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Question Paper Code : 41010

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Sixth Semester
Electrical and Electronics Engineering
EE 6604 – DESIGN OF ELECTRICAL MACHINES
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What are the major considerations to evolve a good design of electrical machine ?
2. What are the different types of heat transfer methods found in electrical machines ?
3. Mention the two types of armature winding used in dc machine and compare.
4. What factor decides the minimum number of armature coils ?
5. Why stepped core are generally used for transformer ?
6. The voltage per turn of a 500 KVA, 11 KV, Δ/Y three phase transformer is 8.7 V. Calculate the number of turns per phase of LV and HV windings.
7. What happens if the air gap length of induction motor is doubled ?
8. Name the losses that occur in three-phase induction motors.
9. What are the factors to be considered for the choice of specific magnetic loading in synchronous machines ?
10. Give the purpose of providing damper windings in synchronous machines.

PART – B (5×13=65 Marks)

11. a) i) Classify the insulating materials based on thermal consideration. (5)

ii) A 350 KW, 500 V, 450 rpm, 6-pole dc generator is built with an armature diameter of 0.87 m and core length of 0.32 m. The lap wound armature has 660 conductors. Calculate the specific electric and magnetic loadings. (8)

(OR)

b) Derive the heating and cooling curve of an electrical machine. (13)

12. a) i) Draw the magnetic circuit of DC machine. (5)

ii) Find the main dimensions and the number of poles of a 37 KW, 230 V, 1400 rpm shunt motor so that a square pole face is obtained. The average gap density is 0.5 Wb/m^2 and the ampere conductors per metre are 22000. The ratio of pole arc to pole pitch is 0.7 and the full load efficiency is 90 percent. (8)

(OR)

b) i) What are the advantages and disadvantages of large number of poles in a dc machine ? (5)

ii) Design a suitable commutator for a 350 KW, 600 rpm, 440 V, 6 pole dc generator having an armature diameter of 0.75 m. The number of coils is 288. Assume suitable values wherever necessary. (8)

13. a) i) What are the salient features of distribution transformer ? (5)

ii) Estimate the main dimensions including winding conductor area of a 3-phase, Δ – Y core type transformer rated at 300 KVA, 6600/440 V, 50 Hz. A suitable core with 3-steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. Emf/turn = 8.5 V, $\delta = 2.5$ A/mm^2, $K_w = 0.28$, $S_f = 0.9$. (8)

(OR)

b) i) List the different methods of cooling of transformers. (5)

ii) 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 radiations = 6 W/m^2-°C, loss dissipation due to convection = 6.5 W/m^2-°C, Improvement in convection due to provision to tubes = 40%, Temperature rise = 40° C, Length of each tube = 1m, Diameter of tube= 50 mm. Find the number of tubes for this transformer. Neglect the top and bottom surface of the tank as regards the cooling. (8)

14. a) i) What are the advantages of squirrel cage induction motors and slip ring induction motors ? (5)

ii) Determine the D and L of a 70 HP, 415 V, 3-phase, 5-Hz, star connected, 6 pole induction motor for which ac = 30000 amp.cond/m and $B_{av} = 0.51$ Wb/m^2. Take $\eta = 90\%$ and pf = 0.91. Assume $\tau = L$. Estimate the number of stator conductors required for a winding in which the coductors are connected in 2-parallel paths. Choose a suitable number of conductors/slots, so that the slot loading does not exceed 750 amp. cond. (8)

(OR)

b) i) List the rules for selecting rotor slots. (5)

ii) 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 suitable values wherever necessary. (8)

15. a) Determine for a 250 KVA, 1100 V, 12 pole, 500 rpm, 3-phase alternator.

- Air gap diameter
- Core length
- Number of stator conductors
- Number of stator slots and
- Cross-section of stator conductors.

Assuming average gap density as 0.6 Wb/m^2 and specific electric loading of 30000 amp. cond/m, $L/\tau = 1.5$. (13)

(OR)

b) i) Mention the factors that govern the design of field system alternator. (5)

ii) Sketch the shape of salient pole rotor and cylindrical rotor. What are the constructional differences between salient pole type alternator and cylindrical rotor type alternator ? (8)

PART – C (1×15=15 Marks)

16. a) A 600 rpm, 50 Hz, 10000 V, 3 phase, synchronous generator has the following design data. $B_{av} = 0.48$ Wb/m^2, $\delta = 2.7$ amp/mm^2, slot space factor = 0.35, number of slots = 144, slot size = 120 × 20 mm, D = 1.92 m and L = 0.4 m. Determine the KVA rating of the machine. (15)

(OR)

b) Show the design procedure of field system of non-salient pole alternator. (15)