R18

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^2; current density = 2 A/mm^2; 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 = $0.6d^2$, 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^2; 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^2. The rotor has 33 bars, each of resistance 110 μΩ and a leakage inductance 2 μH. 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^2, 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-phse 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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