NEW SCHEME

EE62

Reg. No. | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, January/February 2006

Electrical & Electronics Engineering

Electrical Machine Design

Time: 3 hrs.) (Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Any missing data may be suitably assumed.
3. Reference to design data hand book is permitted.

1. (a) Prove that in a d.c motor, torque is proportional to the volume of active material used. **(4 Marks)**

(b) Discuss the different types of insulation materials used in electrical machines. Explain the statement.

"Insulation decides the rating of the machines" **(4+4 Marks)**

(c) Show that the output of a d.c. generator with a single coil is given by $\frac{.03E'V.qA}{P.N.}$ kW where E' is the average voltage between adjacent commutator segments

V, the peripheral velocity in meters /sec

q, the specific electric loading in ac/meter

P is the number of poles

N is the speed in rpm **(8 Marks)**

2. (a) Discuss the choice of number of poles used in a d.c machine. **(8 Marks)**

(b) Calculate the main dimensions of a 20 H.P. 1000 rpm 400V d.c. motor. Average value of flux density = 0.37 tesla, specific electric loading = 16,000 AC/metre, Efficiency 90%.

Choose a suitable pole number and justify the selection **(12 Marks)**

3. (a) Derive the output equation of a 3 phase core type transformer. **(8 Marks)**

(b) Calculate the main dimensions for a 250 kVA 6600/415V, 50HZ, 3phase core type transformer.

Assume the following data

Emf/turn = 10V, maximum value of flux density = 1.1 tesla. Current density 2.5 A/mm^2, window space factor = 0.3. overall height = overall width, Stacking factor = 0.9. Use a 3 stepped core, the width of largest stamping is 0.9, Net iron area = $.6d^2$ where d = diameter of the circumscribing circle. **(12 Marks)**

4. (a) Derive an expression for the leakage reactance of the primary of a transformer. **(10 Marks)**

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(b) A single phase, 240V, 50 H_Z transformer is built from stampings having a relative permeability of 1000. The length of flux path is 1.8m. the area of cross section of the core is 1.8×10^{-3} metre^2 and the primary winding has 650 turns. Estimate the maximum value of flux and the no load current of the transformer. The iron loss at working flux density is 2.6 watts/kg. Iron weighs 7.8×10^3 kg/metre ^{3}. Stacking factor 0.9. **(10 Marks)**

5. (a) A 8 pole , 500 V, d.c shunt generator, with all the field coils connected in series, requires a m.m.f of 5000 At/pole. The poles are of rectangular dimensions $120 \times 200mm^2$ and available winding area is $120 \times 25mm^2$. Determine :

i) the area of cross section of the wire

ii) Number of turns

iii) MMF supplied by the field.

A conductor of round cross section is used. Resitivity is $0.02\Omega - mm^2/metre$ and the insulation of the wire increases the diameter by 0.2mm. Allow a voltage drop of 50 volts in the field regulator. **(8 Marks)**

(b) Discuss the various factors which influence the selection of air gap, stator and rotor slots in an induction motor . **(3×4=12 Marks)**

6. (a) Derive the output equation of an induction motor. **(5 Marks)**

(b) Determine the main dimensions, turns/phase, no. of slots, conductor area and slot area in an induction motor. rated for 250 H.P 400V, 3ph, 1410 rpm (slipring induction motor) Assume $B_{average}$ = 0.5 Tesla, specific electric loading 30,000 AC/m. Efficiency 0.9, P.F. = 0.9, winding factor = 0.955. Current density = 3.5A/mm^2 Slot space factor = 0.4, Ratio of core length to pole pitch = 1.2. The machine is delta connected. **(15 Marks)**

7. (a) What is a short circuit ratio in a synchronous machine? How does it influence the design of alternators? **(4+4 Marks)**

(b) Obtain the main dimensions of a 500 kVA 6600 volts, 50H_Z, 12 pole star connected salient pole alternator giving the following details.

i) internal diameter ii) Length of the machine. No. of stator conductors /phase, B = 0.56 tesla. Sp electric loading = 26,000 AC/metre. Winding factor = 0.95. **(12 Marks)**

8. Write short notes on any FOUR :

a) Peripheral velocity and its influence on design of machines.

b) Cooling of transformers

c) Advantages of rotating field structure

d) Advantage of double cage rotors in induction machines.

e) Logging end crowling of 3 phase induction motor

f) Design of the stator of a single phase induction motor. **(4×5=20 Marks)**

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