PART – B (5×16=80 Marks)

11. a) Discuss in detail the factors affecting the choice of specific electric and magnetic loading in rotating machines. (16)

(OR)

b) Derive an expression for the heating and cooling curve in electrical machines. (16)

12. a) i) Derive an expression for the mmf of airgap of a machine with slotted armature and ventilating ducts. (8)

ii) A 15 kW, 230 V, 4 pole DC machine has the following data : Armature diameter = 0.25 m; armature core length = 0.125 m ; length of airgap at pole centre = 2.5 mm; flux per pole = 11.7×10^{-3} wb ; Pole arc to pole pitch ratio = 0.66. Calculate the mmf required for the airgap i) if the armature surface is treated as smooth ii) if the armature is slotted and the gap contraction factor is 1.18. (8)

(OR)

b) Determine the diameter and length of armature core for a 55 kW, 110 V, 1000 RPM, 4 pole shunt generator assuming specific electric and magnetic loading of 26000 ampere conductor per metre 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 ampere for the field current and assume a voltage drop of 4 V for the armature circuit. Specify the winding used and also determine the values of the number of armature conductors and number of armature slots. (16)

13. a) Estimate the main dimensions including winding conductor area of a 3 ϕ delta star core type transformer rated at 300 KVA, 6600/440 V, 50 Hz. A suitable core with three steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. The emf per turn is 8.5 V. Assume a current density of 2.5 A/mm^2, a window space factor of 0.28 and a stacking factor of 0.9. (16)

(OR)

b) A 1000 KVA 6600/440 V, 50 Hz,3 ϕ, delta star core type oil immersed natural cooled (ON) transformer has the following design data : Distance between centres of adjacent limbs = 0.47 m ; Outer diameter of HV winding = 0.44 m ; Height of frame = 1.24 m; Core loss = 3.7 kW and I^2R loss = 10.5 kW. Design a suitable tank for the transformer. The average temperature rise of the oil should not exceed 35°C. The specific heat dissipation for the tank walls is 6 W/m^2 – °C and 6.5 W/m^2 – °C due to radiation and convection respectively. Assume that the convection is improved by 35% due to the provision to tubes. (16)

14. a) Determine the stator bore and core length of a 70 HP, 415 V, 3 ϕ, 50 Hz star connected, 6 pole induction motor for which the specific electric and magnetic loading are 32000 A/m and 0.51 wb/m^2 respectively. Take the efficiency as 90% and power factor as 0.91. Assume pole pitch = core length. Estimate the number of stator conductors required for a winding in which the conductors are connected in two parallel paths. Choose a suitable number of conductors per slot so that the slot loading does not exceed 750 ampere conductors. (16)

(OR)

b) Estimate the main dimensions, air gap length, stator slots, stator turns per phase and cross sectional area of stator and rotor conductors for a 3 phase, 15 HP, 400 V, 6 pole, 50 Hz, 975 RPM, induction motor. The motor is suitable for star delta starting, Bav = 0.45 wb/m^2, ac = 20000 ampere conductors per meter. L/T ratio = 0.85, efficiency = 0.9 and power factor = 0.85. (16)

15. a) Determine the main dimensions of a 75000 KVA, 13.8 KV, 50 Hz, 62.5 RPM, 3 ϕ, star connected alternator, also find the number of stator slots, conductors per slot, conductor area and work out winding details. The peripheral speed is about 40 m/s. Assume average gap density = 0.65 wb/m^2, ampere conductor/metre = 40000 and current density 4 A/mm^2. (16)

(OR)

b) Explain the design procedure for stator and rotor of turbo alternators. (16)

16/11/17 AN

Reg. No. :

Question Paper Code : 50492

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Sixth Semester

Electrical and Electronics Engineering

EE6604 – DESIGN OF ELECTRICAL MACHINES

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Define short time rating.
2. List the standard specifications of transformer.
3. Define specific electric and magnetic loading.
4. State the advantages of having larger number of poles in DC machines.
5. How does a distribution transformer differ from a power transformer in design aspects ?
6. Why stepped cores are used in transformers ?
7. What are the factors to be considered in selecting the number of stator slots in induction machines ?
8. What is unbalanced magnetic pull in induction machines ?
9. What are the design features of turbo alternators.
10. Define runway speed of an alternator.