Course Name: Electrical system Design I
Course Code: EE-782
Credit: 2

Prerequisites:

Sl. No.	Subject	Description	Level of Study
01	Electromagnetism	Basic concept on magnetic and dielectric material, magnetic induction.	3rd Semester
02	electrical machine	Detailed construction and theoretical knowledge on transformer	4th Semester, 5th Semester
03	Power System	Theoretical concept of substation, Bus-bar arrangement.	6th semester

Course Objective:

- To introduce students with different parts of electromagnetic machine for design.
- To familiarize the students with the design method of underground substation and indoor substation.
- To expose the students about transformer design.

Course Outcomes:

At the end of the course, a student will be able to:

1. **Formulate strategies** for step by step design of electrical systems, machine elements and components within realistic constraints of technical, social, environmental, economic, safety, and ethical guidelines in comprehensive uses of the technical knowledge gained from previous courses in realistic design electrical systems.

2. **Design** electrical systems, machine elements and components to meet desired customer requirements for a given application following regional, national, and international (BS, IEEE, NEMA, IEC) standard charts, tables, and thumb rules.

3. **Collect information in the emerging areas** of electrical system design aspects and implement the same in designing different electrical components and systems and Employ concepts of design in applications demanding multi-disciplinary involvements in electrical, mechanical, civil, chemical industries, commercial installations and domestic areas.

4. **Evaluate possible causes of discrepancy** in practical observations realized during design of real life electrical systems in comparison to theoretical knowledge and Prepare professional quality design report elaborating design data, design steps, design assumptions, design constraints, and design standards utilizing mathematical software, word and image processing tools.

5. **Apply project management skills** including scheduling work, selecting and procuring components parts, documenting expenditures, working with deadlines etc. while implementing a complete design.

6. **Demonstrate the ability** to interact effectively on a social and interpersonal level with fellow students, and will have the ability to divide up and share task & responsibilities to complete design assignments.

CO- PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	2	2	2	1	-	1	1	1	-	-	1
2	1	1	1	2	2	-	-	-	-	-	-	-
3	2	1	2	2	2	1	1	1	1	1	1	-
4	2	2	1	1	1	-	1	1	1	2	2	3
5	1	2	2	2	-	1	-	1	1	1	3	1
6	1	1	1	1	-	1	-	2	1	1	2	2

Correlation levels 1, 2 or 3 as defined above: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and "-" if there is no correlation.

Syllabus Indicating CO:

Module No.	Content	Relevant CO's
Group A	Designing a heating element with specified wattage, voltage and ambient temperature. Designing an air core grounding reactor with specified operating voltage, nominal current and fault current.	***CO3,CO4,CO6 PO1, PO4***
Group B	Designing the power distribution system for a small township. Design a double circuit transmission line for a given level and power (MVA) transfer.	***CO1,CO3,CO6 CO2***

	Wiring and installation design of a multistoried residential building (G+4, not less than 16 dwelling flats with a lift and common pump) Designing of a substation	***PO1,PO4,PO6***
Group C	Designing an ONAN distribution transformer Designing a three phase squirrel cage induction motor. Designing a three phase wound rotor induction motor. Designing a split phase squirrel cage induction motor for a ceiling fan or a domestic Pump. Designing a permanent magnet fractional hp servo motor	***CO5,CO6*** ***CO4*** ***PO1,PO4***

Lecture Plan:

Cl. No.	Date	Topics	Remarks
1		**Introduction:** The electromagnetic machines, induction and interaction, circuit behavior, electrical engineering materials	
2		**Magnetic circuit:** Basic formulae, magnetizing curves, magnetic leakage, laws of the magnetic circuit, mmf for air gap, net length of iron, mmf for teeth.	
4		Types of iron losses, hysteresis losses, eddy currents and eddy currents losses, eddy current loss in the sheets, total iron losses, pulsation losses.	
5		Real and apparent flux density, tapered teeth, magnetizing current, effect of leakage flux, specific permeance, armature leakage, slot leakage, overhang leakage.	
6		**Substation design:** Introduction, classification of substation, comparison between outdoor and indoor substation, Transformer substation, pole mounted substation.	Problems to be solved as assignment

7		Underground substation, symbols for equipment of substation, equipments in a transformer substation.	
8		Bus-bar arrangement in substation, terminal and through substation, key diagram of 66/11KV substation.	
9		Key diagram of 11/400 kV indoor substation.	
10 & 11		**Transformer Design:** Introduction, core and shell type transformer, distribution and power transformer, core, core cross section, core construction, yoke cross section.	Problems to be solved as assignment
12		Clamping of core, cooling of core, core construction of modern core type power transformer, transformer winding.	Memorizing basics of induction machine
13		Method of transformer cooling, cooling ducts, transformer oil, terminals and leads, bushings, transformer assembly.	
14 &15		Output equations, ratio of iron loss and copper loss, specific loading, relation between core area and weight of iron and copper.	problem to be solved
16		Design of transformer—design for Optimum design, design for minimum cost, design for minimum loss or maximum efficiency.	
17		Design of core-- square and stepped core, calculation of core area, choice of flux density,	
18		design of windings-- selection of type of winding. Position of windings relative to core,	Problems to be solved
19 &		design of insulation, window space factor,	Problems to be

20		window dimensions, width of window for optimum output.	solved
21		Over all realization of design of complete transformer	Problems to be solved

Recommended Books:

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai & Co.Quantitative Analysis by R.A. Day and A.L. Underwood.
2. V.N. Mittle, A. Mittal, "Design of Electrical Machines", Standard Publishers & Distributors.
3. R.K. Agarwal, "Principles of Electrical Machine Design", S.K. Kataria & Sons
4. "Design of Magnetic Components For Switched Mode Power Converters", L.Umanand & S.R.Bhat.