B.E.(with Credits)-Regular-Semester 2012 - Electrical Engineering & (E. & P.) Sem VI

EE605 - Design of Electrical Machines

P. Pages : 3 **GUG/W/16/5362**

Time : Three Hours * 3 5 3 7 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Use of non programmable calculator is permitted.

1. a) Explain the classification of Insulating materials depending on permissible temperature rise. **5**

b) State the advantages and disadvantages of adding Silicon to Iron. **3**

c) Calculate the maximum over load that can be carried by 20 Kw motor if temperature rise does not exceed 50ºC after 1 hour on over load. Temperature rise on full load after 1 Hour is 30ºC and after 2 Hr is 40ºC. Assume losses to be proportional to square of Load. **8**

OR

2. a) Write a short note on: Specification and properties of transformer oil. **8**

b) A 500 KVA transformer has total loss 7.5 KW at full load the rate of heat dissipation from tank is 300 W/ºC and heat energy require to raise its temperature rise 1ºC is 0.45 per hour. Calculate the final steady temp. rise and thermal time constant half hour rating of transformer to give the same temperature rise (as loss at full load is twice the iron loss). **8**

3. a) Explain the significance and selection of following design constants alongwith their permissible values for transforms: **8**
i) Choice of flux density
ii) Choice of current density
iii) Choice of window space factor.

b) Estimate the main dimensions, number of turns and winding conductor areas of transformer rated at 300 kVA, 6600/440 V, 50Hz. A suitable core with three steps having circumscribing circle of 0.25 m diameter and a Leg spacing at 0.4m is available. The emf per turn is 8.5 V. Assume a current density of 2.5 A/mm^2, a window space factor of 0.28 and a stacking factor at 0.9 **8**

OR

4. a) State and prove design criteria that results into minimum weight. **8**

b) Calculate the overall dimensions, Number of turns and Area of Cross – Section of 100 kVA, 11 KV/400V, 3 phase, Δ / Y core type distribution transformer for optimum output per unit height of window. **8**
Assume:
Volt/turn = 5V; Flux density = 1.2 Wb/m^2; Current density = 2.2 A/mm^2; Stacking factor = 0.9; window space factor = 0.25 cruciform core cross section and gross iron area of Yoke is 20% more than that of core.

5. a) For cylindrical concentric windings at equal length find the relation for total reactance at transformer referred to primary side. **8**

b) A 6600 V, 50Hz, single phase transformer has a net iron cross – sectional area of core 22.6×10^{-3} m^2. The length of flux path is 2.23m. There are four lap joints. Each lap joint takes mmf ¼th of magnetising mmf per metre of core. **8**
If, Bm = 1.1 Wb/m^2
Amplitude factor = 1.52 mmf per metre of core = 232 A/m and specific iron loss = 1.76 W/kg at working flux density.
Specific gravity = 7.5×10^3 kg/m^3
Determine no – load current.

OR

6. a) Why tapping are provided on HV side of transformer? **6**

b) Design a cooling system for a 500 kVA transformer with the dimensions: **10**
length, width and height 1.05 x 0.62 x 1.6. The full load loss is 5325 W. Find the number of tubes for transformer assuming W/m^2 - ºC due to radiation = 6 W/m^2 - ºC and due to convection = 6.5 W/m^2 - ºC. Improvement in convection due to provision of tubes = 40 percent, temperature rise = 40ºC, Length of each tube = 1.5 m, diameter of tubes = 50 mm. Neglect the top and bottom surfaces of the tank as regards cooling. Show the arrangement of tubes.

7. a) How the outside diameter of stator core is found for a three phase induction motor if the stator bore diameter is known? **8**

b) Calculate core dimensions and total I^2R loss of stator of 3 phase 120 kw, 2200 V, 50Hz, 750 RPM, star connected slip ring Induction motor from following particulars: **8**
BaV = 0.48 Wb/m^2
ac = 26,000 A/m
efficiency = 0.92
Power factor = 0.88
Kws = 0.955
Ratio of core length to pole pitch = 1.25,
Length of mean turn of stator
Conductor = 75 cm,
$\rho = 2.1 \times 10^{-8}$ ohm – m

OR

8. 250 HP, 3 phase 50 Hz 400V 4 pole squirrel cage Induction motor has following data: **16**

Stator bore diameter	= 40 cm
Axial length of stator	= 37.5 cm
Number of stator slot	= 60
Stator turns/phase	= 32
Current in each stator conductor	= 200 A
Current density in bar	= 6 A/mm^2
Current density in end ring	= 6.5 A/mm^2

Design a suitable cage rotor giving number of rotor slots, Section of each bar and end ring and rotor speed. Use copper bars for rotor bars and end rings.
$\rho = 0.021 \times 10^{-6}$ Ωm.

9. a) Explain the step for design of field winding of hydro – alternator. **8**

b) Determine the main dimensions for a 1 MVA, 50 Hz, 3 phase, 375 rpm alternator, BaV = 0.55 Wb/m^2 and ac = 28,000 A/m. Use rectangular poles. Maximum permissible peripheral speed is 50 m/s. The run away speed is 1.8 times the synchronous speed. **8**

OR

10. a) Explain procedure for pole design of salient pole alternator. **8**

b) Determine a suitable number of slots and conductors per slot for stator of 3 phase, star conn., 3300 V, 50 Hz, 300 RPM alternator. Diameter is 2.3 axial length of core is 0.35, Bm = 0.9 Wb/m^2. Use single layer winding. **8**

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