B.TECH. SEM -V ELECTRICAL 2014 COURSE (CBCS) : WINTER - 2017

SUBJECT : ELECTRICAL MACHINE DESIGN

Day : **Tuesday** Time : **02.30 PM TO 05.30 PM**

Date : ***16/01/2018*** Max. Marks : 60

W-2017-2136

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use of nonprogrammable **CALCULATOR** is allowed.
4) Assume suitable data if necessary.

Q.1 **a)** Which factors influence the choice of specific magnetic and electric loadings for a rotating machines? **[04]**

b) Prove that the flux density in the teeth of rotating machine is directly proportional to specific magnetic loading. **[06]**

OR

a) A field coil has a heat dissipating surface of $0.15m^2$ and a length of mean turns of 1m. It dissipates loss of 150w, the emmitivity being $34w/m^2\ ^0C$. Estimate the final steady temperature rise of the coil and its time constant if the cross section of the coil is 5000 mm^2. Specific heat of copper is 390J/kg ^0C. The space factor is 0.56. Copper weighs 8900 kg/m^3. **[06]**

b) Elaborate the modern trends in design of electrical machines. **[04]**

Q.2 **a)** Derive relation between core area and weight of iron and copper for single phase core transformer. **[04]**

b) The ratio of flux to full load mmf in a 400 kVA, 50Hz single phase core type transformer is 2.4×10^{-6} AT. Calculate the net iron area and the window area of the transformer. Maximum flux density in the core is 1.3 wb/m^2; current density 2.7 A/mm^2 and window space factor is 0.26. **[06]**

OR

a) Write down the steps along with formulae to estimate the magnetizing current of a single phase transformer. **[06]**

b) What is bracing of windings? Why it is necessary? How is it obtained? **[04]**

Q.3 **a)** State any four rules used for selecting the number of rotor slots for known number of stator slots. **[04]**

b) Derive the expression for rms value of end ring current for squirrel cage induction motor. **[06]**

OR

P.T.O.

a) What are the factors considered while estimating the length of air gap of three phase induction motor? What is the effect of increase in air gap length on noise of the motor? **[04]**

b) Find the main dimensions of a 15kw, 3 phase, 400v, 50Hz, 2810 rpm squirrel cage induction motor having an efficiency of 88% and full load power factor of 0.9 lag. Assume B_{av} = 0.5 wb/m^2 and ac = 25000 A/m. Take peripheral speed as 20m/s at synchronous speed. **[06]**

Q.4 a) For a single phase induction motor how would you select: **[05]**
i) Area of Rotor bars
ii) Area of End ring

b) Discuss the design of starting winding for split phase motors. **[05]**

OR

Describe the design of main winding of single phase induction motor with reference to: **[10]**
i) No. of turns in running winding.
ii) Running winding conductors
iii) Number of stator slots
iv) Size of stator slot
v) Stator teeth

Q.5 a) Discuss the calculation of resistance steps of starters for d.c. shunt motors. **[05]**

b) Determine for a 500 kVA, 6600 V, 12 pole, 500 rpm, 3 phase alternator, suitable values for: **[05]**
i) The diameter of air gap.
ii) The core length.
iii) The number of stator conductors.
iv) The number of stator slots.
Assume a star connected stator winding, a specific magnetic loading 0.6 wb/m^2 and a specific electric loading of 30,000 A/m.
Assume ratio length : pole pitch = 1.5.

OR

a) Why a machine designed with a higher flux density has better stability. **[03]**

b) Design the suitable values of diameter and length of a 75 MVA, 11kV, 50Hz, 3000 rpm, 3-phase star connected alternator. Also determine the value of flux, conductors per slots, no. of turns per phase and size of armature conductor. **[07]**

Q.6 a) List out the modern electrical machine design challenges. **[04]**

b) What is Design optimization? Discuss the optimization procedure. **[06]**

OR

a) Explain design optimization of any machine using FEA. **[04]**

b) Discuss the FEA based machine design methods Maxwell 2D and 3D. **[06]**

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