Register Number:……..

B.E., DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Sixth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

EEE116: Design of Electrical Apparatus

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10x1=10 Marks)

1. The output of a rotating electrical machine is limited by

   (A) size of the machine (B) peripheral velocity

   (C) temperature rise (D) none of the above.

2. The hum in the transformer is due to

   (A) transformer winding (B) magnetostriction

   (C) transformer oil (D) tank walls.

3. Turbo alternators are characterized by

   (A) short diameters and great axial lengths (B) short diameters and narrow axial lengths

   (C) large diameters and narrow axial lengths (D) large diameters and great axial lengths.

4. Short circuit ratio for turbo-alternators is usually

   (A) 0.1 to 0.2 (B) 0.2 to 0.4 (C) 0.5 to 0.7 (D) 0.8 to 0.95.

5. For a simplex lap winding, the commutator pitch is equal to

   (A) +1 (B) ± 1 (C) –1 (D) ± 2.

6. A ACSR conductor has central core of steel surrounded by a bunch of aluminium wires. In such conductors

   (A) Current flows through aluminium conductors only

   (B) Current flows through steel wire only

   (C) Current flows through both steel as well as aluminium conductors

   (D) Majority of current flows through aluminium and negligible amount flows through steel.

7. Which property of copper enables it to be drawn into thin wires and sheets?

   (A) Ductility (B) Elasticity (C) Toughness (D) Tenacity.

8. If y_b is the back pitch and u is the no. of coil sides per slot, then split coils can be avoided if the following quantity is an integer

   (A) $(y_b + 1)/ \mu$ (B) $(y_b + 1)$ (C) $(y_b - 1)/ \mu$ (D) $(y_b - 1)$

9. Hysteresis loss varies with frequency (f) as

   (A) f (B) $f^{1.6}$ (C) f^2 (D) $f^{2.6}$

10. Skewing of rotor slots helps in

    (A) improving beat transfer (B) reducing noise

    (C) suppressing undesirable harmonics (D) all of the above.

PART B (10x2 = 20 Marks)

11. State the merits of CAD of an electrical machine?

12. What is meant by temperature gradient in an electrical motor?

13. Define specific magnetic loading and electric loading.

14. List the various guiding factors for selecting the armature slots of a D.C. machine.

15. Write the expression for output equation – of transformer.

16. What is the functional difference between CT and PT?

17. Distinguish between crawling and cogging in induction motor.

18. What is called as unbalanced magnetic pull?

19. Define the short circuit ratio of synchronous machine.

20. How does the damper winding improves the performance of a synchronous machine.

PART C (5x14 = 70 Marks)

21. a) i) Estimate the difference in temperature between the hottest spot and any point on the outer surface of a coil in a machine having large axial length compared with its thickness. (7)

ii) Determine the apparent flux density in the teeth of a D.C. machine when the real flux density is 2.15 Wb/m^2. Slot pitch is 28 mm, slot width is 10 mm and the gross core length is 0.35 m. The number of ventilating ducts is 4. Each duct is 10 mm wide. The magnetizing force for a flux density is 2.15 Wb/m^2 is 55000 H/m. The iron stacking factor is 0.9. (7)

(OR)

b) A lap connected generator has the following particulars. No load voltage 500V, gap length 0.5 cm, pole pitch 0.5 m , pole arc 0.33 m armature core 0.3 m, speed 300 rpm, width of the slot is 1.3 cm, number of ventilating ducts 5 of each 1.0 cm wide, number of slots is 90, conductors per slot 16, number of poles 6, Carter's coefficient for slots 0.33 and for ducts 0.29. Calculate the following (i) flux per pole or useful flux (ii) ampere turns required for air gap.

22. a) The field coils of (cylindrical) of a 4 pole, 460V, D.C. shunt motor are required to produce an mmf of 5700 A per pole. The length of mean turn is 0.66 m and the winding depth is 40 mm, heat is dissipated at a rate of 1000 W/m^2 of the outside cylindrical surface of coil. Determine (a) dimensions of the coil (b) the size of the coil and (c) the number of turns. Assume the diameter of insulated conductor to be 0.175 mm grater than the diameter of bare conductor. Resistivity = $0.02\Omega/m/mm^2$.

(OR)

b) Determine the diameter and length of armature core for a 55 KW, 110 V, 1000 rpm, 4 pole shunt generator, assuming the electric and magnetic loadings as 26000 ac/ 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 of the pole arc. Allow 10 A for the field current and assume a voltage drop of 4 V for the armature circuit. Specify the winding used and also determine the suitable values for the number of armature conductors and the number of slots.

23. a) A 100 KVA, 6600/440 V ,50Hz 3 phase, delta/ star, core type, oil immersed Natural cooled transformer has the following data:

Distance between centres of adjacent limbs = 0.47 m, outer diameter of highvoltge winding = 0.44 m, Height of frame = 1.24 m, core loss = 3.7 KW and rated copper loss = 10.5 KW. Design a suitable tank with tubes for this transformer. The average temperature rise of oil should not exceed 35 ^oC. Specific heat dissipation from the tank walls is 6 $W/m^2/^oC$ and 6.5 $W/m^2/^oC$ due to radiation and convection respectively. Assume that convection is improved by 35 % due to provision of tubes.

(OR)

b) Determine dimensions of core and yoke for a 200 KVA, 50 Hz single phase core type transformer. A cruciform core is to be used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn is 14 volts. Maximum flux density is 1.1 Tesla, window space factor is 0.32, current density is 3 A/mm^2 and stacking factor is 0.9.The net iron area is 0.56 d^2 where d is the diameter of the circumscribing circle of the cruciform core. Width of the largest stamping is 0.85 d.

24. a) Give a detailed procedure for the design of rotor bars and end rings of a squirrel cage Induction motor.

(OR)

b) Estimate the main dimensions, air gap length, stator slots, stator turns per phase for a 3 phase 15 HP. 4OOV, 6 – pole, 50 Hz, 975rpm, induction motor. The motor is suitable for star- delta starting. B_{av} = 0.45 Wb/m^2, L/τ =0.85, η = 0.9, ac = 20,000 amp.cond./metre.

25. a) Explain the choice of specific magnetic and electric loadings of synchronous machines.

(OR)

b) A 1250 KVA, 3 phase, 600V salient pole alternator has the following data: Air gap diameter = 1.55 m, length of the core = 45 cm, number of poles is 20, armature ac = 30000, pole arc/pole pitch = 0.7, stator slot pitch is 28 mm, current density in damper bar = 3 A/mm^2.Design suitable damper winding for machine.

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