58373

Name:

Reg.No:

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2009

EE.04.605 – Electrical Machine Design

Time: Three hours **Maximum: 100 marks**

PART – A
(Answer all questions)

1. a. Briefly explain the factors to be considered in the choice of armature winding in a DC machine.
   b. What are the different losses occurring in a DC machine.
   c. Explain the factors to be considered in the design of insulation in transformers.
   d. Write down the design procedure for a CT.
   e. Differentiate the specific magnetic and electric loading of an alternator.
   f. What are the various losses occurring in an alternator?
   g. Explain the magnetic circuit of an induction machine.
   h. Explain how the harmonic torques can be reduced in an induction machine.

(8x5=40 marks)

PART – B

II. a. i. What is armature reaction in DC machines? Explain the effects of armature reaction in the performance of the machine and show how it can be minimized? **(8 marks)**

ii. The armature of a 12 pole, 500 KW, 550 V generator has a complex lap winding consisting of 2484 conductors. There are 621 commutator segments. The ratio of pole arc to pole pitch is 0.7.

i. Calculate the demagnetizing mmf per pole at rated full load current if the brushes are shifted through three segments from the geometric neutral axis. What is the cross magnetizing mmf per pole. **(5 marks)**

ii. Calculate the number of conductors that must be provided in each pole face if a compensating is used for the machine. **(2 marks)**

OR

b. A 150 KW, 230 V, 500 rpm dc shunt motor has a square field coil. Find its main dimensions, number of poles and air gap length. Assume the average gap density over the pole are as 0.85 W6/m^2 , and the ampere conductors per meter as 29000. The ratio of width of pole body to pole pitch is 0.7. The efficiency is 91%. Assume that the mmf required for air gap is 55% of armature mmf and the gap contraction factor is 1.15. **(15 marks)**

III. a. i. Derive the output equation for a 3-phase transformer. **(5 marks)**

ii. Elaborate on the different cooling methods employed for various types of transformers. **(10 marks)**

OR

b. Calculate the approximate overall dimensions for a 200 KVA, 6600/440 V, 50 Hz, 3 phase core type transformer. The following data may be assumed: emf per turn = 10 V; maximum flux density = 1.3 W6/m^2; current density = 2.5 A/mm^2; window space factor = 0.3; overall height = overall width; stacking factor = 0.9. Use a 3 stepped core. For a 3 stepped core, width of largest stamping = o.9d and net iron area = 0.6 d^2 where d is the diameter of the circumscribing circle. **(15 marks)**

IV. a. i. Explain the various methods employed for the elimination of harmonies in a synchronous machine. **(5 marks)**

ii. Determine the main dimensions of a 75000 KVA, 13.8 KV. 50 Hz, 62.5 rpm, 3 phase star connected alternator. Also find the number of stator slots, conductors per slot, conductor area and work out the winding details. The peripheral speed should be 40m/s. Assume average gap density = 0.65 Wb/m^2 ampere conductors per metre = 40000 and current density = 4A/mm . Assume any missing data. **(10 marks)**

OR

b. i. Explain the use of damper windings in synchronous machines. **(5 marks)**

ii. A 1250 KVA. 3 phase 6500 V, salient pole alternator has the following data: air gap diameter = 1.6m; length of core = 0.45 m; number of poles = 20; armature ampere conductors per metre = 28000; ratio of pole arc to pole pitch is 0.68; stator slot pitch = 28 mm; current density in damper bars = 3A/mm^2. Design a suitable damper winding for the machine. **(10 marks)**

V. a. Determine the main dimensions, turns per phase, number of slots, conductor cross section and slot area of a 250 hp, 3 phase, 50 Hz, 400 V, 1410 rpm clip ring induction motor. Assume Bav. = 0.5W6/m , ac = 30000 A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5A/mm^2. The slot space factor is o.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected. **(15 marks)**

OR

b. i. Write down the procedure for the design of a wound rotor. **(5 marks)**

ii. A 90 KW, 500 V, 50 Hz, 3 phase 8 pole induction motor has a star connected stator winding accommodated in 63 slots and 6 conductors per slot. If the slip ring voltage on open circuit is to be about 400 V, find suitable rotor winding, stating:

a). number of slots, b). number of conductors per slot, c). coil span, d). slip ring voltage on open circuit, e). approximate full load current per phase in rotor. Assume efficiency = 0.9, power factor = 0.86. **(10 marks)**

(4x15=60 marks)