Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 91451

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Sixth Semester

Electrical and Electronics Engineering

EE 2355/EE 65/10133 EE 605 — DESIGN OF ELECTRICAL MACHINES

(Regulation 2008/2010)

(Common to PTEE 2355/10133 EE 605 – Design of Electrical Machines for B.E. (Part-Time) Fifth Semester – Electrical and Electronics Engineering – Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is gap concentration factor for slots?

2. Define stacking factor.

3. Why DC motors are preferred in general?

4. Mention the factors governing the length of armature core in a dc machine.

5. Why stepped cores are used in transformers?

6. Why are the cores of large transformers built-up of circular cross section?

7. List the advantages of using open slots.

8. Why fractional slot winding is not used for induction motor?

9. How is the efficiency of an alternator affected by load power factor?

10. Mention the factors to be considered for the selection of number of armature slots.

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the limitations in the design of Electrical apparatus? Explain them. (8)

(ii) Calculate the mmf required for the air gap of machine having core length = 0.32 m including 4 ducts of 10 mm each pole arc = 0.19 m, slot pitch = 65.4 mm, slot opening = 5 mm, air gap length = 5 mm, flux per pole = 52 mwb. Given Carter's coefficient is 0.18 for opening/gap =1, and is 0.28 for opening / gap = 2. (8)

Or

(b) (i) Explain the modern trends in design of electrical machines. (8)

(ii) Derive the equation of temperature rise of a machine when it is run under steady load conditions starting from cold conditions. (8)

12. (a) (i) Derive the output equation of a DC machine. (8)

(ii) Calculate the diameter and length of armature for a 7.5 kW, 4 pole 1000 rpm, 220 V shunt motor. Given : full load efficiency = 0.83, maximum gap flux density = 0.9 Wb/m^2, specific electric loading = 30000, ampere conductors per metre, field form factor = 0.7. Assuming that the maximum efficiency occurs at full load and the field current is 2.5% of rated current. The pole face is square. (8)

Or

(b) (i) Explain the various factors that are affected by the selection of poles in a dc machine. (8)

(ii) Determine the diameter and length of a armature core for 55 KW, 110 V, 1000 rpm, 4 pole shunt generator assuming specific electric and magnetic loadings of 26000 amp.con/m and 0.5 wb/m^2 respectively. The pole arc should be about 70% of pole pitch and length of core about 1.1 times the pole arc. Allow 10 A for the field current and assume a voltage drop of 4 V for the armature circuit. (8)

13. (a) (i) Derive the output equation of a single phase transformer in terms of core and window area. (8)

(ii) Determine the dimension of core and yoke for a 200 kVA, 50 Hz single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn 14 V, maximum flux density 1.1 Wb/m^2, window space factor 0.32, current density $3A/mm^2$, and stacking factor = 0.9. The net iron area is 0.56 d^2 in a cruciform core whereas d is the diameter of circumscribing circle. Also the width of largest stamping is 0.85d. (8)

Or

(b) A 250 kVA, 6600/400V, 3 phase core type transformer has a total loss of 4800W at full load. The transformer tank is 1.25 m in height and 1 m × 0.5 m in plan. Design a suitable number of tubes if the average temperature rise is to be limited to 35° C. The diameters of the tubes are 50 mm and are spaced 75 mm from each other. The average height of tubes is 1.05 m. Specific heat dissipation due to radiation and convection is respectively 6 and 6.5W/m^2 °C. Assume that the convection is improved by 35 percent due to provision of tubes. (16)

14. (a) (i) Derive the output equation of ac machine in terms of the main dimensions. (8)

(ii) Find the main dimension of a 15 Kw, 3 phase, 400 V, 50 Hz, 2810 rpm squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume :

Specific magnetic loading = 0.5 Wb/m^2, specific electric loading = 25000 ac/m. Take the rotor peripheral speed as approximately 20 m/s at synchronous speed. (8)

Or

(b) Estimate the stator core dimensions, number of stator slots and number of stator conductors per slot for a 100 KW 3300V, 50 Hz, 12 pole star connected slip ring induction motor. Assume :

Average gap density = 0.4 Wb/m^2

Conductors per metre = 25000 Ampere

Efficiency = 0.9, power factor = 0.9 and winding factor = 0.96.

Choose main dimension to give best power factor. The slot loading should not be exceed 500 ampere conductors. (16)

15. (a) Find the main dimensions of a 2500 KVA, 187.5 rpm, 50 Hz, 3 phase 3 KV, salient pole synchronous generator. The generator is to be vertical water wheel type. Use circular pole with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the runaway speed is about 2 times the normal speed. (16)

Or

(b) Find the main dimensions of a 100 MVA, 11 KV, 50 Hz, 150 rpm., 3 phase water wheel generator. The average gap density is 0.65 Wb/m^2 and ampere conductors per metre are 40000. The peripheral speed should not exceed 65 m/s at normal running speed in order to limit the run away peripheral speed. (16)
