Register Number:……………………..

B.E DEGREE EXAMINATIONS: NOV / DEC 2014

(Regulation 2009)

Sixth Semester

DEPARTMENT OF ELECTRICAL AND ELECTRONCS ENGINEERING

EEE 116**:** Design Of Electrical Apparatus

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The ratio of total flux of slot pitch to tooth area is called as _____ flux density.

   a) Rated   b) Reactive

   c) Real   d) Apparent

2. The MMF required for air gap with slotted armature is _____times that of smooth armature

   a) K_{CS} b) K_{CD}

   c) K_G d) K_{GD}

3. In a DC machine the slot pitch should lie between

   a) 15 to 25 mm   b) 25 to 35mm

   c) 35 to 45 mm   d) 7 to 15mm

4. For better commutation the slot per pole for DC machine should be_____

   a) ≥ 9 b) ≤ 9

   c) ≥ 30 d) ≤ 30

5. The EMF per turn of a transformer is given by

   a) KQ^2 b) $KQ/2$

   c) $K(Q)^{1/2}$ d) $2KQ$

6. In a transformer, the diameter of circumscribing circle ____ with increase in number of steps

   a) Decreases   b) increases

   c) remains constant   d) doubles

7. The range of slot pitch in Induction motor is

   a) 25 to 35mm   b) 35 to 45 mm

   c) 15 to 25 mm   d) 7 to 15 mm

8. The range of specific magnetic loading in Induction motor is

   a) 0.3 to 0.6 Wb/m^2 b) 0.8 to 1.2 Wb/m^2

   c) 1.8 to 2.2 Wb/m^2 d) 1.2 to 1.8 Wb/m^2

9. The total number of slots in stator of an alternator having 4poles, 3Φ, 6 slots per pole phase is

   a) 18 slots   b) 72 slots

   c) 24 slots   d) 12 slots

10. The short circuit ratio is equal to ----------- of Synchronous reactance

    a) Twice   b) inverse

    c) square   d) half

PART B (10 x 2 = 20 Marks)

11. Define specific magnetic and electric loading.

12. Define gap contraction factor for slots and ducts and give its expressions.

13. What are the factors to be considered for selection of number of poles in a DC machine?

14. Calculate the output coefficient of DC shunt generator from the given data B_g=0.89 Wb/m^2, ac=32,000 Ampere conductors/m, Ψ =0.66.

15. In transformers, why the low voltage winding is placed near the core?

16. What are the advantages of stepped cores in transformer?

17. Write the expression for output equation and output coefficient of induction motor.

18. What are the undesirable effects caused by certain combination of rotor and stator slots?

19. What is crawling and cogging in induction machine?

20. What is short circuit ratio in induction machine?

PART C (5 x 14 = 70 Marks)

21. a) (i) Determine the air gap length of DC machine from the following particulars (i) (8) Gross length of the core = 0.12m; Number of ducts =1; and is 10mm wide, slot pitch =25mm; slot width =10mm; carters coefficient for slots and ducts= 0.32; Gap density at pole arc =0.7 Wb/m^2.Field MMF/pole=3900 AT, MMF required for iron parts of magnetic circuit = 800 AT.

    (ii) What are the limitations in design of electrical apparatus? Explain them. (6)

    (OR)

    b) (i) Calculate the apparent flux density at a particular section of teeth from the (8) following data: Tooth width =12 mm; slot width =10 mm; Gross core length =0.32 m; Number of ventilating ducts =4; each 10mm wide; real flux density =31.4x 10^{-6} H/m; stacking factor=0.9.

(ii) Explain the different methods of cooling of turbo alternators. (6)

22. a) (i) Find the main dimensions and number of poles of a 37 KW, 230 V, 1400 rpm (8) shunt motor so that a square pole face is obtained. The average gap density is 0.5 Wb/m^2 and the ampere conductors per meter are 22,000. The ratio of pole arc to pole pitch is 0.7 and the full load η is 90%. Specify suitable winding.

(ii) Derive the output equation of DC machine. (6)

(OR)

b) (i) The following particulars refer to the shunt field coil for a 440 V, 6 pole Dc (8) generator: MMF per pole =7000 AT; Depth of winding =50 mm; Length of inner turn =1.1 m; Length of outer turn =1.4 m; Loss radiated from outer surface excluding outer ends = 1400 W/m^2; space factor =0.62; Resistivity = 0.62 $\Omega/m/mm^2$.Calculate a) Diameter of the wire b) Height of the coil c) Number of turns d) exciting current. Assume a voltage drop of 20% of terminal voltage across the field regulator.

(ii) Discuss how the specific magnetic and electric loadings are chosen for DC (6) machine.

23. a) Determine the dimensions of the core, the number of turns, cross sectional area of conductors in primary and secondary windings of a 100 KVA, 2200/480 V, 1ϕ core type transformer to operate at a frequency of 50 Hz by assuming the following data. Approximate voltage per turn = 7.5 V; Maximum flux density =1.2 Wb/ m^2. Ratio of effective cross sectional area of core to square of diameter of circumscribing circle is 0.6.Ratio of height to width of window is 2. Window space factor = 0.28; current density=2.5 A/mm^2.

(OR)

b) Derive the output equation of single and 3 phase transformer.

24. a) (i) Find the main dimensions, number of stator turns, size of conductor and number (10) of stator slots of 5 HP, 400V, 3Φ, 50 Hz, 1500 rpm cage induction motor. Star delta starting is used. Use the following data. Average flux density in air gap = 0.46 Wb/m^2.Ampere conductors per meter of periphery =22,000; full load efficiency =83 %. Full load power factor =0.84 lagging. Choose L/τ Ratio to give cheap design and semi closed slots.

(ii) Discuss the choice of specific magnetic loadings in 3Φ Induction machine. (4)

(OR)

b) A 90 KW, 500 V, 50 Hz, 3Φ , 8 pole Induction motor has a star connected stator winding accommodated in 63 slots with 6 conductors per slot. If the slip ring voltage on open circuit is to be about 400 V, find the suitable rotor winding and the following a) Number of slots b) Number of conductors per slot c)Slip ring voltage on open circuit d) Full load current per phase in rotor Assume $\eta = 0.9$ and power factor =0.86.

25. a) Determine the main dimensions of a 12 MVA, 13.8 KV, 50 Hz, 1500 rpm, 3Φ star connected alternator. The following particulars are provided. Average gap density = 0.6 T;Ampere conductors per meter = 42,000; Peripheral speed = 80 m/sec. Find also the maximum flux, Number of stator slots if one conductor per slot is used, the number of turns per phase.

(OR)

b) The field coil of a salient pole alternator are wound with a single layer winding of base copper strip 30 mm deep, with separate insulation of 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop an MMF of 12,000 A with a potential difference of 5 V per coil and with a loss of 1200 W/m^2 of total coil surface. The mean length of turn is 1.2m. The resistivity is 0.021Ω/m/mm^2.

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