Reg. No. :

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Sixth Semester

Electrical and Electronics Engineering

14UEE602 - ELECTRICAL MACHINE DESIGN

(Regulation 2014)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Unit for specific electric loading
    (a) ampere-conductors   (b) ampere-conductors /m
    (c) ampere/m   (d) ampere

2. For motors

    (a) Pa= P   (b) Pa = P/η (c) Pa = P/Po   (d) Pa= ηP

3. _____ is defined as the ratio of actual length of iron in stacks of assembled core
    plates to total axial length of the stack.

    (a) Stacking factor   (b) Gap contraction factor
    (c) Field form factor   (d) Space factor

4. The maximum value of voltage between adjacent commutator segments at load to avoid
    flash over is

    (a) 15   (b) 70   (c) 50   (d) 30

5. Utilisation factor is high for a transformer with

    (a) rectangular core   (b) square core   (c) 4 stepped core   (d) 2 stepped core

6. For designing a transformer with minimum cost the cost of copper must be _____ to
    cost of iron.
    (a) greater than   (b) less than   (c) equal to   (d) two times

7. For designing an induction machine with good efficiency, the ratio of core length to pole pitch must be equal to

    (a) 1   (b) 2   (c) 1.25   (d) 1.5

8. If the value of Dispersion coefficient is large, then the induction machine will have

    (a) unity power factor   (b) low power factor

    (c) good power factor   (d) best power factor

9. What type of pole construction is used for a synchronous machine with the diameter 1.36m and speed 6.25 rps with the runaway speed 1.8 times the normal speed.

    (a) T head construction   (b) Bolted on pole construction

    (c) Dove tailed construction   (d) both a and c

10. What is the range of SCR (Short Circuit Ratio) for turbo alternators?

    (a) 0.5 to 0.7   (b) 0.05 to 0.07

    (c) 0.15 to 0.17   (d) 0.25 to 0.27

PART - B (5 x 2 = 10 Marks)

11. What are the electrical properties of insulating materials?

12. Distinguish between real and apparent flux densities in DC Machine.

13. What are the advantages of stepped core?

14. Define dispersion coefficient of an Induction Motor.

7. 15. State any two rules for selecting rotor slots of squirrel cage machines

PART - C (5 x 16 = 80 Marks)

16. (a) Name the various conducting material and where it is exactly used in electrical machines. Also describe the properties of a material for to be a good conducting material.

          (16)

Or

    (b) Define specific electric loading. Explain various factors that influence the choice the of specific electric loading in machines.   (16)

17. (a) (i) Derive the output equation of a DC machine.   (8)

          (ii) Explain the effects of choice of number of poles in a DC Machine on (1) Frequency of flux reversal (2) Weight of iron (3) Weight of copper and (4) Length of commutator.   (8)

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(b) Determine the main dimensions, number of poles and the length of air gap of a 500 volt, 600 kW, 900 rpm DC machine. Assume average gap density as 0.6 wb/m^2 and ampere conductors per metre as 35000 AC/m. The ratio of pole arc to pole pitch is 0.75 and the efficiency is 91 percentage. The following are the design constraints: Peripheral speed should not be greater than 40 m/s, Frequency of flux reversals should not be greater than 50 Hz, Current per brush armature should not be greater than 400 A. The mmf required for air gap is 50 percent of armature mmf and gap contraction factor is 1.15. (16)

18. (a) (i) Derive the output equation of single phase transformer in terms of core and window area. (8)

(ii) A 3 phase, 50 Hz, oil cooled core type transformer has the following dimensions: Distance between core centers = 0.2m, Height of window = 0.24m, Diameter of circumscribing circle = 0.14m. The flux density in the core =1.25Wb/m^2, the current density in the conductor = 2.5A/mm^2. Assume a window space factor of 0.2 and the core area factor = 0.56. The core is 2 stepped. Estimate KVA rating of the transformer. K_C for two stepped core = 0.56. (8)

Or

(b) A 250 kVA, 6600/400V three phase core type transformer has a total loss of 4800 W at full load. The transformer tank is 1.25 m in height and 1 m × 0.5 m in plan. Design a suitable scheme for tubes if the average temperature rise is to be limited to 35° C. The diameter of each tube is 50 mm and are spaced 75 mm from each other. The average height of tubes is 1.05 mm. Specific heat dissipation due to radiation and convection is respectively 6 and 6.5 W/b m^2 °C. Assume that convection is improved by 35% due to the provision of tubes. (16)

19. (a) Find the main dimensions of a 15KW, 3 phase, 400V, 50Hz, 2810 rpm squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9.Assume:Bav=0.5wb/m^2,ac=25000amp.cond/meter. Take rotor peripheral speed as approximately 20m/s at synchronous speed. (16)

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(b) (i) Discuss the factors to be considered in estimating the length of air gap of an Induction Motor. (8)

(ii) Discuss the step by step procedure to design the rotor of a squirrel cage Induction Motor. (8)

20. (a) (i) Define Short Circuit Ratio. Explain how it is determined for an alternator. Also discuss its effects on the performance of alternator. (8)

(ii) Derive the output equation of an AC machine. (8)

Or

(b) Determine a suitable number of slots and conductors per slot for the stator winding of a 3 phase 3300v . 50hz , 300 rpm alternator. The diameter is 2.3m and the axial length of core is .35m. The maximum flux density in the air gap should be approximately 0.9 wb /m2. assume sinusoidal flux distribution. Use single larger winding and star connection for stator. (16)

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