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Name of Examination : **Summer 2021** - (Preview)

Course Code & Course Name : **EE451 - Electrical Machine Design**

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Maximum Marks : **60**

Duration : **3 Hrs**

[Edit](#) [Print](#) [View Answer Key](#) [Close](#) **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. All questions are compulsory.
2. Illustrate your answer with suitable figures/sketches wherever necessary.
3. Assume suitable additional data; if required.
4. Use of logarithmic table, drawing instruments and non programmable calculators is allowed.
5. Figures to the right indicate full marks.

1) Attempt any three

- a) Derive the output equation of single phase transformer Determine the dimensions of core and yoke for a 200kVA 50 Hz single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core lamination. Assume voltage per turn 14V maximum flux density 1.1 wb/m² Window space factor 0.32, current density 3A/mm², and stacking factor = 0.9. The net iron area is 0.56d² in a cruciform core where d is the diameter of circumscribing circle. Also the width of largest stamping is 0.85d. [6]
- b) Explain: [6]
 - i) Front pitch. ii) Back pitch iii) Winding pitch iv) Commutator pitch
- c) Design the sections of a rotor starter for a 75kW, 3 phase induction motor, using 7 notches. Rotor resistance per phase = 0.018 Ω . The upper current limit is to be full load current for which the slip is 2 percent. [6]
- d) Write a short note on computer aided design of analysis method for Electrical machine [6]

2) Attempt any three

- a) Show that the cooling curve of electrical machine is exponential in nature. Define cooling time constant and heating time constant [6]
- b) Derive the output equation of single phase transformer. [6]
- c) The temperature rise of a transformer is 25°C after one hour and 37.5°C after two hour of starting from cold condition. Calculate its final steady temperature rise and the heating time constant. If it temperature falls from the final steady value of 40°C is 1.5 hours when disconnected calculate its cooling time constant. The ambient temperature is 30°C. [6]
- d) What are the factors affecting size of rotating machines [6]

3) Attempt any three

- a) A 250 V, 37 kw, d.c. shunt motor has to exert a maximum torque of 150 percent of full load torque during the starting period. The resistance of armature circuit is 0.2Ω and the full load efficiency is 84 percent. The number of studs is 8
Determine : [6]
 1. the upper and lower limits of current during starting
 2. the resistance of each section
- b) Explain distribution and power transformer [6]
- c) Calculate the approximate overall dimensions for a 200 KVA, 6600/440 V, 50 Hz, 3 phase core type transformer. The following data may be assumed : emf per turn = 10 V, maximum flux density = 1.3 wb/m², Current density = 2.5 A/mm², window space factor = 0.3, overall height = overall width, stacking factor 0.9. Use a 3 stepped core.
for a 3 stepped core :
Width of largest stamping = 0.9 d and Net iron area = 0.6d². Where d is the diameter of circumscribing circle. [6]
- d) Derive the output equation of three phase induction motor [6]

4) Attempt

- a) Find the main dimensions of a 15kw, 3 phase, 400 volt, 50 Hz, 2810 rpm squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. [6]

Assume.

Specific magnetic loading = 0.5 wb/m².

Specific electric loading = 25000 A/m.

Take the rotor peripheral speed as approximately 20m/s at synchronous speed.

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