

**MODEL QUESTION PAPER**

B.E. Electrical and Electronics Engineering

Fifth Semester

**EE336 – Design of Electrical Apparatus**

Time : 3 Hours

Max Marks : 100

**PART – A**

Answer All Question (10 x 2 = 20 marks)

1. Cooling time constant of a rotating machine is normally larger than its heating time constant Why?
2. Explain the square pole criterion. What is the advantage of it?
3. List the factors that control the length of the air gap in DC Machine.
4. Prove that the maximum ampere turns that can be provided in a shunt coil is independent of exciting voltage.
5. What is the significance of stepping the core of a transformer?
6. In a 3 phase transformer, the primary coils over the outer limbs draw more magnetising current than the primary coil over central limb. Why?
7. Comment on the hysteresis loss and eddy loss when voltage and frequency of a transformer is doubled?
8. Why is it better to have more number of slots for an induction motor?
9. Explain  $B_{30}$  and its significance in induction motors.
10. Why is it possible to design alternators to generate much higher voltage than AC generators?

**PART – B (5 x 16 = 80 Marks)**

11. Determine the main dimensions of the core and the core section of conductors for a 120 kVA 6600 / 460 V, 50 Hz single phase core type transformer. The maximum flux density in the core and yoke is  $1.25 \text{ wb/m}^2$ , current density  $2.3 \text{ amps/m}^2$ . Assume cruciform section for the core with a stacking factor of 0.94 and window space factor of 0.33, height of the window is twice the width of the window. The net cross section of copper in the window is 0.2 times the net cross section of iron in the core.
- 12.a) During heat run test of a 100 kVA transformer the temperature rise after 1 hr and 2 hrs is found to be  $25^\circ \text{ C}$  to  $35^\circ \text{ C}$  respectively. Calculate the heating time constant and final steady temperature rise. If the rate of heat dissipation is increased by 15% by cooling with an external fan, find the new kVA rating for the same final temperature rise. Assume the maximum efficiency occur at 75% of full load and unity power factor.

**OR**

- 12.b) An induction motor has a final steady temperature rise of  $50^\circ \text{ C}$  when running at its rated output. Calculate its half hour rating for the same temperature rise if the copper

losses at rated output are 1.5 times its constant losses. The heating time constant is 90 minutes.

- 13.a) The commutator of a 10 pole, 1200 kW, 400 volts, 300 rpm dc generator has 450 segments and an external diameter of 100 cm. Assuming suitable values wherever required find the approximate length of the commutator. Determine the total commutator losses assuming a drop of 2.2 V due to brush surface resistance and current density of 6 amps/cm<sup>2</sup>. Friction co-efficient of 0.025 and brush pressure of 1250 kg/m<sup>2</sup>. Also check for the temperature rise.

**OR**

- 13.b)i) Derive the output equation of a DC machine related to the main dimensions.
- ii) Calculate the suitable armature core dimensions for a 400 kW, 550 V, 1800 rpm, 16 poles dc generator by assuming an average flux density to be 0.55 wb/m<sup>2</sup> and the ampere conductor to be 30,000. Assume an efficiency of 92%.
- 14.a) Determine the approximate diameter and length of the stator core, the stator slots and the number conductors for a 10 kW, 400 V 3 phase, 4 pole, 1425rpm induction motor. Assume  $B_{av} = 0.5 \text{ wb/m}^2$ ,  $q = 4,000 \text{ ac/m}$ . Assume full load efficiency and power factor as 0.85. Core length is equal to pole pitch.

**OR**

- 14.b) A 6 pole 3 phase squirrel cage induction motor has 72 slots with 12 conductors per slot. There are 55 rotor slots. Determine the current in rotor bars and in end rings if the equivalent stator current is 30 A.
- 15.a) A 3000 rpm, 50 Hz, 3 phase turbo alternator has a core length of 94 cm. The average gap density is 0.40 wb/m<sup>2</sup> ampere conductors / metre are 23000. Peripheral speed of rotor is 100 m/s and length of air gap is 2 cm. Find the kVA output of the machine when the coil is full pitched.

**OR**

- 15.b) A 1250 kVA 3 phase 6600 V salient pole alternator has the following data:  
Air gap diameter = 1.55 m,  
Length of the core = 45 cm,  
No. of poles = 20  
Armature ac = 30000  
Pole arc/pole pitch = 0.7  
Stator slot pitch = 28 mm  
Current density in damper bar = 3 A/mm<sup>2</sup>

Design suitable damper winding for the machine.

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