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Question Paper Code : 41228

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Sixth Semester

Electrical and Electronics Engineering

080280035 – ELECTRICAL MACHINE DESIGN

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is real and apparent flux density?

2. Define gap contraction factor for slots.

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

4. Why equalizer connections are necessary for the armature winding of a DC machine with lap winding?

5. Why is the area of yoke of a transformer usually kept 15-20% more than that of limb?

6. Why stepped cores are generally used for transformer?

7. List out the factors that determine the choice of air gap length of a 3-phase induction motor.

8. What are the advantages of cage induction motor over slip ring induction motor?

9. What is the effect of SCR on synchronous machine performance?

10. What are the types of poles used for salient pole machines?

PART B — (5 × 16 = 80 marks)

11. (a) Calculate the apparent flux density at a section of the teeth of an armature of a D.C machine from the following data at that section. Slot pitch = 24mm, slot width = tooth width = 12mm, length of armature core including five ducts of 10mm each = 0.38m,iron stacking factor = 0.92. True flux density in the teeth at that section is 2.2T for which the mmf is 70000AT/m.

Or

(b) A 6-pole D.C. machine has the following design data. Armature diameter = 30cm,armature core length = 15cm,length of air gap at pole center = 0.25cm,flux per pole = 12 mwb. Field form factor = 0.65. Calculate the amp. turns required for the air–gap.

(i) if the armature surface is smooth

(ii) if the armature surface is slotted and the gap contraction factor is 1.2.

12. (a) Determine the diameter and length of armature core for a 55kW, 110 V, 1000 rpm, 4 pole shunt generator, assuming specific electric and magnetic loadings of 26000 amp.cond. / m and 0.5 Wb / m^2 respectively. The pole–arc should be about 70% of pole–pitch and length of core about 1.1 times the pole–arc. Allow 10 ampere for the field current and assume a voltage drop of 4 volt for the armature circuit. Specify the winding to be used and also determine suitable values for the number of armature conductors and slots.

Or

(b) The following data refers to the shunt field coil for a 440V, 6 pole, DC generator. mmf per pole = 7000A, depth of winding = 50mm, length of inner turn = 1.1 m, length of outer turn = 1.4 m, losses radiated from outer surface excluding ends = 1400W/m^2 ,space factor = 0.62,resistivity =0-02Ω/m and mm^2. Assuming a voltage drop of 20% of terminal voltage across the field regulator, calculate the diameter of wire,length of coil,number of turns and exciting current.

13. (a) Determine the dimensions of core and yoke of a 200kVA 50Hz single-phase transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6time the width of core laminations. Assume voltage per turn of 14V,maximum flux density 1.1 T,window space factor 0.32, current density 3A/mm^2 and a stacking factor of 0.9.The net iron area is 0.56d^2 in a cruciform core and width of largest stamping is 0.85d.

Or

(b) A 250kVA, 6600/400V, 3 phase core type transformer has a total loss of 4800 watt on full load. The transformer tank is 1.25m in height and lmx0.5m in plan. Design a suitable scheme for cooling tubes if the average temperature is to be limited to 35°C. The diameter of the tube is 50mm and tubes are spaced 75mm from each other. The average height of the tube is 1.05m. Specific heat dissipation due to radiation and convection is 6 and 6.5 W/m^2-°C. Assume that convection is improved by 35% due to provision of tubes.

14. (a) A 90 kW, 500V, 50Hz, three phase, 8 pole induction motor has a star connected stator winding accommodated is 63 slots with a 6 conductors / slot. If slip ring voltage, an open circuit is to be about 400V at no load find suitable rotor winding stating number of rotor slots, number of conductors / slot, coil span, number of slots. pole slip ring voltage an open circuit , approximately full load current / phase is rotor. Assume efficiency= 0.9, P.F = 0.8.

Or

(b) A 15 kW, three phase, 6 pole, 50 Hz, squirrel cage induction motor has the following data, stator bore dia = 0.32m, axial length of stator core = 0.125 m, number of stator slots = 54, number of conductor / stator slot = 24, current in each stator conductor = 17.5 A, full load P.F = 0.85 lag. Design a suitable cage rotor giving number of rotor slots section of each bar and section of each ring. The full speed is to be 950 rpm, use copper for rotor bar and end ring conductor. Resistivity of copper is $0.02\Omega/m$ & mm^2.

15. (a) (i) Determine the main dimension for 1000 kVA, 50Hz, three phase, 375 rpm alternator. The average air gap–flux density = 0.55 wb/m^2 and ampere conductors / m = 28000. Use rectangular pole. Assume a suitable value for ratio of core length to pole pitch in order that bolted on pole construction is used for which machine permissible peripheral speed is 50 m/s. The runway speed is 1.8 times synchronous speed. (8)

(ii) Derive the output equation for alternator. (8)

Or

(b) The following is the design data available for a 1250kVA. 3 phase, 50Hz, 3300V star connected, 330 rpm alternator of salient pole type. Stator bore D=l9m; Stator core length L = 0.335m; pole arc/pole pitch = 0.66, turns/phase=150,single layer concentric winding with 5 conductors per slot, short circuit ratio = 1.2. Assume that the distribution of gap flux is rectangular under the pole arc with zero values in the interpolar region. Calculate (i) specific magnetic loading (ii) armature mmf per pole (iii) gap density over pole (iv) air gap length. mmf required for air gap is 0.88 of no load field mmf and the gap contraction factor is 1.15.
