UNIVERSITY OF KERALA

MODEL QUESTION PAPER

VIII SEMESTER B.TECH DEGREE

SUBJECT – 13.802: ELECTRICAL MACHINE DESIGN

TIME: 3 Hrs. Max. Marks: 100

PART A

(Answer all questions from PART A)

1. What do you meant by continuous rating and short time rating of electrical machines.

2. Derive the output equation DC machines.

3. Describe different methods for the calculation of ampere turns for tapered tooth in a slotted armature.

4. Distinguish between power transformer and distribution transformer.

5. Define specific electric loading. Give the range of values for induction motor.

(5 x 4=20 Marks)

PART B

Answer any one full question from each module

Module - I

6. a) Explain different types of enclosures used in electrical machines.

(8 Marks)

b) A 450kVA transformer has a total loss of 7.5kW at full load .The rate of heat dissipation from tank wall is 298W/°C. The heat energy required to rise temperature by 1°C is 0.5kWh.Calculate(1)Θm&Th of transformer

(2)Half hour rating of transformer which give the temperature rise as in 1 if full load copper loss =2xcore loss.

. (12 Marks)

7. a) Derive an expression for the number of cooling tubes needed for a transformer tank.

(10 Marks)

b) Calculate the main dimensions and winding details of a 100kVA, 2000/400V, 50Hz, single phase shell type , oil immersed, self cooled transformer. Given the following data: Voltage per turn -10V, Flux density in core -1.1 Wb/m^2, Current density-2A/mm^2, Window space factor-0.33, Window height/ Window width -3, Core depth/ Width of Central limb- 2.5.

(10 Marks)

Module – II

8. The following values refer to the shunt field coil for a 440V, 6 pole dc generator
m.m.f per pole – 7000A
Depth of winding- 55 mm
Length of inner turn- 1.1m
Length of outer turn – 1.3 m
Loss radiated from outer surface excluding ends- 400W/m^2
Space factor-0.63
Resistivity-0.02 ohm-m
Calculate a) Diameter of wire b) Length of coil c) Number of turns d) Exciting current. Assume the voltage drop of 26% of terminal voltage across the field regulator.

(20 Marks)

9. a) What are the factors to be considered while selecting the number of poles for the dc machine and give brief explanation. (10Marks)

b) Determine the main dimensions of a 45kW, 220V ,850rpm dc motor given: average flux density- 0.5 Wb/m^2, ampere conductors per meter-26000, Maximum efficiency 90% on full load, Field current is 2.5% of full load current.

(10 Marks)

Module -III

10. a) Distinguish between real and apparent flux density in the teeth of a slotted armature and derive an expression connecting them.

(8 Marks)

b) Calculate the mmf required for the air gap of a machine having core length-0.32m including 4 ducts of 10mm each, Pole arc-0.19m, slot pitch-65.4mm, slot opening- 5mm, air gap length-5mm, flux per plole- 52mWb. Take carters coefficient as 0.18 for opening/gap=1 and 0.28 for opening/gap=2.

(12 Marks)

11. Determine the main dimensions of the stator core,number of stator slots and stator conductors per slot for a 3-phase, star connected, 8-pole alternator rated at 300KVA, 3300V, 50Hz, ac/m=28000, Bav=0.6T. Assume a square pole phase with pole arc/ pole pitch ratio of 0.65.

(20 Marks)

Module -IV

12. a) Derive the output equation of a three phase induction motor. (8 Marks)

b)Determine the main dimensions of 10kW, 400V, 50Hz, 4 pole, 3 phase induction motor B_{av}- 0.45Wb/m^2, Ampere conductors/cm-220, efficiency-0.9, power factor-0.85. Determine the number of conductors/phase when the stator is star connected. (12 Marks)

13. a) Explain the general procedure for optimization in the design of an electrical machine. (6 Marks)

b) Design a cage rotor for 40hp, 3 phase, 400V, 50Hz, 6 pole Delta connected Induction Motor having a full load efficiency of 87% and full load power factor of 0.85. Take D=33 cm, and L= 17 cm, stator slots= 54, conductors/slot=14, Assume suitably the missing data if any.

(14 Marks)