Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject code: 170902 **Date:08 /05/2015**

Subject Name: Electrical Machine Design I

Time: 02.30pm-05.00pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** Derive equation $E_t = k\sqrt{Q}$ where Q = kVA rating of a transformer. Explain how service condition of transformer affect the value of K. **07**

(b) Make a list of losses in transformer. Derive the condition for maximum efficiency of a transformer. **07**

Q.2 **(a)** Explain different types of winding used in core type power transformer. **07**

(b). Design a 250KVA, 2000/400 Volt, 50 Hz, 1- phase, core type oil immersed self cooled power transformer with following data: **07**

Induced emf per turn = 15 Volt
Max flux density Bm= 1.25 wb/m^2
Current density= 2.75 A/mm^2
Window space factor = 0.3
Height of the window Hw/ width of window Ww = 3
Assume 3 stepped core and Ai=0.6d^2, a= 0.9d
Determine the main dimensions of the core and yoke

OR

(b) A 200 KVA, 6600/400 Volt, 3 phase core type transformer has a total loss of 4800 W at full load. The transformer tank is 1.25 m in height and 1m X 0.5m in plan. Design a suitable scheme for tube if the average temperature rise is to be limited to 35 degree Celsius. The diameter of tubes is 50 mm and are spaced 75 mm from each other. The average height of the tubes is 1.05 m. Specific heat dissipation due to radiation and convection is respectively 6 and 6.5 W/m^2-degree Celsius. Assume that convection is improved by 35 percent due to provision of tubes. **07**

Q.3 **(a)** Derive the equation of Leakage reactance of a 3 phase core type distribution transformer. **07**

(b) Explain the differences between power and distribution transformer in design. **07**

OR

Q.3 **(a)** Explain the effects of change of supply frequency upon the voltage, losses, leakage reactance and resistance of the winding. **07**

(b) How will the output and losses in a transformer vary with linear dimensions? **07**

Q.4	**(a)**	Explain design principles of current transformer and its behavior under system short circuit.	**07**
	(b)	A 150 KW , 230 Volt, 500 RPM, D.C. shunt motor has a square field coil. Find the number of poles and the main dimensions and air gap length. Assume the average gap density over the pole arc as 0.85 Wb/m^2 and the ampere conductors per meter as 29000. The ratio of width of pole body to pole pitch is 0.55 and the ratio of pole arc to pole pitch is 0.7. The Efficiency is 91 percent. Assume that mmf required for air gap is 55 percent of armature mmf and the gap contraction factor is 1.15	**07**

OR

Q.4	**(a)**	Explain the various steps while designing d.c. machine, to reduce the effects of armature reaction	**07**
	(b)	Determine main dimensions(D and L) of a 5 kW, 250V, 4 pole, 1500 rpm D.C. shunt generator if the required data is : full load efficiency = 87% polearc/pole pitch = 0.66 avg. flux density = 0.42 Wb/m^2. Ampere conductors / m =15000. Machine is designed to have square pole face.	**07**
Q.5	**(a)**	Discuss the factors affecting the selection of No. of poles in D.C. machine.	**07**
	(b)	Discuss factors to be considered while deciding the length of air gap in the design of a d.c. machine	**07**

OR

Q.5	**(a)**	Explain guidelines used for the selection of number of armature slots in d.c. machine design	**07**
	(b)	Which are the factors which decide the choice of specific electric loading and specific magnetic loading in d.c. machine?	**07**

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