Reg. No. :

Question Paper Code : X10377

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2021
Sixth Semester
Electrical and Electronics Engineering
EE 8002 – DESIGN OF ELECTRICAL APPARATUS
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What is the importance of magnetizing current in machine design considerations ?
2. Define gap contraction factor.
3. Define specific magnetic loading and give the ranges for the same for DC machine design.
4. Write short notes on the selection of number of poles for a DC machine.
5. Draw the cross section of a single phase transformer and hence write down the equations of overall dimensions H and W.
6. List four important characteristics of transformer oil.
7. What is a spider in the design of armature core of rotating machines ?
8. Give the ranges for the specific loadings, in case of 3 phase induction motor.
9. Define SCR in an alternator.
10. Write down the output equation for the design of main dimensions of an alternator and name each terms appearing in it.

PART – B **(5×13=65 Marks)**

11. a) i) Explain high conductivity materials and mention any four conducting materials. **(6)**

ii) List out the properties of insulating materials and mention any five insulating materials. **(7)**

(OR)

b) i) Express and discuss the relation between real and apparent flux densities. **(8)**

ii) On the basis of design compare lap winding and wave winding. **(5)**

12. a) Estimate the main dimensions including winding conductor area of a 3 phase, delta-star core type transformer rated at 300 KVA, 6600/400 V, 50 Hz. A suitable core with 2-steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. Em/turn = 8.5 V, space factor = 0.28, δ = 2.5 A/mm^2, stacking factor is 0.9. **(13)**

(OR)

b) The tank of 1250 KVA, natural oil cooled transformer has the dimensions length, width and height as 1.55 × 0.65 × 1.85 m respectively. The full load loss = 13.1 kw, loss dissipation due to radiation = 6 W/m^2 – °C, loss dissipation due to convection = 6.5 W/m^2 – °C, improvement in convection due to provision of tubes = 40%, temperature rise = 40°C, length of each tube = 1 m, diameter of tube = 50 mm and are spaced 75 mm from each other. Find the number of tubes for this transformer and draw the layout for arrangement of cooling tubes. Neglect the top and bottom surface of the tank as regards the cooling. **(13)**

13. a) Calculate the diameter and length of armature core for a 55kw, 110 V, 1000 rpm, 4 pole shunt generator, assuming specific electric and magnetic loadings of 26000 amp.cond/m and 0.5 wb/m^2 respectively. The pole arc should be about 70% of pole pitch and length of core is about 1.1 times the pole arc. Allow 10 ampere for the field current and assume a voltage drop of 4 volts for the armature circuit. Derive the output equation used to determine the main dimensions. **(9+4)**

(OR)

b) A 4 pole, 400 V, 960 rpm, shunt motor has an armature of 0.3 m in diameter and 0.2 m in length. The commutator diameter and 0.2 m in length. The commutator diameter is 0.22 m. Give full details of a suitable winding including the number of slots, number of commutator segments and number of conductors in each slot for an average flux density of approximately 0.55 wb/m^2 in the air-gap. **(13)**

14. a) Estimate the main dimensions, air gap length, stator slots, stator turns per phase and cross-sectional area of a stator 3ϕ, 15 HP, 400 V, 6 pole, 50 Hz, 975 rpm, induction motor. The motor is suitable for star delta starting. B_{av} = 0.45 Wb/m^2, ac = 20000 amp.cond/m, L/T = 0.85, η = 0.9, pf = 0.857. **(13)**

(OR)

b) Design a cage rotor for a 40 HP, 3-phase, 400 V, 50 Hz, 6 pole, delta connected induction motor having a full load η of 87% and a full load pf of 0.85. Take D = 33 cm and L = 17 cm. Stator slots = 54, conductors/slot = 14. Assume suitably missing data if any. **(13)**

15. a) i) Derive the output equation of synchronous machine. **(6)**

ii) Explain short circuit ratio of a synchronous machine and its effect on machine performance. **(7)**

(OR)

b) Determine a suitable stator winding design of a 3 phase, 3300 V, 50 Hz, 300 rpm alternator. The diameter is 2.3 m and the axial length of core is 0.35 m. The average flux density in the air gap is 0.574 wb/m^2. Assume slot pitch should be 40 mm and use single layer winding and star connection for stator. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Discuss the practical construction of field system in a DC machine, including poles and field windings. Derive a suitable expression to determine the height of the field winding, h_f, considering various parameters such as losses to be dissipated, height of pole shoe, height of poles etc. **(7+8)**

(OR)

b) What are turbo alternators and where are they widely used ? Give range of various output equation parameters for this machine. Give a step-by-step procedure to design the armature of this machine. **(3+6+6)**

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