C 62964 (Pages : 3) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE [SUPPLEMENTARY] EXAMINATION, APRIL 2014

(2009 Scheme)

EE /PTEE 09 704—ELECTRICAL MACHINE DESIGN

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *the questions.*
Each question carries 2 *marks.*

1. How the armature reaction is taken into account in the design of a d.c. machine ?
2. What is the condition for minimum cost in the design of transformers ?
3. What is the purpose of providing a conservator on a transformer tank.
4. What is the basis for selecting the number of rotor slots in three-phases induction motor.
5. Name and justify the selection of the type of synchronous generators used in (i) thermal and (ii) hydel power stations.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*
Each question carries 5 *marks.*

6. What is a wave winding. Explain its design procedure.
7. What is specific magnetic loading. Explain its significance in the design of d.c. machine.
8. How the current transformer design differs from a conventional transformer design Explain.
9. Explain the selection of speed and number of poles of an a.c. generator.
10. How the open circuit characteristics of alternator is determined from the design data.
11. What are the factors to be considered in the design to prevent/reduce cogging and crawling in an induction machine ?

(4 × 5 = 20 marks)

Turn over

Part C

Answer four **four** *full questions.*
Each full question carries 10 *marks.*

12. (a) For a 40kW, 440V, 6-pole, 600 r.p.m. d.c. shunt motor, design a suitable field coil if mmf/pole = 7200A, mean length of the turn = 120 cm, depth of field coil = 3.5cm specific loss = 650W/square metre of the total surface area of the coil.

(10 marks)

Or

(b) Calculate the MMF required for the air gap of a d.c. machine having core length = 0.32m including 4 ducts of 10 mm each, pole arc = 0.19m, slot pitch — 65.4 mm, slot opening = 5mm ; air gap length = 5mm, flux per pole = 52mWb. Carter's co-efficient is 0.18 for opening/gap = 1, and is 0.28 opening/gap = 2. Assume any missing data properly.

(10 marks)

13. (a) Calculate the main dimensions and winding details of a 100 kVA, 2000/400V, 50 Hz-single phase shell type, oil immersed, self cooled transformer. Assume voltage/turn = 10V, Flux density in core = 1.1wb/m^2 , Current density = 2A/mm^2, window space factor = 0.33. The ratio of window height to window width and ratio of core depth to width of central limb = 2.5. The stacking factor is 0.9.

(10 marks)

(b) A 1000 kVA, 6600/440V, 50 Hz, 3-phase delta/star, core type oil immersed natural cooled transformer. Distance between centers of adjacent limb of the transformer is 0.47 m, Outer diameter of hV winding is 0.44m, Height of frame is 1.24m, Core loss and Copper losses are 3.7kW and 10.5 kW respectively. Design a suitable tank for the transformer. The average temperature rise of oil should not exceed 36°C. The specific heat dissipation from the tank walls is 6W /m^2 – °C and 6.5 W/m^2 –°C due to radiation and convection is improved by 40% due to convection with the provision of tubes.

(10 marks)

14. (a) Design the field coil of a 12 pole salient pole alternator with the following specifications : Exciter voltage is 110V, mmf per coil is 14000A, specific loss is 1800W per square meter of the total surface area of the coil, cross section of pole body is 28 cm × 15cm, Approximate depth of coil is 3.5cm. Take the diameter of the insulated wire to be 0.4mm greater than the diameter of bare conductor.

(10 marks)

Or

(b) A 1250 KVA, 3-phase, 6000 V, salient pole alternator has the following data : Air gap diameter = 1.6 m ; length of core = 0.45 m number of poles = 20 ; armature ampere conductors per meter = 28,000 ; ratio of pole arc to pole pitch = 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)

15. (a) Determine the main dimensions and the number of turns per phase of a 3.7 Kw, 400V, 3ϕ, 4-pole, 50Hz squirrel cage induction motor to be started by a star delta starter. Average flux density in the gap = 0.45 wb/m^2, Ampere conductors/metre = 23,000, Efficiency = 85%, power factor = 0.84, Winding factor = 0.955. Stacking factor = 0.9, Machine is to be sold at a competitive price and therefore choose the main dimensions to give a cheap design. Assume suitable data accordingly, if required

(10 marks)

Or

(b) A 15kW, 400V, 4-pole, 50Hz, three-phase induction motor is built with a stator bore 0.25m and core length of 0.16m. The specific electrical loading is 23000 Ampere conductors per metre. Using the data for this machine, determine the main core dimensions, number of stator slots and the number of stator conductors for a 11 kW, 440V, 6-pole, 50Hz motor. Assume the full load efficiency as 84% and power factor of 0.8lag for each machine. The winding factor is 0.98.

(10 marks)

[4 × 10 = 40 marks]