B.E(E.E) Part-III 5th Semester Examination, 2011

ELECTRICAL MACHINE DESIGN
(EE-505)

Time:2 Hours **Full Marks : 35**

Answer Q no 1 *and any TWO from the rest.*
Two marks are reserved for neatness.

1 Answer any three
- (a) Write down the complete specification of a 3phase transformer.
- (b) Why sheet steel with higher silicon content is used for transformer core where as lower silicon content sheet for rotating machines?
- (c) Give three important reasons to indicate why taps are provided in the hv winding of transformer.
- (d) Why cooling time constant of a rotating machine is larger than its heating time constant?
- (e) How a boltless core construction can be achieved in a transformer using CRGO as core material?
- (f) The synchronous reactance of a turbo generator is larger than water wheel generator—Explain.
- (g) Draw a sketch showing how different insulations are arranged in transformer. Also mention their names and class. [3 x 3]

2 (a) Show that voltage/turn of a transformer winding is given by $E_T = KQ^{1/2}$, the symbols having usual significance.

(b) Stepped core section is preferred to a square section for transformers – Give reasons.

(c) Determine the window height, the number of turns in the winding and the cross-sectional area of the conductors for a 350 KVA, 3 phase, 50 Hz, star-delta transformer having a no load voltage ratio of 11000/3300 V. Assume the following data : approximate Voltage/turn = 11V, maximum flux density = 1.25T, current density = 2.5 A/mm^2, window height to width ratio = 3, window space factor = 0.35. [3+3+6]

3 (a) How the choice of specific electric loading is affected by (i) temp rise and (ii) overload capacity of three phase induction motor.

(b) Large rotating machines use slightly higher specific magnetic loading than that in small ones – Explain.

(c) Determine suitable values of diameter and core length for a 1500 KVA, 3.3 KV, 3 phase star connected, 50 Hz, 10 pole alternator which is to have specific loadings of about 0.51 T and 34000 amp conductors per metre. The ratio of pole pitch/core length may be taken as 0.8. Also determine suitable number of stator conductors and slots limiting the ampere conductors per slot to 2000A. Find the number of turns per coil if double layer winding is used. Assume winding factor to be 0.955. [3 + 3 +6]

4 (a) Why belt leakage reactance for a squirrel cage induction motor is zero? On what factors does the zig zag leakage reactance depend ?

(b) Compare the performance regarding pullout torque and power factor of two identical 3 phase induction motors, one having open type stator slots and the other having semi closed type. Rotors of the two motors are identical.

(c) Obtain an expression for leakage reactance of a circular slot that can be used in rotating machines. [(1+2)+3+6]

5 (a) Why Carter's coefficient for semi closed slot is larger than open slot?

(b) Explain for a 3 phase induction motor the significance of choosing flux density at an angle of 30° from the pole center for the purpose of calculation of magnetizing current. Establish a relation between flux density at this angle and specific magnetic loading of the motor.

(c) Determine the air gap length of a DC machine from the following particulars: gross core length = 0.12 m; slot pitch = 25 mm; slot width = 10 mm; number of ducts = one of 10 mm wide; Carter's coefficient for slots and ducts = 0.32; gap density at the pole center = 0.7 T; field mmf per pole = 3900 A, mmf required for iron parts of magnetic circuit = 800 A. Assume open type slots. [2 + (2+2) +6]