

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING ELEMENTS OF ELECTRICAL DESIGN SUBJECT CODE: 2150904 B.E. 5th SEMESTER

Type of course: Engineering Science (Electrical)

Prerequisite: Elements of Electrical Engineering, DC Machines and Transformer

Rationale: This course is a preliminary course for design of various electrical equipments. The aim is to provide the basic principles useful for the subjects related to design in subsequent semesters. The course also includes basics of estimation and costing of house wirings and commercial wirings.

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 | | | |
| 2 | 0 | 2 | 4 | 70 | 20 | 10 | 20 | 10 | 20 | 100 |

Content:

| Sr. No. | Content | Total Hrs | % Weightage |
|-----------|---|-----------|-------------|
| 1. | GENERAL DESIGN ASPECTS: Basic principles of magnetic circuits – use of B-H curves in magnetic circuit; Calculations of MMF for air gap and teeth; Real and apparent flux density; Field Form; Air gap flux distribution factor (field form factor); Magnetising current calculation; Leakage Reactance calculation for various types of slots, Iron loss calculation concepts; Insulating Materials & Classifications. | 6 | 20 |
| 2 | DESIGN OF STARTERS AND FIELD REGULATORS: Introduction and review of A.C. and D.C. starters; Schematic diagrams of control circuit and power circuit for starters with contactors and timers. Design of starters and Field regulators. DESIGN OF SMALL TRANSFORMERS AND CHOKE COILS: Design of Small single-phase transformers; Design of variable air gap single phase and three phase choke coil; Design of ballast | 6 | 20 |
| 3 | Armature Windings: DC windings : Simplex & Duplex windings; Lap & Wave windings; Applications; Basic terms related to armature windings; Dummy Coils; Equalizer connections; Split coils. AC windings : Introduction; No. of phases; Phase spread; Concentric winding, Hemitropic winding; Whole coil winding; Mush winding; Double layer windings; Integral slot lap and wave winding; Fractional slot lap and wave windings; Performance analysis of various windings. | 8 | 20 |
| 4. | Estimation and Costing for Residential and Commercial wiring: Preparation of schematic diagrams and estimation of cost of wiring for | 5 | 20 |

| | | | |
|-----------|---|----------|-----------|
| | Tenaments, Row houses, Bungalows, Flats, Multi – Storied Buildings, Commercial Complexes like Offices, Hospitals, Hotels, Theatres. | | |
| 5. | Design consideration of Electrical Installation: Types of load, Electrical Supply Systems, Wiring systems, Load Assessment, Permissible voltage drops & Conductor size calculations, Design of Control panel. Estimation and costing for service connections. | 5 | 20 |

NOTE : Minimum 30 to 40% weightage should be given to numerical problems in the theory exams.

Suggested Specification table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 20 | 20 | 30 | 10 | 10 | 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 course in electrical machine Design – A. K. Sawhney
2. Electrical Machine Design – R. K. Agrawal
3. Design of Electrical Machine - V. N. Mittle
4. Elements of Electrical Design – J G Jamnani

Course Outcome:

After learning the course the students should be able to:

- Explain the basic concepts related to design of electrical equipments.
- Design the starters, field regulators, small transformers and choke coils.
- Draw and explain the winding diagrams for AC and DC machines.
- Estimate the cost of wirings.

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. After carrying out the detailed design, drawing sketches and winding diagrams should be prepared by the students. Minimum five drawing sheets must be prepared and evaluated at the end of the term.

Major Equipment:

Lab set ups of following machines

- (1) Cut section models of (a) Transformer (b) DC machine
- (2) Small transformers, starters, choke coils etc
- (3) Charts to explain various parts of machines

List of Open Source Software/learning website:

Learning website

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

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.