06EE63

Sixth Semester B.E. Degree Examination, June-July 2009
Electrical Machine Design

e: 3 hrs. Max. Marks:100

Note: 1.*Answer any FIVE full questions, selecting at least TWO questions from each part.*
2.Design data book may be used if necessary.

PART – A

a. Explain clearly the factors which impose limitations in the design of electrical machines. **(06 Marks)**

b. Define specific loadings for D.C machines and what are the merits and demerits of selecting higher values of specific loadings. What are the factors to be considered during the choice of specific loading? **(07 Marks)**

c. Discuss the various factors which govern the choice of number of poles in D.C machines. **(07 Marks)**

a. A 250 kW, 500V, 600 rpm, d.c. generator is built with an armature diameter of 75cm and a core length of 30cm. The lap connected armature has 720 conductors using the data obtain form this machine determine the armature diameter, core length, number of armature slots, armature conductors and conductors per slot for a 350 kW, 440V, 720rpm, 6 pole d.c. generator. Assume a square pole face with ratio of pole arc to pole pitch equal to 0.7. The full load efficiency is 0.91 and the internal voltage drop is 4 percent of rated voltage. Take slot pitch for 350 kW d.c. generator is 2.5cm. **(12 Marks)**

b. The following particulars refer to the shunt field coil for a 440V, 6 pole d.c. generator.

mmf per pole	= 7000 AT
depth of winding	= 50 mm
length of inner turn	= 1.1 m
length of outer turn	= 1.4 m
loss radiated from outer surface excluding ends	= 1400 W/m^2
space factor	= 0.62
resistivity	= 0.02 ohm per m/mm^2

Calculate : i) The diameter of wire ii) Length of coil
iii) No. of turns iv) Exciting current **(08 Marks)**

a. Show that EMF/turn of a three phase transformer is given by $E_t = K\sqrt{KVA/phase}$ and write a brief note on factors affecting the value of K. **(10 Marks)**

b. Calculate :
i) Net cross section of core ii) Gross area of the core
iii) Core dimensions iv) Window area
v) Dimensions of the window for 200 KVA, 6600/250V 1ϕ shell type oil immersed self coded, distribution transformer based on the following design parameters.

Window space factor	= 0.28
Maximum flux density on the core	= 1.1 Tesla
Average current density	= 2.2A/mm^2
Window proportion	= 2.5 : 1
Reactangular core proportion	= 1.8 : 1

Net cross section of copper in the window is 0.2 times net cross section of iron in the core.
Assume stacking factor = 0.9 **(10 Marks)**

4 a. Derive an expression for leakage reactance of 1ϕ core type transformer with primary and secondary coils of equal length. State clearly the assumptions made. **(12 Marks)**

b. Design the suitable number of coding tubes necessary for a 3 phase transformer having the following particulars :
KVA rating = 500 ; Efficiency 98% at 0.88 p.f ; Heat dissipiation = 12.5 watts/$m^2/^0C$; Tank Dimensions = 48cm x 96cm x 150cm. Assume the diameter of cooling tubes as 6cm and average height is 120cm. **(08 Marks)**

PART – B

5 a. Calculate the following design information for a 30kW, 440V, 3ϕ, 6 pole 50H_z delta connected sequirrel cage induction motor :
i) Main dimensions of stator frame ii) No. of turns per phase on stator winding
iii) N. of stator slots iv) No. of conductor per slot
Assume B_{ave} = 0.48 Tesla ; q = 26,000 ac/m ; Full load efficiency = 88% ; Full load power factor = 86%. Assume winding factor = 0.955. **(10 Marks)**

b. Explain the factors which influence the length of air gap of 3 phase induction motor and write few empherical formulae for the length of air gap. **(10 Marks)**

6 a. A 11kW, 3 phase , 6 pole 50 H_z 220V star connected induction motor has a 54 stator slots, each containing a conductors. Calculate the value of bar and end rising currents. The number of rotor bars is 64. The machine has an efficiency of 86% and power factor of 85%. The rotor mmf may be assumed as 85% of the stator mmf. Also find the bar and end ring sections if the current density is 5 A/mm^2. **(10 Marks)**

b. A 5 HP, 4 pole , 3ϕ induction motor works on a 50H_z , 400 volts mains. It is designed for Y- Δ starting and has following design data :
Rotor diameter = 14 cm ; Gross core length= 11.5 cm ; Turns per phase on stator = 360 ; Air gap length = 0.4 mm ; Winding factor = 0.955 ; Iron factor = 0.95 ; Carters gap – contraction coefficient = 1.25
Assume that the ampere-turns required for the iron parts are about 30% of that required for the gap. Calculate the magnetizing current. **(10 Marks)**

7 a. From first principles, derive the output equation of a 3-phase alternator in terms of specific loadings, diameter and length of the stator core. What are the usual values of specific loadings? **(10 Marks)**

b. During the design of stator of 3 phase, 7.5 KVA, 6.6 KV, 50H_z, 3000 rpm, turbo generator, following information have been obtained.
Internal diameter of stator = 0.75 m ; Gross length of core = 0.9 m ; Number of stator slots per pole per phase = 7 ; Sectional area of stator conductor = 190 mm^2 ; Number of conductor per slot = 4. Based on the above data, calculate the following:
i) Flux per pole ; ii) Specific magnetic loading ;
iii) Specific electrical loading iv) Current density for the stator winding. **(10 Marks)**

8 a. Define short circuit ratio in connection with 3 phase synchronous generator. Explain the factors affecting by short circuit ratio. **(10 Marks)**

b. Find the main dimensions of a 2500KVA, 187.5 rpm 50H_z, 3-phase, salient pole synchronous generator. The generator is to be vertical water wheel type. The specific magnetic loading is 0.6 ω b/m^2 and the specific electric loading is 34,000 AC/m, use circular poles with ratio of core length to pole pitch = 0.65. specify the type of pole construction used if the run away speed is about two times the normal speed. **(10 Marks)**

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