Question Paper Code: 46302

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

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. Sheet steels possessing higher silicon content are called

    (a) Dynamo grade steel   (b) Transformer grade steel
    (c) Cold rolled steel   (d) Stainless steel

2. Magnetic materials with relative permeability slightly less than unity are called

    (a) Diamagnetic materials   (b) Ferromagnetic materials
    (c) Paramagnetic materials   (d) Soft magnetic materials

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. _____ is defined as the distance between the starts of two consecutive coils measured in terms of coil sides.

    (a) Back pitch   (b) Front pitch
    (c) Winding pitch   (d) Commutator Pitch

5. Which part of the transformer does not allow the oil to come in contact with the atmospheric air? Also which part of the transformer is used to maintain the oil level?

    (a) Buccholz relay   (b) Conservator
    (c) LV winding   (d) HV winding

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. Which types of slots are generally used in induction motors?.

   (A) Open type   (B) Semi-closed type (C) Closed type   (D) None of the above.

8. In the design of induction motors, normally the number of slots per pole per phase is taken as

   (A) two   (B) three   (C) Three or more   (D) three or less.

9. Name the winding in Synchronous generator that is used to reduce oscillations and increases stability.

   (a) Running winding   (b) Main winding
   (c) Damper winding   (d) Auxiliary winding

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. Mention the different types of duties of a machine.

12. What is unbalanced magnetic pull?

13. What are the advantages of stepped core?

14. What is runaway speed?

15. Distinguish between cylindrical pole and salient pole construction.

PART - C (5 x 16 = 80 Marks)

16. (a) (i) Describe the classification of insulating materials used for electrical machines. Also discuss the applications of insulating materials.   (8)

    (ii) Discuss the choice of Specific magnetic loading.   (8)

Or

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

46302

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

(ii) A 5 kW, 250 V, 4 pole, 1500 rpm, shunt generator is designed to have a square pole face. The design constraints are: Average flux density in the gap = 0.42 wb/m^2, Ampere conductors per metre = 15000 A/m, find the main dimension of the machine. Assume full load efficiency = 87% and ratio of pole arc to pole pitch = 0.66. (8)

Or

(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)

46302

19. (a) (i) Distinguish between squirrel cage rotor and slip ring rotor with neat diagrams.

(8)

(ii) Discuss the effect of length of air gap on Induction machines.   (8)

Or

(b) A 15KW ,440V,4pole,50Hz,3 phase induction motor is built with a stator bore 0.25m and a core length of 0.16m .The specific electric loading is 23000 ac/m.Using the data of this machine, determine the core dimensions, number of stator slots and number of stator conductors for 11Kw,460V,6 pole,50Hz motor. Assume a full load efficiency of 84% and power factor of 0.82 for each machine. The winding factor is 0.955

(16)

20. (a) (i) Write short notes on the design of turbo alternators.   (8)

(ii) Compute the main dimensions of a 100 MVA, 11 kV, 50 Hz, 150 rpm three phase water wheel generator. The average gap flux density is 0.65 Tesla and ampere conductor per meter is 40000. The peripheral speed should not exceed 65 m/s at normal running speed.   (8)

Or

(b) A 1000 KVA, 3300V, 50Hz, 3 phase alternator has 180 slots with 5 conductors per slot. Single layer winding with full pitch coils is used. The winding is star connected with one circuit per phase .Determine the specific electric and magnetic loadings, if the stator bore is 2.0m and core length is 0.4m .The machine has 60° phase spread.

(16)