Course code	Course Name	L-T-P - Credits	Year of Introduction
EE409	Electrical Machine Design	3-0-0-3	2016

Prerequisite: EE202 & EE205

Course Objectives

- To impart knowledge on principles of design of static and rotating electrical machines.
- To give a basic idea about computer aided design (CAD) and finite element method.

Syllabus

Machine design basic principles, Heating and cooling of electrical machines, Magnetic circuit design, Design of - Dc machine, Synchronous machine , Three phase induction motor, Computer aided design, Finite element method.

Expected outcome

- The students will be able to design transformers, DC machines, synchronous machines and induction motors

Text Book:

1. A K Sawhney, " A Course in Electrical Machine Design", Dhanpat rai *and* sons, Delhi.

References:

1. M. V. Deshpande, " Design and Testing of Electrical Machines", Wheeler Publishing.
2. R. K. Agarwal, " Principles of Electrical Machine Design", Essakay Publications, Delhi.
3. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.
4. M. N. O. Sadiku, " Numerical techniques in Electromagnetics", CRC Press Edition-2001.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Principles of electrical machine design - General design considerations - specifications of machines - types of enclosures - types of ventilation - heating - short time rating - overload capacity - temperature rise time curve - hot spot rating. Magnetic circuit calculation - calculation of field ampere turns - air gap mmf - effect of slot and ventilating duct - active iron length - mmf for teeth - real and apparent flux densities - mmf per pole Magnetic Leakage Calculation- Effects of Leakage. Armature Leakage –Components. Unbalanced Magnetic Pull-Practical aspects of unbalanced magnetic pull	8	15%
II	Design of transformers - single phase and three phase transformers - distribution and power transformers - output equation - core design - window area - window space factor - overall dimensions of core. Windings – no. of turns - current density - conductor section - Cooling of transformers	6	15%
FIRST INTERNAL EXAMINATION			
III	Design of DC machines - output equation - specific loading - choice of speed and no of poles - calculation of main dimensions - choice of type of winding - number of slots - number of conductors per slot-current density - conductor section - slot insulation -	8	15%

	length of air gap - design of field winding - conductor cross section - height of pole - design of inter pole - flux density under inter pole - calculation of turns of inter polar winding – design of compensating winding – brushes and commutators.		
IV	Design of synchronous machines - specific loading - output equation - main dimensions - types of winding - number of turns - number of slots and slot design - field design for water wheel and turbo alternators - cooling of alternators.	6	15%
SECOND INTERNAL EXAMINATION			
V	Design of three phase induction motors - main dimensions - stator design - squirrel cage and slip ring types - number of stator and rotor slots - rotor bar current - design of rotor bar - end ring current - design of end ring - design of slip ring rotor winding.	7	20%
VI	Introduction to computer aided design. Analysis and synthesis methods -hybrid techniques. Introduction to Finite element method - historical background, applications, advantages. Study of new computer aided machine software using Finite Element Case study: Complete design of an ac machine –steps.(Assignment only)	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.