Student Exam No._____

GANPAT UNIVERSITY

B. TECH. SEMESTER. VI (ELECTRICAL ENGINEERING)

REGULAR EXAMINATION APRIL – JUNE 2016

2EE 603: ELECTRICAL MACHINE DESIGN

Time: 3 Hours **Total Marks: 70**

Instruction:
1. All questions are compulsory.
2. Answers of each section must be written in separate answer book.
3. Figures to the right indicate full marks.
4. Assume suitable data wherever necessary.

Section - I

Que. – 1 **(A)** What do you mean by design optimization? Optimise the transformer design from the point of view of (i) minimum cost (ii) minimum loss. **06**

(B) Estimate the main dimensions including winding conductor areas of a 3 phase delta/star core type transformer rated at 300 kVA, 6600/440 V, 50 Hz. A suitable core with three steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. The emf per turn is 8.5 V. Assume a current density of 2.5 A/mm^2, a window space factor of 0.28 and a stacking factor of 0.9. **06**

OR

Que. – 1 **(A)** What is window space factor? Find the width of window for optimum output of a transformer. **06**

(B) A 300 kVA, 6600/400 V, 50 Hz, delta/star, 3 phase core type transformer has the following data: width of h.v. winding = 25 mm, width of l.v. winding = 16 mm, height of coils = 0.5 m, length of mean turn = 0.9 m, h.v. winding turns = 830, width of duct between h.v. and l.v. windings = 15 mm. Calculate (a) the leakage reactance of the transformer referred to the h.v. side. (b) if the h.v. coil is split into two parts with one part on each side of the h.v. coil, calculate the leakage reactance referred to the h.v. side. Assume that there is a duct 15 mm wide between h.v. winding and each part of l.v. winding. **06**

Que. – 2 **(A)** Derive the relation between core area and weight of iron and copper for a transformer. **05**

(B) A single phase, 400 V, 50 Hz transformer is built from stampings having a relative permeability of 1000. The length of the flux path is 2.5 m, the area of cross-section of the core is 2.5 x 10^{-3} m^2 and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6 W/kg. Iron weighs 5.8 x 10^3 kg/m^3. Stacking factor is 0.9. **06**

OR

Que. – 2 **(A)** List out the class of duty cycles for the selection of motor power rating and explain continuous, short time and intermittent duty cycle in detail with necessary waveforms. **06**

(B) Prove that in a d.c machine the volume of active parts is proportional to torque of the machine. **05**

Que. – 3 Attempt the following: 12

(A) Which are the different modes of heat dissipation in electrical machines? Explain the conduction mode in detail.

(B) Derive the output equation for 'm' phase ac machine.

(C) What do you mean by crawling and cogging? How they are affecting the performance of induction motor?

Section - II

Que. – 4 (A) Discuss the factors affecting the choice of number of stator slots in three phase induction motor. 06

(B) Determine the main dimensions, number of radial ventilating ducts, number of stator slots and the number of turns per phase of a 3.7 kW, 400 volt, 3 phase, 4 pole, 50 Hz squirrel cage induction motor to be started by a star delta starter. Work out the winding details. Assume: Average flux density in the gap = 0.45 Wb/m^2, ampere conductors per metre = 23000, efficiency = 0.85, and power factor = 0.84, winding factor = 0.955, stacking factor = 0.9. 06

OR

Que. – 4 (A) Which factors should be considered when estimating the length of the airgap of induction motor? Why the airgap should be as small as possible? 06

(B) A 11 kW, 3 phase, 6 pole, 50 Hz, 220 V, star connected induction motor has 54 stator slots, each containing 9 conductors. Calculate the values of bar and end ring currents. The number of rotor bars are 64. The machine has an efficiency of 0.86 and a power factor of 0.85. The rotor mmf may be assumed as 85 percent of stator mmf. Also find the bar and the end ring sections if the current density is 5 A/mm^2. 06

Que. – 5 (A) Why harmonics are generated in the synchronous machine? What are the different methods for elimination of harmonics in synchronous machine? 05

(B) Determine a suitable number of slots and conductors per slot, for the stator winding of a 3 phase, 3300 V, 50 Hz, 300 rpm alternator. The diameter is 2.3 m and the axial length of core is 0.35 m. The maximum flux density in the air gap should be approximately 0.9 Wb/m^2. Assume sinusoidal flux distribution. Use single layer winding and star connection for stator. 06

OR

Que. – 5 (A) Discuss effect of air gap length on performance of synchronous machine. 05

(B) Define Short Circuit Ratio (SCR). Write short note on "Influence of SCR on performance of synchronous machine." 06

Que. – 6 Attempt the following: 12

(A) Discuss the factor that governs the choice of average gap density for synchronous machine.

(B) Write a brief note on choice of "Shape of pole face".

(C) Write a short note on classification of insulating materials.

END OF PAPER