

B.E. Electrical (Electronics & Power) Engineering (Model Curriculum) Semester - V  
**TE101A - Electrical Machine Design**

P. Pages : 2

Time : Three Hours



**GUG/S/23/13861**

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
  2. Due credit will be given to neatness and adequate dimensions.
  3. Illustrate your answer wherever necessary with the help of neat sketches.
  4. Use of slide rule, Logarithmic Tables, Steam Tables, Mollier's Chart, Drawing Instruments, Thermodynamic tables for moist air, Psychometric Charts and Refrigeration charts is permitted.
  5. Read the question paper carefully (Branch, Semester, Scheme) before attempting the questions.
  6. Every question has equal weightage.
  7. Use of programmable calculator is prohibited.
  8. Assume suitable data wherever necessary.
  9. Draw neat and proper diagram/sketches.
  10. Don't use red pen for writing the answers.
  11. Don't write any other comments except answers of questions.

1. a) Core loss of a machine is 50 W at 50 Hz and 75 W at 70 Hz. If both are measured at same flux density, calculate the hysteresis and eddy current loss at 60 Hz. **8**  
b) What are the desirable properties of insulating materials? Explain the classification of insulating materials based on the thermal consideration with two examples of each. **8**

**OR**

2. a) A single phase transformer when supplied with 220V, 50Hz has eddy current loss of 50 W. If the transformer is connected to a voltage of 330V, 50 Hz, the eddy current loss will be? **8**  
b) Discuss in detail about the materials used in the construction of electrical machines? **8**
3. a) Explain tap changers and its necessity. **8**  
b) Derive an expression for volts/turn of transformer. **8**

**OR**

4. a) Write short note on **8**  
i) Need of stepped core.  
ii) Comparison of distribution and power transformer.  
b) Derive the output equation of single phase transformer. **8**
5. a) Design an adequate cooling arrangement for a 300 KVA, 7000/520V, 50 Hz, 3 phase oil immersed transformer with following details. **8**  
a) Winding temperature rise not to exceed 55 degree C  
b) Total losses at 95 degree C are 8 KW  
c) Tank dimensions i.e height \* length \* width = 130 \* 110 \* 55 (all in cm)

- b) Write about the resistance and leakage reactance of the transformer. **8**

**OR**

6. a) Design an adequate cooling arrangement for a 250 KVA, 6600/400 V, 50 Hz, 3 phase oil immersed transformer with following details. **8**
- a) Winding temperature rise not to exceed 50 degree C
  - b) Total losses at 90 degree C are 5 KW
  - c) Tank dimensions i.e. height \* length \* width = 125 \* 100 \* 50 (all in cm)
  - d) Oil level = 115 cm length.

- b) Discuss in detail about the design of cooling tanks. **8**

7. a) In the design of a 30 h.p., 3 ph, 440 V, 960 rpm, 50 Hz delta connected induction motor, assume the specific electric loading of 25000 ac/m, specific magnetic loading = 0.46 wb/m<sup>2</sup>. Full load efficiency 86%, p.f. 0.87 and estimate the following: **8**
- i) Stator core dimensions
  - ii) Number of stator slots and winding turns.

- b) Derive the output equation of induction motor. **8**

**OR**

8. a) Find the main dimensions, number of stator turns, size of conductor and number of stator slots of a 5 h.p., 400 V, 3-phase, 4-pole squirrel cage induction motor using star-delta starter running at a synchronous speed of 1500 rpm. Assume the following data: **8**
- Average flux density in the air gap = 0.46 Wb/m<sup>2</sup>
  - Ampere conductors per meter of armature periphery = 22 x 10<sup>3</sup>
  - Full load efficiency – 83%
  - Full load p. f. = 0.84 lagging
  - Winding factor = 0.955
  - Stacking factor = 0.9
  - Current density = 4 A/mm<sup>2</sup>
  - No. of slots per poles per phase = 3
  - L/t = 1.5

- b) Write in detail about the design of stator windings and stator slots. **8**

9. a) Write a short note on: **8**
- i) Direct cooling of turbo alternator.
  - ii) Cooling air circuit.

- b) Explain how to quantity of air required to absorb loses of electrical machines is determined. **8**

**OR**

10. a) Write about the field coil design for salient pole machine and for turbo generator rotor. **8**
- b) Write a short note on: Ventilation of synchronous generator. **8**

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