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RN-7407

B. E. IV (Sem. VII) (Electrical) Examination

May / June – 2010

Elements of Electrical Design

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 4 (Sem. 7) (Electrical)**

Name of the Subject :

☛ **Elements of Electrical Design**

☛Subject Code No. : **7 4 0 7** ☛Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Attempt all the questions.

(3) Figures to the **right** indicate full marks.

(4) Assume suitable data if **necessary**.

SECTION - I

Q.1(a) Answer the following questions 5

1 List classes of insulation.

2 Define : Heating time constant

3 Why soft magnetic materials are used for rotating electrical machines?

4 What do you mean by duty S_2 for a motor?

5 What is zigzag leakage flux?

(b) State "True" or "False" for the following sentences. 5

1 Copper is having better mechanical strength compared to aluminum.

2 A machine will have more rating if class B type insulation is used in place of class F insulation.

3 In case of rotating machines, majority is heat dissipated is through conduction.

4 Axial ventilating ducts increase diameter of rotating machine.

5 A motor with continuous rating of 5KW can not be loaded more than 5KW even for very short time.

(C)(1) List properties of good conducting material. 5

(2) Discuss any two methods to determine power rating of a motor. 5

Q.2(a) In case of heat flow in two dimensions prove that the difference in temperature with respect to outer surface: 6

$$\theta = \frac{Q}{8l\left(\frac{w}{t\rho_x} + \frac{t}{w\rho_y}\right)}$$, with usual notations.

(b) A field coil has a cross section of 100X50 mm^2 and its length of mean turn is 1 m. Estimate the hot spot temperature above that of the outer surface of the coil if the total loss in the coil is 120 W. Assume space factor =0.56. Thermal resistivity of insulating material =8 Ω-m. 6

OR

Q.2(a) Explain various methods used for cooling in a rotation machine. 6

(b) A 50 MVA turbo-alternator has total loss of 1500kW. Calculate the volume of air reqired per second and also the fan power if the temperature ris in the machine is to be limited to 30°C. The other data given is : 6

Inlet temperature of air = 25°C, Barometric height =760 mm of Hg, pressure = 2 kN/m2, fan efficiency = 0.4

Q.3 Attempt and "Three" 18

1 The temperature rise of a transformer is 25°C after one hour and 37.5°C after two hours of starting from cold conditions. Calculate its final steady temperature rise and the heating time constant. If its temperature falls from the final stead caule to 40°C in 1.5 hours when disconnected, calculate its cooling time constant. The ambient temperature is 30°C.

2 Discuss: Types of duties for rotating machines.

3 Explain methods to calculate mmf for teeth in case of rotating machines.

4 Discuss various leakage fluxes in case of rotating machines.

SECTION II

Q-4 a **State whether True or False** 5

1 Hytsteris losses in a transformer vary as the square of the maximum flux density.
2 Real flux density in teeth is always greater than apparent flux density.
3 Current transformers is always operated with the secondary open circuited
4 The iron losses vary with load
5 Breather is used in transformers to cool the oil.-

Q-4 b Calculate approximate overall dimensions for a 200 kVA ,6600/440V,50Hz,3-phase core type transformer. **10**
The following data may be assumed:
Emf per turn=10V, maximum flux density=1.3wb/m^2,Current density=2.5A/mm^2,Window space factor=0.3,
Overall height=Overall width , Staking factor=0.9, Use 3-stepped core.

Q4 c Obtain the dimensions of the steps and net core area for a two stepped (cruciform) core in terms of circumcicle diameter. 5

Calculate no load current of a 400V, 50Hz, 1 Ph core type transformer the particulars of which are as follows Length of mean magnetic path 200 cm, gross core area 100cmsquare joints eqvt to .1 mm gap , max flux debsity .7T loss per kg .5 W per kg ampere turns 2.2 per cm for B= .7 T stacking factor .9 density of core material

Q5 **a** 7.5Kg/cm square **7**
magnetic path 200 cm, gross core section 100 cm^2, joints to 0.1mm , air gap,
watts per kg ; ampere turns 2.2 per cm for a flux density of 0.7 T kg/m^3 .
stacking factor 0.9 density of core material 7.5

Q5 **b** Show how to obtain the resistance of the section of a d.c shunt motor starter. **8**

OR

Q5 **a** Determine the air gap length of a d.c machine form the following particulars **7**
Gross length of core=0.12m, Number of ducts=one and is 10mm wide, Slot pitch=25mm,Slot width=10mm,Carter's co-efficient for slots and ducts=0.32,Gap density at pole centre=0.7wb/m^2,Field mmf per pole=3900A,Mmf required for iron parts of magnetic circuit=800A.

Q5 **b** Discuss the different types of windings used in transformer in brief

Q6 **a** Design the 6 stud section of a7 stud rotor starter for a 3-phase wound rotor induction motor. The slip at full load current is 2% and the maximum starting current is 1.5 times full load current. The resistance of rotor per phase is 0.02Ω. **8**

b Using simplifying assumton derive the expression for the leakage reacance of core typ **7**
or

Q 6 **a** Explain the steps involved in the design of a choke coil **7**

b Obtain an expression for net core area for single Phase transformer in terms of ration w **8**