Register No: ……

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Fifth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U07EE501: Design of Electrical Apparatus

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

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. For air or any other non-magnetic material, mmf per metre is;

   a) 600,000B b) 800,000B c) 700,000B d) 900,000B

2. Which coolant is used in direct cooling of turbo-alternators;

   a) Hydrogen b) Oxygen c) Carbon dioxide d) Air

3. What helps to neutralize the effect of armature reaction in DC machines?

   a) Interpoles b) Brushes c) Compensating winding d) Commutator

4. Which DC machine is used in paper mills?

   a) Universal motor b) DC series motor c) DC generator d) DC shunt motor

5. At what condition minimum losses in a transformer is achieved;

   a) Hysteresis losses = Eddy current losses b) Variable losses = Constant losses

   c) Windage losses = Friction losses d) Iron losses = Windage losses

6. Name the relay used for the protection of transformer against faults inside the transformer tank.

   a) Buchholz relay b) Static relay c) Microprocessor relay d) Thermal relay

7. Which expression estimates the air –gap length in mm of small induction motors?

   a) $0.2 - 2\sqrt{(DL)}$ b) $0.2 / 2\sqrt{(DL)}$ c) $0.2 + 2\sqrt{(DL)}$ d) $0.2 \times 2\sqrt{(DL)}$

8. In wound rotors, the type of rotor winding used in small induction motor is;

   a) Lap winding b) Mush winding c) Wave winding d) Barrel winding

9. For the water heads above 400 m, which hydraulic turbine is used?

   a) Kaplan turbine b) Francis turbine

   c) Pelton wheel d) Both Kaplan and Francis turbines

10. Which prime mover is used for small rating synchronous generators?

    a) Diesel engine b) Steam turbine c) Hydraulic turbine d) Gas turbine

PART B (10 x 2 = 20 Marks)

11. Define real and apparent flux densities of rotating machine.

12. The initial temperature of a machine is 40˚C. Calculate the temperature of the machine after 1 hour if its final steady temperature rise is 80˚C and the heating time constant is 2 hours. The ambient temperature is 30˚C.

13. Derive the output equation of dc machine.
14. How sparkless commutation in dc machine is acquired?
15. What is the difference between distribution and power transformers?
16. What quantities are required for optimum design of transformers?
17. List out the advantages of squirrel cage motor comparing with wound rotor machine.
18. Define crawling and cogging.
19. What is the purpose of damper winding and how power factor of damper winding current is improved?
20. Define the two different approaches used in computer aided machine design.

PART C (5 x 14 = 70 Marks)

21. a) Calculate the mmf required for the air gap of a machine having core length = 0.32 m including 4 ducts of 10 mm each, pole arc = 0.19m; slot pitch = 65.4 mm; slot opening = 5 mm; air gap length = 5 mm; flux per pole = 52 mWb. Given Carter's co-efficient is 0.18 for opening / gap =1, and is 0.28 opening / gap = 2.

(OR)

b) Explain briefly about the thermal state in electrical machines. Draw neatly the heating and cooling curves.

22. a) Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 r.p.m., 220V shunt motor. Given: full load efficiency = 0.83; maximum gap flux density = 0.9 Wb/m^2; specific electric loading = 30,000 ampere conductors per metre; field form factor = 0.7. Assume that the maximum efficiency occurs at full load and the field current is 2.5 % of rated current. The pole face is square.

(OR)

b) Determine the total commutator losses for a 800 kW, 400V, 300 r.p.m., 10 pole generator having the following data:
Commutator diameter: 100 cm; current density in brushes: 0.075 A/mm^2; brush pressure: 14.7 kN/m^2; co-efficienct of friction: 0.23; total brush contact drop: 2.2 V.

23. a) Derive the designing aspects in achieving minimum cost and minimum loss of the transformers.

(OR)

b) Calculate approximate overall dimensions for a 200 kVA, 6600 / 440V, 50 Hz, 3 phase core type transformer. The following data may be assumed: emf per turn = 10 V; maximum flux density = 1.3 Wb / m^2; current density = 2.5 A/mm^2; window

space factor = 0.3; overall height = overall width; stacking factor = 0.9. Use a 3 stepped core.

For a three stepped core:

Width of largest stamping = 0.9 d, and

Net iron area = 0.6 d^2 where, d is the diameter of circumscribing circle.

24. a) Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250 h.p., 3 phase , 50 Hz, 400 V, 1410 r.p.m., slip ring induction motor. Assume Bav = 0.5 Wb/m^2, ac = 30000 A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5 A/mm^2. The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.

(OR)

b) Calculate the equivalent resistance of rotor per phase referred to stator, from the following data of a 400 V, 3 phase, 4 pole, 50 Hz cage motor.

Stator slots = 48 with 30 conductors per slot; Rotor slots = 53 with one bar in each slot. The length of each rotor bar is 0.12 m and area 60 mm^2. The end rings have a mean diameter of 0.18 m and an area of cross section 150 mm^2.

Full pitch winding with 60° phase spread is used for the stator.

The material used for bars and end rings has a resistivity of 0.021 Ω / m and mm^2.

25. a) Define Short circuit ratio. Write the output equation of synchronous machine. List out the factors that influence specific magnetic and electric loading.

(OR)

b) Two preliminary designs are made for a 3 phase alternator, the two designs differing only in the number and size of stator slots and the dimensions of stator conductors. The first design uses 2 slots per pole per phase and there are 9 conductors per slot, each slot being 75 mm deep and 19 mm wide, and the mean width of stator tooth is 25 mm. The thickness of slot insulation is 2 mm; all other insulations may be neglected. The second design is to have 3 slots per pole per phase. Retaining the same flux density in the teeth and current density in the stator conductors as in the first design, calculate the dimensions of the stator slots for the second design.

The total height of lip and wedge may be assumed as 5 mm.

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