D 90277 (Pages : 3) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. [ENGINEERING] (09 SCHEME) DEGREE EXAMINATION, NOVEMBER 2015

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. List the factors affecting the design of length of air gap.
2. On what factors the output coefficient of a d.c. machine depend.
3. Name the different types of winding used in transformer design.
4. How the Open circuit characteristics helps in designing the synchronous machine.
5. Throw light on the induction motor design for best power factor.

(5 × 2 = 10 marks)

Part B

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

6. Explain the difference between progressive and retrogressive winding of a d.c machine. Explain their uses.
7. State and explain the various factors that depends upon the commutator design in a D.C. machine.
8. What are the factors affecting the selection of core flux density in a transformer. Explain.
9. What are damper winding ? Explain their design for an alternator.
10. Explain the gap design procedure and its importance in the operation of inducting motor.
11. What are the factors to be considered in deciding the number of stator slots in a three-phase induction motor. Explain.

(4 × 5 = 20 marks)

Part C

Answer **four** *full questions.*
Each full question carries 10 *marks.*
Assume missing data judiciously.

12. (a) A 5 kW, 230 V, 4 pole, 1500 r.p.m. d.c. shunt connected generator is designed to have a square pole face. The specific magnetic and electrical loading are 0.42 Wb/m^2 and 15000 AC / m respectively. Find the main dimensions of the machine. Assume that the pole arc is 0.6 times the pole pitch and full-load efficiency as 0.88.

(10 marks)

Or

Turn over

(b) Determine the airgap length of a d.c. machine form the following particular gross length of core0.12m ; no. of ducts = 1 and is 10 mm wide, slot pitch = 25 mm ; slot width = 10 mm ; Carter's coefficient for slots and ducts = 0.32 ; gap density at pole centre is 0.7Wb/m^2. Field m.m.f./pole = 3900 A and m.m.f. required for iron parts of magnetic circuit is 800 A.

(10 marks)

13. (a) A 1250 kVA, 3-phase, 50 Hz, 3300 V, 300 r.p.m. synchronous generator with a concentric winding has the following design data : Specific magnetic loading and electric loading are 0.45W*b*/m^2 and 23000 Ampere Conductors / meter respectively. Air gap length is 6 mm, Field turns per pole = 60, Short Circuit Ratio is 1.2. The effective gap area is 0.6 times the actual area. The peripheral speed is 30m/s. Find the stat or bore, core length, turns / phase, m.m.f. for airgap, armature m.m.f. / pole and field current at no-load.

(10 marks)

Or

(b) A 20 pole, 175 MVA water wheel generator has a core length of 1.72 m and a diameter of 6.5 m. The stator open slots have a width if 22 mm, the slot pitch being 64 mm and the air gap length at the center of the pole is 30 mm. There are 41 radial ventilating ducts each of 6 mm width . The total m.m.f. per pole is 27000AT. The m.m.f. required for the air gap is 87% of the total m.m.f. per pole. Estimate the average flux density in the air gap if the field form factor is 0.7.

(10 marks)

14. (a) Calculate the main dimensions and winding details of a 100 KVA, 2000 / 400 V, 50 Hz single-phase shell type, oil immersed, self cooled transformer. Assume voltage / turn = 10 V, flux density in core = 1.1Wb/m^2, current density = 2 A / 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)

Or

(b) The tank of a 500 kVA, single-phase, 50 Hz, 6600 / 400V transformer is 110 cm × 155 cm. If the load losses is 6.2 kW, find the suitable arrangements for the cooling tubes to limit the temperature rise to 35°C. Take the diameter of the cooling tubes as 5 cm and average length of tube as 110 cm.

(10 marks)

15. (a) Determine approximate values for the stator bore and the effective core length of a 55 kW, 415 V, three-phase, star connected, 50 Hz four pole induction motor. Efficiency = 90% ; power factor = 0.91 ; winding factor = 0.955. Assume suitable data wherever necessary with proper justification. Also explain the relevant expressions used.

(10 marks)

Or

(b) Determine the main dimensions, turns / phase, number of slots, conductor cross-section and slot area of a 250 HP, 3-phase, 50 Hz, 400 V, 1410 r.p.m. slip ring induction motor. Assume average flux density as $0.5 Wb/m^2$, Ampere conductors = 30,000 A / M, efficiency = 0.9 and power factor = 0.9 ; winding factor = 0.955, current density = $3.5 A/mm^2$. The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.

(10 marks)

[4 × 10 = 40 marks]