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B.E. SEMESTER VII EXAMINATION NOV/2015

SUBJECT CODE: EE-702 **SUBJECT NAME:** ELECTRICAL MACHINE DESIGN-I

DATE: 24/11/2015 **TIME:** 10:30 a.m. to 01:30 p.m. **TOTAL MARKS:** 70

Instructions:

1. Answer each section in separate answer sheets
2. Use of scientific Calculator is permitted.
3. All questions are compulsory
4. Indicate clearly the options you attempted along with the respective question number.
5. Use the last page of your supplementary for rough work.

Section – I

Q-1A	Derive the expression for the KVA rating of a three phase transformer and show that the e.m.f per turn $E_t=K\sqrt{KVA}$.	5
B	Derive the condition for the optimum design of transformer for the minimum cost and minimum losses.	5
C	The output co-efficient of 1250 kVA, 300 rpm, synchronous generator is 200 k VA/m^3-r.p.s. (i) Find the values of main dimensions of the machine if the ratio length to diameter is 0.2. Also calculate the value of main dimensions if (ii) specific loading are decreased by 10 % each with speed remaining the same,(iii) speed is decreased to 150 rpm with specific loading remaining the same as in part (i).Assume the same ratio of length to diameter. Comment upon the results.	5
	OR	
C	A 200 KVA 6600/440 volts 3-phase mesh star connected 50 Hz core type transformer has the following particulars: Maximum flux density: 1.3 wb/m^2 , Current density: 2.5A/mm^2, Window Factor: 0.3 , Overall Height = Overall width, Window area= $1\frac{1}{4}$ times core area. Calculate overall core dimensions.	5
Q-2A	What is window space factor? Find the width of window for optimum output of a transformer.	5
B	Estimate the main core dimension for a 50Hz, 3-phase 200kVA, 6600/500 volts star/mesh core type transformer. Use the following data: Core limb section to be 4-stepped for which the area factor =0.62, Window space factor=0.27, Height of window which is two times width of window, current density =2.8MA/m^2, Volts per turn=8.5, maximum flux density=1.25wb/m^2, Take Ai=0.62d^2.	5
	OR	
Q-2A	How will the output and losses in a transformer vary with linear dimension?	5
B	Determine the main dimensions of the core, the number of turns and the area of conductors for a 5 KVA, 50 Hz, 11000/400 V, Single phase, core type distribution transformer. The net conductor area in the window is 60% of the net cross-section (square) of the iron core. Assume a flux density of 1 wb/m^2, a current density of 1.4 A/mm^2 and a window space factor of 0.2.The window height is 3 times its width.	5

Q-3A	Explain design of tank with tubes of transformer.	5
B	Calculate approximate overall dimensions for a 200 KVA, 6600/440V, 50Hz, 3-phase core type transformer. The following data may be assumed: e.m.f per turn=10 V; maximum flux density=1.3wb/m^2; current density =2.5 A/mm^2; window space factor=0.3, overall height=overall width: stacking factor=0.9.Use a three stepped core. Width of largest stampings=0.9d, and Net iron area=0.6d^2 where d is the diameter of circumscribing circle.	5

OR

Q-3A	Draw and explain phasor diagram of potential transformer.	5
B	Derive the expression for total leakage reactance of a transformer referred to primary side.	5

Section – II

Q-4A	What is Specific electric loading? What are the factors those influence the choice of specific electric loading? Explain any one.	5
B	What is an end ring? How do you calculate the area of end rings?	5
C	Explain the following terms: (i) Harmonic induction torque (ii) Harmonic synchronous torque	5

OR

C	Determine the main dimension for a 1000 kVA, 50Hz, 3-phase 375 rpm alternator. The average air gap flux density is 0.55 wb/m^2 and the ampere conductor per meter are 28000.Use rectangular poles and assume a suitable value for ratio of core length to pole pitch in order that bolted on pole construction is used for which the maximum permissible peripheral speed is 50m/s. The runaway speed is 1.8 times the synchronous speed.	5

Q-5A	What is dispersion coefficient? Explain it effect on power factor.	5
B	Determine the main dimension turns per phase, turns per phase, number of slots, Conductor cross section and slot area of a 250 h.p. 3-phase,50 Hz,400 V, 1410r.p.m. slip ring induction motor. Assume: B_{av} = 0.5wb/m^2, ac=30000A/m^2, efficiency=0.9 and power factor =0.9, winding factor =0.955, current density =3.5A/mm2.The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2.The machine is delta connected.	5

OR

Q-5A	Which factor should be considered when estimating the length of the air-gap of induction motor?	5
B	A 11kW, 3 phase, 6 pole, 50 Hz, 220 V, star connected induction motor has 54 stator slots, each containing 9 conductors. Calculate the value of bar and end ring currents. The number of rotor bars is 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 mm. Also find the bar and the end ring section if the current density is 5 A/mm^2.	5

Q-6A	Find the value short circuit (blocked Rotor) current, the value of resistance & leakage reactance of the winding.	5
B	Calculate the equivalent resistance of rotor per phase referred to stator, from the following data of a 400 V, 3 phase, 4 pole, 50 Hz cage motor. Stator slots=48 with 30 conductors per slot, Rotor slots=53 with one bar in each slot. The length of each rotor bar is 0.12 m and area 60 mm2.The end rings have a mean diameter of 0.18 m and an area of cross-section 150 mm^2.Full pitch winding with 60^o phase spread is used for the stator. The material used for bars and end rings has a resistivity of 0.021 ohm/m and mm^2.	5

OR

Q-6A	Design starting winding for split phase motors.	5
B	State some methods to reduce the harmonic torque in induction motor. Why does skewing lower the power factor and overload capacity of the machine?	5

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