Student Exam No. _____

GANPAT UNIVERSITY

B. Tech. Semester: VI (Electrial Engineering)

Regular Examination April – June 2015

2EE 603: Electrical Machine Design

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

Instruction: 1. Attempt all questions.
2. Make suitable assumptions wherever necessary
3. Figures to the right indicate full marks.

Section - I

Que. – 1 **(A)** Derive the output equation for a single phase as well as for three phase transformer. **06**

(B) Calculate approximate overall dimensions for a 200 kVA, 6600/440 V, 50 Hz, 3 phase, core type transformer. The following data may be assumed: emf per turn = 10 V, maximum flux density = 1.3 T, current density = 2.5 A/mm^2, window space factor = 0.3, overall height = overall width, stacking factor = 0.9. Use a 3 stepped core. **06**

OR

Que. – 1 **(A)** List out different types of windings used in 3 phase transformer with its voltage rating. Also explain continuous disc type winding for 3 phase transformer. **06**

(B) Calculate the percentage regulation at full load 0.8pf lag for a 300 kVA, 6600/440V, delta-star, 3 phase, 50Hz, core type transformer having cylindrical coils of equal length with the following data. Height of coils = 4.7 cm, thickness of HV coil = 1.6 cm, thickness of LV coil = 2.5 cm, insulation between LV & HV coils = 1.4 cm, Mean diameter of the coils = 27 cm, volt/turns = 7.9 V, full load copper loss = 3.75 Kw. **06**

Que. – 2 **(A)** What is Design Optimization? Derive necessary condition for designing a transformer with minimum cost. **07**

(B) Design a suitable cooling tank with cooling tubes for a 500 kVA, 6600/440V, 50Hz, 3 phase transformer with the following data. Dimensions of the transformer are 100 cm height, 96 cm length and 47 cm breadth. Total losses = 7 kw. Allowable temperature rise for the tank walls is 350C. Tubes of 5 cm diameter are to be used. Determine the number of tubes required and their possible arrangement. **04**

OR

Que. – 2 **(A)** Prepare a technical note on classification of insulating materials. **07**

(B) Calculate the no load current and power factor of a 3300/220 V, 50Hz, single phase core type transformer with the following data. Mean length of the magnetic path = 300 cm, gross area of iron core = 150 cm2, specific iron loss at 50 Hz and 1.1 T = 2.1 W / kg ampere turns / cm for transformer steel at 1.1T = 6.2. The effect of joint is equivalent to an air gap of 1.0 mm in the magnetic circuit. Density of iron = 7.5 grams / cc. Iron factor= 0.92. **04**

Que. – 3 **Attempt the following questions:** **12**

(A) Explain the different modes of heat dissipation.

(B) Discuss the factors affecting the size of rotating machines and also for choice of specific magnetic loading.

Section – II

Que. – 4 (A) Discuss the factors affecting the choice of average flux density in airgap and choice of ampere conductors per meter for three phase induction motor. 06

(B) Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250 HP, 3 phase, 50 Hz, 400 V, 1410 rpm, slip ring induction motor. Assume B_{av} = 0.5 Wb/m^2, ac= 30000 A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5 A/mm^2. The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected. 06

OR

Que. – 4 (A) Explain the methods used for reduction or elimination of harmonic torques in three phase induction motor. 06

(B) A 15 kW, 400 V, 3 phase, 50 Hz, 6 pole induction motor has a diameter of 0.3 m and the length of core 0.12 m. The number of stator slots are 72 with 20 conductors per slot. The stator is delta connected. Calculate the value of magnetizing current per phase if the length of airgap is 0.55 m. The gap contraction factor is 1.2. Assume the mmf required for the iron parts to be 35 per cent of the airgap mmf. Coil span = 11 slots. 06

Que. – 5 (A) What do you mean by Short Circuit Ratio (SCR)? Discuss the effect of SCR on the performance of a synchronous machine. 07

(B) Determine for a 15 MVA, 11kV, 50 Hz, 2pole, star connected turbo alternator (i) airgap diameter, (ii) core length, (iii) number of stator conductors, from the given data Bav= 0.55 Wb/m2, ac = 6000 amp.cond/m, δ = 5A/mm2, synchronous speed ns = 50 rps, Kws = 0.98, peripheral speed=160 m/s. 04

OR

Que. – 5 (A) Give the procedure of estimating air gap length in synchronous machine. 07

(B) Which are the factors affecting the selection of armature slots? Explain them in brief. 04

Que. – 6 **Attempt the following questions:** 12

(A) Derive the output equation for a synchronous machine.

(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.

END OF PAPER