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Question Paper Code : 10548

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025

Sixth Semester

Electrical and Electronics Engineering

EE 8002 – DESIGN OF ELECTRICAL APPARATUS

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State any two factors considered in the design of electrical machine.
2. What is flux leakage?
3. Write the expression for output kVA of a transformer.
4. List the factors influencing temperature rise in transformer.
5. What are the main dimensions of a DC machine?
6. Define specific magnetic loading.
7. What is the short circuit current in induction motor design?
8. List the advantages of wound rotor over squirrel cage rotor.
9. Define short circuit ratio in synchronous machine.
10. Mention any two applications of Brushless DC machine.

PART B — (5 × 13 = 65 marks)

11. (a) Discuss in depth the key factors to be considered in the electrical machine design.

Or

- (b) Analyze the advantages of wave winding over overlap winding.

12. (a) (i) Analyze the salient feature of distribution transformer. (7)
(ii) Elucidate the different methods of cooling the transformer. (6)

Or

- (b) Determine the required core and window areas for a single-phase core-type transformer with a rating of 250 kVA, input voltage of 11,000 V, output voltage of 440 V, and operating frequency of 50 Hz. Assume a maximum flux density of 1.3 Wb/m^2 , a current density of 2.8 A/mm^2 , and a voltage per turn of 35 V. Use a window space factor of 0.30.
13. (a) (i) Sketch and explain the magnetic circuit of a DC machine. (7)
(ii) List and explain the factors that influence the selection of specific magnetic loading in a DC machine. (6)

Or

- (b) Perform a preliminary design analysis for a 75 HP, 460 V, 1200 rpm DC shunt motor. Calculate the armature diameter, core length, number of poles, and peripheral speed. Use the following design parameters: average flux density $B_{av} = 0.45 \text{ Wb/m}^2$, specific electric loading $a_c = 30,000 \text{ A-conductors/m}$, and assume an efficiency of 91%.
14. (a) Discuss the advantages and disadvantages of having small airgap of a 3 phase Induction motor.

Or

- (b) A 7.5 kW, 415 V, 4-pole, 50 Hz, 3-phase induction motor has a stator bore of 0.22 m and a core length of 0.18 m. The specific electric loading is 28,000 ampere-conductors per meter. Assume: Full-load efficiency 87%, Power factor = 0.85. Calculate the specific magnetic loading of the machine.
15. (a) Design the salient pole rotor for a synchronous machine and estimate the full load field MMF.

Or

- (b) Explain the procedure involved in designing the damper winding of a synchronous machine. Also, depict the placement of damper bars with the help of a diagram.

PART C — ($1 \times 15 = 15$ marks)

16. (a) A 1000 kVA naturally oil-cooled transformer is housed in a tank with dimensions 0.60 m in length, 1.45 m in width, and 1.75 m in height. The total load loss of the transformer is 11.8 kW. The heat dissipation due to radiation is estimated at $6 \text{ W/m}^2\text{-}^\circ\text{C}$, and the convection loss is improved by 35% due to the provision of cooling tubes. The permissible temperature rise of the transformer is 45°C . Each cooling tube provided is 1.2 m long with a diameter of 60 mm. Neglecting the top and bottom surfaces of the tank for heat dissipation, determine the number of tubes required for effective cooling of the transformer.

Or

- (b) Estimate the approximate stator core diameter and length, the number of stator slots, and the total number of conductors for a 30 kW, 415 V, 3-phase, 6-pole, 960 rpm, star-connected induction motor. Assume the average flux density $B_{av} = 0.45 \text{ T}$, efficiency $\eta = 85\%$, specific electric loading $a_c = 28,000 \text{ A-cond/m}$, power factor = 0.85, and a ratio of core length to pole pitch $L/\tau = 0.9$. The motor uses a double-layer stator winding.
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