Course Name: Electrical system Design II
Course Code: EE-882
Credit: 4

Prerequisites:

Sl. No.	Subject	Description	Level of Study
01	Electromagnetism	Basic concept on magnetic and dielectric material, magnetic induction, Inductor.	3rd Semester
02	electrical machine	Detailed construction and theoretical knowledge on Induction Motor, DC Machine	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 heating element and Induction motor.
- To expose the students about Inductor design.

Course Outcomes:

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

1. **Develop a creative physical realization** of theoretical concepts based on knowledge, experience and practice to recognize the design patterns using software applications relating it to application oriented.

2. **Estimate constraints, uncertainties and risks** of the system with the application of science, technology and invention to perform specified tasks with optimum economy and efficiency; considering social, environmental, business issues etc.

3. **Realization of machine design** considering various section like- insulation, ventilation, cooling and machine parts.

4. **Prepare professional quality** textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.

5. **Primarily via team-based** laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

6. **Originate a practical and professional experience** on working in a design of electrical system, household wiring, power plant or any practical field.

CO- PO mapping:

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

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	***CO1,CO3,CO6***

	power (MVA) transfer. 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	***CO2*** ***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***
Group D	Design the control circuit of a Lift mechanism. Design a controller for speed control of DC machine. Design a controller for speed control of AC machine**.**	***CO1, CO6*** ***PO1, PO4***

Lecture Plan:

Cl. No.	Date	Topics	Remarks
1		**Introduction:** The electromagnetic machines, induction and interaction, circuit behavior, electrical engineering materials	
2		Magnetic materials, magnetic circuit, insulating material for machine and insulating material for insulation.	
4		**Heating element design:** Introduction, high conductive materials, materials of high resistivity, materials used for rheostats and heating devices	
5		Heat dissipation, conduction, radiation, convection, Newton's Law of cooling.	
6		Design procedure of heating element , numerical problem based on design method, assignment	Problems to be solved as assignment

7		**Inductor design:** Introduction, analysis of B-H curve of magnetic material, remnant flux density, turns ratio, volt-area product.	
8		Leakage flux, power handling capacity of inductor, area product, window utilization factor, familiarization with wire gauze selection table.	
9		Different application area of inductor, power inductors in transmission system, chock of tube light, filters circuit, reactor to damp oscillation.	
10 & 11		Difference between transformer and inductor core materials, principles of inductor design, flow chart of inductor design, discussion on a numerical example of inductor design, summary of design procedure.	Problems to be solved as assignment
12		**Induction motor design:** introduction, the generalized transformer, equivalent circuit, simple theory of induction machine, construction, general arrangement.	Memorizing basics of induction machine
13		Stator and rotor frames, cores, windings, comparison between squirrel cage and wound rotor induction machine,	
14 &15		Standard frames, rating and dimension, output equation and coefficient, specific loadings, main dimension.	problem to be solved
16		Choice of average flux density in air gap and ampere conductor per meter, their pros and cons, efficiency and power factor, stator winding.	
17		Turns per phase, stator conductors, shape of	

		stator slots, number of stator slots, area of stator length, length of mean turn.	
18		Stator core, stator teeth, length of the air gap, number of rotor slots, rules for selecting rotor slots, design of rotor bars and slots.	Problems to be solved
19 & 20		Rotor bar current, area of rotor bars, shape and size of rotor slots, rotor slot insulation, design of end rings, end ring current, area of end rings.	Problems to be solved
21		Full load slip, design of wound rotor, number of rotor slots, number of rotor turns, area of rotor conduction.	Problems to be solved
22		Rotor windings, rotor teeth, rotor core, sizes of induction motor lamination available in the market.	
23		Discussion on summary of design procedure.	Problems to be solved as assignment

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.