be used for a lab with given specifications and constraints. Use of GUI may be a better choice.
- (9) Prepare a small transformer model using finite element technique.
- (10) Do a survey and prepare a report on application softwares being used for computer aided design of electrical equipments. List their relative merits and demerits.
- (11) Do a literature survey about the optimization techniques for design problems.
- (12) Find leakage inductance of transformer using FEM software
- (13) Find force on plunger using FEM software

Learning website

- <http://www.electrical-engineering-portal.com/>
- <http://nptel.iitm.ac.in/courses.php>

www.femm.info

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.