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B.Tech.(EE) (2012 Onwards E-I) (Sem.–6)

COMPUTER AIDED ELECTRICAL MACHINE DESIGN

Subject Code : BTEE-605A

M.Code : 71152

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Q1. Answer briefly :

a. Define Electric Loading.

b. Derive the output equation for a 3-phase induction machine.

c. Discuss the factors for the choice of magnetic loading.

d. What are the advantages of computer aided design?

e. Point out the difference between the expression for output coefficient of a dc and an ac machine.

f. Draw the flowchart for the synthesis method for design of electrical machine design.

g. Write down the advantages over synthesis method over analysis approach of design.

h. Obtain the output equation of a single-phase distribution transformer.

i. Discuss the choice of current density in primary and secondary windings of a transformer.

j. Discuss the choice of 'k' for different types of transformers.

SECTION-B

Q2. The initial temperature rise of a transformer is 26°C. After two hours operation on full load it is 56°C and after four hours run it is 71°C.

a. Calculate the maximum final temperature with full load on the transformer

b. Estimate the heating time constant

c. How much time will it take after start for the transformer to reach $(5/6)^{th}$ of its final steady state temperature?

Q3. Determine the main dimensions of a 350 kVA, 3-Φ, 50 Hz Y/Δ, 11,000/3300 V, core-type distribution transformer. Assume distance between core centres as twice the width of core.

Q4. Find the main dimensions, number of turns per phase, number of stator slots and conductors of a 15 kW, three-phase, 2-pole, 400 V, 50 Hz, 2810 rpm, Squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume specific magnetic loading = 0.5 T, specific electric loading = 25,000 ac/m. Take the rotor peripheral speed approximately as 20 m/s. Use star delta starting.

Q5. A 10 kW, 500 V, 4-pole, 1500 rpm DC shunt generator has the average flux density in the air gap as 1.2 T and the specific electric loading is 20,000 A/m. Find the main dimensions of the machine if it has to be designed with square pole face. Assume the ratio of pole arc to pole pitch as 0.6 and full load efficiency as 80%.

Q6. An induction motor has to drive the loads at a constant speed but different loading pattern of 140 kW for 25 minutes and then rest for 10 minutes, 100 kW for 20 minutes and then rest for 10 minutes. This operating sequence has to be continued indefinitely. Calculate the suitable capacity of a continuously rated motor for the above load cycle. Motors of capacity 105, 110 and 120 kW are available. The ratio of maximum to nominal power should not exceed 1.6.

SECTION-C

Q7. Design a suitable cooling system for a 500 kVA, 6600/440 V, 50 Hz, 3-Φ transformer with a total full load loss of 7 kW. The transformer main dimensions are 1 m in height, 0.96 m in length and 0.47 m in breadth. Use cooling tubes of diameter 50 mm to limit the average temperature rise to 35°C. Use clearance of 50, 14 and 13 cm on the height, length and width sides.

Q8. A three-phase 50 Hz, 400V, 12 kW delta-connected induction motor has the following design parameters:

$D = 15cm$	$\delta = 6A/mm^2$
$L = 9cm$	$S_s = 36$
$B_{av} = 0.45T$	$S_r = 30$
$\eta = 83\%$	$l_b = 15cm$
$p.f. = 0.85$	$d_e = 12cm$
$\rho = 0.021\Omega/m/mm^2$	

Assume $l_g = 0.2 + 2 \times \sqrt{DL}$

Calculate the no load flux, length of air gap, no. of turns per phase, stator current, rotor bar current and area, end ring current and area, resistance of rotor bar and end ring, losses in rotor bars and end rings and total rotor copper loss.

Q9. A 300 kW, 500 V, 500 *rpm*, 6-pole DC generator has average flux density over pole as 0.67 Wb/m^2 and specific electric loading as 25,000 A/m. The ratio of core length to pole pitch is 0.75. Estimate suitable dimensions of core diameter, length, number of armature conductors, number of slots and number of commutator segments.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.