

**Code No: 155BB****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B. Tech III Year I Semester Examinations, January/February - 2023****ELECTRICAL MACHINE DESIGN****(Electrical and Electronics Engineering)****Time: 3 Hours****Max. Marks: 75**

- Note:** i) Question paper consists of Part A, Part B.  
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.  
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A****(25 Marks)**

- 1.a) What is space factor in machine design? [2]  
b) What is the need of thermal considerations in machine design? [3]  
c) What are the major causes of temperature rise in transformers? [2]  
d) For a power transformer operating at full load it draws voltage and current equal to 200 V and 100 A respectively at 0.8 pf. Iron and copper losses are equal to 120 kW and 300kW. What is efficiency? [3]  
e) If all the stator coils of an induction motor are connected for the same magnetic polarity, what will happen to rotor pole polarity? [2]  
f) Why blades are provided to the squirrel cage induction motors? [3]  
g) In synchronous machines, short circuit ratio indicates what? [2]  
h) A 6 kVA, 220 V, 3 phase, star connected synchronous generator has a winding resistance of 0.15 ohm per phase and synchronous reactance of 6.1 ohm per phase. Find the voltage regulation of alternator at a load power factor of 0.8 lagging. [3]  
i) What are design optimization methods used in Computer Aided Machine Design? [2]  
j) Write some applications of claw-pole machines. [3]

**PART – B****(50 Marks)**

- 2.a) What are the important design factors to be considered in machine design? Explain.  
b) Discuss about the choice of specific electrical and magnetic loadings of machines. [5+5]
- OR**
- 3.a) Explain about the different basic principles used in the design of electrical machines.  
b) What are drawbacks of temperature rise in machines? [6+4]
- 4.a) Give the detailed comparison of power and distribution transformers.  
b) Calculate approximate overall dimensions for a 200 kVA, 6600/440 V, 50 Hz, 3 phase core type transformers. The following data may be assumed: EMF per turn = 9V; maximum flux density = 1 Wb/m<sup>2</sup>; current density = 2 A/mm<sup>2</sup>; window space factor = 0.3, overall height = overall width; stacking factor = 0.9; Use a 3 stepped core. For a three stepped core: Width of largest stamping = 0.9 d and Net iron area = 0.6d<sup>2</sup>, where d is the diameter of the circumscribing circle. [4+6]

**OR**

- 5.a) Explain in detail about the core design of the transformers.  
b) Show that the output of a 3-phase core type transformer is:  $Q = 5.23 f B_m d^2 H_w \times 10^{-2}$  kVA, where  $f$  = frequency in Hz;  $B_m$  = maximum flux density in Wb/m<sup>2</sup>;  $d$  = effective diameter of the core in m;  $H$  = magnetic potential gradient of limb in A/m;  $H_w$  = height of window in m. [5+5]

- 6.a) Explain in detail about different factors that should be considered while designing the rotor slots of squirrel cage rotor.  
b) A 3 phase, 2 pole, 50 Hz squirrel cage induction motor has a rotor diameter 0.17 m and core length 0.1 m. The peak density in the air gap is 0.45 Wb/m<sup>2</sup>. The rotor has 33 bars, each of resistance 110  $\mu\Omega$  and a leakage inductance 2  $\mu$ H. The slip is 5%. Calculate the rotor output and torque exerted. Neglect the resistance of end rings. [4+6]

**OR**

- 7.a) Explain in detail about the stator design of three phase induction machine.  
b) Estimate the stator core dimensions and number of stator conductors for a 100 kW, 3300 V, 50 Hz, 12 pole star connected slip ring induction motor. Average gap density = 0.45 Wb/m<sup>2</sup>, ampere conductors per meter = 25000, efficiency = 0.89, power factor = 0.9 and winding factor = 0.95. The slot loading should not exceed 500 ampere conductors. [5+5]

8. Discuss the design procedure of armature of a 3-phase synchronous generator. [10]

**OR**

9. Explain the procedure of design of a) Field winding and b) Damper winding of 3-phase synchronous machine. [10]

- 10.a) Write about the limitations of traditional designs need for CAD analysis.  
b) Discuss about complex structures of Permanent Magnet Synchronous Machines. [4+6]

**OR**

11. Explain in detail about FEM based machine design. [10]

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