[Total No. of Questions - 9] [Total No. of Printed Pages - 3] (2125)

15307

B. Tech 7th Semester Examination

Electrical Machine Design (NS)

EE-412

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt Five questions. Select one question from each of the section A, B, C and D. Question no. 9 in Section E is compulsory. All questions carry equal marks.

SECTION - A

1. (a) Which insulating materials are used in modern electrical machines? (10)

   (b) Explain the term 'heating time constant', and show that it has a small value for well ventilated machine and large value for poorly ventilated machine. (10)

2. (a) Discuss with relevant diagrams the radial ventilating system, axial ventilating system and combined axial and radial ventilating system for the cooling of electrical machines. (10)

   (b) Explain cooling methods of three phase transformers. (10)

SECTION - B

3. (a) Derive an expression for leakage reactance of a transformer with primary and secondary cylindrical coils of equal length, stating clearly the assumptions made. (10)

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   (b) Derive an expression for specific slot permeance for induction motor using semi-closed round slots. Clearly specify the assumptions made. (10)

4. (a) Describe the different types of windings used for three phase induction motor. (10)

   (b) Explain with neat sketches the following types of windings for transformers:

   (i) Cross-over winding (ii) Disc winding. (10)

SECTION - C

5. (a) Derive output equation for single phase as well as three phase transformer. (10)

   (b) A 200 kVA, 6600/440 volts, 3-phase, delta star connected 50 Hz, core type transformer has the following data:

   Maximum flux density = 1.3 wb/m^2; current density = 2.5 amps/mm^2; window factor = 0.3; over all height = overall width; window area =1.25 times core area. Calculate the overall core dimension. (10)

6. (a) Draw the flow chart for overall design of a transformer. The design must include main dimensions, efficiency, design of tank, cooling system and cost. (10)

   (b) Determine the no load current of a 6600/400 volts, 50 Hz, 1-phase transformer from the following data:

   Mean length of flux path= 270 cm; net area of cross section of iron = 130 cm^2; maximum flux density = 1.2 Wb/m^2; specific core loss at 50 Hz and at 1.2 Wb/m^2 = 2.1 watts/kg; mmf per meter for iron at a flux density of 1.2 Wb/m^2 = 650; specific gravity of iron = 7.5. The effect of joints is equal to an air gap of length 1 mm in series with iron. (10)

SECTION - D

7. (a) Discuss the factors which govern the choice of specific loadings for a 3-phase induction motor. (10)

   (b) Find the values of diameter and length of stator core of a 75 kW, 220 V, 50 Hz, 4 pole, 3-phase induction motor for best power factor. Given: magnetic loading = 0.4 Wb/m^2; specific electric loading = 22000 A/m, efficiency = 0.86; and power factor = 0.87. Also find the main dimensions if the ratio of core length to pole pitch is unity. (10)

8. (a) With equations, explain the estimation of No-load current of a three phase induction motor. (10)

   (b) Develop an algorithm for overall design of three phase squirrel cage induction motor. (10)

SECTION - E

9. (a) Why hard magnetic materials cannot be used in making the core of electrical machines?

   (b) Why large size machines have large heating time constant?

   (c) Why an a.c. armature winding is always made short pitched?

   (d) What are the advantages of stepped core in transformer?

   (e) Why cooling tubes are provided in transformers?

   (f) What is slot space factor?

   (g) Why the air gap of an induction motor is made as small as possible?

   (h) What is carter's coefficient?

   (i) What are the advantages of hydrogen cooling of electrical machines?

   (j) What are the methods adopted to reduce harmonic torques? (10×2=20)