Register Number.....

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fifth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U07EE501: Design of Electrical Apparatus

Time: Three Hours **Maximum Marks: 100**

Answer ALL the Questions:-

PART A (10 × 1 = 10 Marks)

1. The force between two long parallel conductors is inversely proportional to

   (A) radius of the conductors
   (B) current in one conductor
   (C) distance between the conductors
   (D) product of current in two conductors

2. In electrical machines laminated core are used with a view to reducing

   (A) copper loss
   (B) hysteresis loss
   (C) eddy current loss
   (D) soft iron .

3. Due to which of the following reasons, copper bushes in d.c machines are used?

   (A) when small current and high voltage are involved
   (B) when low voltage and high currents are involved
   (C) to reduce friction losses
   (D) to reduce reactance voltage.

4. With given power rating for lower current and higher voltage rating following winding is preferred.

   (A) lap winding
   (B) wave winding
   (C) barrel winding
   (D) mush winding

5. When a given transformer is operating at its rated voltage with reduced frequency its

   (A) iron losses are reduced
   (B) flux density remains unaffected
   (C) core flux density is increased
   (D) core flux density is reduced

6. Which of the following gives the highest secondary voltage for a given primary voltage?

   (A) star/ delta
   (B) delta/star
   (C) star/star
   (D) delta/delta

7. When the voltage and frequency of a three phase induction motor is halved

   (A) air gap flux is halved
   (B) slip at rated torque increases
   (C) the maximum torque is halved
   (D) maximum torque remains the same

8. Leakage flux in an induction motor is more than that of a transformer because

   (A) it has air gap
   (B). it has three phase supply
   (C) it has moving member
   (D) high flux density is set up

9. A synchronous machine with low value of short circuit ratio

(A) higher is the stability limit
(B) lower is the stability limit
(C) speed regulation is better
(D) voltage regulation is improved

10. Salient pole rotors are used where

(A) high speed prime movers are required
(B) high frequency out put is required
(C) high capacity is needed
(D) low and medium speed prime movers are required

PART B (10 × 2 = 20 Marks)

11. Define air gap expansion factor..

12. Define field form factor..

13. State the factors which limit the armature diameter of a d.c machine.

14. What are the factors to be considered in the design of commutator?.

15. How tertiary winding is connected? Why?

16. Give typical values of k_c for different types of stepped cores

17. Why short pitched windings are employed in induction motor?

18. What is slot space factor?.

19. Write the expressions for length of air gap in salient pole synchronous machine

20. What is Short Circuit Ratio?

PART C (5 × 14 = 70 Marks)

Any missing data can be assumed with proper justification.

21.(a) (i) Derive relation to determine the real and apparent flux densities of slotte including fringing effect.

(ii) Determine the air gap length of a d.c machine from the following details: g of core is 0.12 m, number of duct is one with width of 10mm, slot pitch I 2 width is 10 mm. Carter's co-efficient for slots and ducts I 0.32. Flux dens centre is 0.7Tesla.. Field mmf / pole is 3900 AT and mmf required for ir magnetic circuit is 800 AT.

(OR)

(b) (i) What are the different types of slot leakage fluxes explain with necessary di

(ii) Calculate the mmf required for air gap of a d.c machine with an axial length of 20 cm and pole arc of 18 cm. The slot pitch is 27 mm, slot opening is 12 mm, air gap is 6 mm and useful flux per pole is 25 mweb.

Take carter's co-efficient for slot as 0.3. (7)

22. (a) (i) Explain the choice of specific electric and magnetic loadings of a d.c machine (7)

(ii) Calculate the reactance voltage induced per coil for a single turn two layer winding with two conductors per slot, of a 250 kW, 525 V, 8 pole lap wound d.c generator driven at 220 r.p.m. The number of armature conductors is 600. The inductance per coil is 0.0057 mH. The brush covers one commutator segment. If the armature diameter is 1.6 m and core length is 0.3 m, determine the flux density under the inter pole. The length of inter pole is 0.18 .m (7)

(OR)

(b) (i) Draw the sequence winding diagram for a simplex lab wound 24 slots, 4 pole d.c armature with 24 commutator segments. Show the position of brushes, (7)

(ii) Design a suitable commutator for a 350 kW, 600 r.p.m, 440 V, 6 pole d.c generator having an armature diameter of 0.75 m. The number of coils is 288. (7)

23. (a) (i). Derive a relation to express EMF per turn of a transformer in terms of its kVA rating. Mention the values of K for different types of transformers. (7)

(ii) A 3 – phase, 50 Hz, oil cooled core typr transformer has the following dimensions. Distance between core centre is 0.2 m, height of window is 0.24 m. Diameter of circumscribing circle is 0.14 m, the flux density in the core is 1.25 Tesla. The current density is 2.5 A/ mm^2 . Assume a window space factor of 0.2 and the core area factor as 0.56. The core is two stepped. Estimate kVA rating of the transformer (7)

(OR)

(b) (i) Derive the output equation of a three phase transformer. (7)

(ii) A tank of 1250 kVA, transformer has the following dimensions: length, width and height as 0.65 x 1.55 x 1.85 m respectively. The full load loss is 13.1 kW, loss dissipation due to radiation is 6 W/m^2/ $^\circ$ C, loss due to convection is 6.5 W/m^2/ $^\circ$ C , improvement in convection due to provision of tubes is 40 % temperature rise is 40 $^\circ$ C and length of each tube is 1 m, diameter of tube is 50 mm. Find the number of tubes for this transformer. (7)

24. (a) (i) What is dispersion co-efficient? Mention its influence in the design of indu motor.

(ii) A. 3-phase induction motor has 54 slots with 8 conductors per slot and 72 rotor with 4 conductors per slot. Find the number of stator and rotor turns. Find voltage across the slip rings, when the rotor is open circuited and at rest. Both s and rot are star connected and a voltage of 400 V is applied across the s terminals.

(OR)

(b) (i) Explain the effect of length of air gap in the design of induction motor. What ar various relations to find the length of air gap in the design of induction motor?

(ii). Calculate the magnetizing current per phase of 15 kW, 400 V, delta connec 3-phase, 6 pole induction motor has a bore diameter of 0.3 m and length of the as 0.12 m. The stator has 72 slots with 20 conductors is each slot. The length o gap is 0.55 mm, total gap contraction factor is 1.25.. MMF required for iron par 35% of air gap MMF.

25. (a) (i) Explain the choice of electrical and magnetic loadings in the design of synchron machines.

(ii). A 1000 kVA, 3.3.kV, 50 Hz, 300 r.p.m, 3-phase, alternator has 180 slots with fiv conductors in each slot. Single layer full pitched winding with 60° phase spread . used .in the stator. The winding is delta connected. Determine the specific electri and magnetic loadings

(OR)

(b) (i) What is f SCR (Short Circuit Ratio)? Mention its significance in the design synchronous machine.

(ii) Determine the main dimensions of a 1250 kVA, 3-phase, 50 Hz, 3.3kV, 300 r.p synchronous generator has the following design data.: Specific magnetic loading 0.58 wb/m^2 specific electrical loadings is 33ac/mm. Peripheral speed is limited 30m/sec.

(7)

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