GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09)
DESIGN OF DC MACHINES AND TRANSFORMER
SUBJECT CODE:2160912
B.E. 6thSEMESTER

Type of course: Engineering Science (Electrical)

Prerequisite: Elements of Electrical Engineering, DC Machines and Transformer

Rationale:NA.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	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	GENERAL DESIGN ASPECTS: Specific electric loading and Specific magnetic loading; Output coefficient; Output equations for transformers and rotating machines; Factors affecting size of machines; Criteria for selection of specific loadings; Heating and Cooling of Transformers and rotating machines.	**6**	**20**
2	DESIGN OF THREE PHASE TRANSFORMER: Types of transformers; Position of HV and LV windings and its importance; Relation between core and yoke cross section area and its significance; Different types of transformer windings; Different positions of taping; Window space factor; Factors affecting window space factor; Relation between emf per turn and transformer rating; Stacking factor. MAIN DIMENSIONS: Design of window dimensions, yoke dimensions and overall core dimensions; Numerical examples. DESIGN OF WINDINGS: Design of HVand LV windings (No. of turns and area of cross section); Selection of type of winding. PERFORMANCE PARAMETERS ESTIMATION: Primary and secondary winding resistance and Leakage reactance calculation; Calculation of no load current, losses and temperature rise of transformer; Design of tank with tubes; Calculation of dimension of tank; Numerical examples. Variation of output and losses in transformer with linear dimensions; Basic design aspects of dry transformer and high frequency transformers. Basic design aspects of welding transformers and instrument transformers.	**18**	**40**

3	DESIGN OF DC MACHINES: Introduction; Output equation; MMF calculation; Selection of number of poles; Design of core length and armature diameter; Carter's fringing curves and its significance; Design of length of air gap; Numerical examples. ARMATURE DESIGN: Choice of armature winding; Armature conductor; Number of armature slots; Slot dimensions; Slot loading; Design of armature core; Numerical examples. DESIGN OF FIELD SYSTEMS: Pole design; Design of field winding of shunt, series and compound machines; Design of inter poles; Effects and minimization of armature reaction; Design of commutator and brushes; Numerical examples. Performance parameters evaluation.	**18**	**40**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**25**	**15**	**10**	**10**	**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. A course in electrical machine Design – A. K. Sawhney
2. Electrical Machine Design – R. K. Agrawal
3. Design of Electrical Machine- V. N. Mittle

Course Outcome:

After learning the course the students should be able to:

1. Design the DC machine of given specifications.
2. Design the transformers of given specifications.
3. Prepare the detailed sketches of the designed machines.

List of Experiments:

During the laboratory hours, the design problems based on the syllabus should be assigned to the students. After carrying out the detailed design, drawing sketches should be prepared by the students. Minimum five drawing sheets must be prepared and evaluated at the end of the term.

Design based Problems (DP)/Open Ended Problem:

(1) Carry out the detailed design of a 63 kVA, 11 kV/440 V, 50 Hz, Three phase, Delta/Star, core type, oil immersed, natural cooled distribution transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer.

(2) Carry out the detailed design of a 10 MVA, 66 kV/11 kV, 50 Hz, Three phase, Delta/Star, core type, oil immersed, Oil natural Air forced cooled power transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer.

(3) Carry out the detailed design of a 100 MVA, 132 kV/66 kV, 50 Hz, Three phase, Star/Star, core type, oil immersed, Oil forced Air forced cooled power transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer.

(4) Do the survey of latest trends in transformer manufacturing technology and corresponding applications. What is its impact on the power system? Use internet and other resources.

(5) Carry out the detailed design of a 50 kW, 240 Volt, 1500 rpm, DC shunt motor to be used for industrial application. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed machine with appropriate scale.

(6) Carry out the detailed design of a 3.8 kW, 240 Volt, 1500 rpm, DC shunt machine to be used for the laboratory of an academic institution. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed machine with appropriate scale.

Major Equipment:

Lab set ups of following machines

(1) Cut section models of (a) Transformer (b) DC machine
(2) Charts to explain various parts of machines

List of Open Source Software/learning website:

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php
3. Virtual Lab Website www.vlab.co.in

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.