Q. Code:757557

B.E./B.TECH. Degree Examination, December 2020

Fifth Semester

EE18003-Design of Electrical Apparatus

Regulation 2018

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. The armature reaction in d.c. machine causes distortion in the main field flux. This effect of armature reaction can be reduced by

   a. Increasing the length of air gap b.Decreasing the length of air gap

   c.Increasing the number of poles d. Decreasing the number of poles

2. A transformer core is laminated to

   a.Reduce hysteresis loss b.Reduce eddy current loss

   c.Reduce copper loss d.All of the above

3. If the slip of 3 phase induction motor is increases, the current in its stator winding

   a. Decreases b. Increases c. Remains the same d. none of the above

4. A synchronous motor can be made self-starting by providing

   a. Damper winding on rotor poles

   b. Damper winding on stator

   c. Damper winding on stator as well as rotor poles

   d. None of the above

5. Why square pole is preferred for DC machine?

6. Define window space factor.

7. Why fractional slot winding is not used for induction motor?

8. Give the need for damper winding in synchronous machine.

PART B - (4 X16 = 64 marks)

09. (a) (i) State and explain the general factors that influence the choice of specific electric and magnetic loadings for rotating machines. **(10)**

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

(OR)

(b) (i) A 6 pole DC machine has the following design data. Armature diameter 30 cm, armature core length 15cm, length of air gap at pole center 0.25cm, flux per pole 12 milliweb. Field form factor 0.65. Calculate the ampere turns required for air gap. **(8)**

(a) If the armature surface is smooth

(b) If the armature surface is slotted and the gap expansion factor is 1.2

(ii) Derive an expression for the mmf of air gap of a machine with slotted armature and ventilating ducts. **(8)**

10. (a) Determine number of poles, the main dimensions and the length of air gap of a 1000KW,500V,300 rpm DC generator. Assume average gap density as 0.7 Wb/m^2 and ampere conductors per metre as 40,000.The pole arc to pole pitch ratio is 0.7 and efficiency is 92 %.The mmf required for air gap is 55 % of armature mmf and gap contraction factor is 1.15. **(16)**

The following are the design constrains: Peripheral speed should not exceed 30 m/s, frequency of flux reversals should not exceed 50Hz, current per brush arm should not exceed 400A and armature mmf per pole should not exceed 10,000(AT)

(OR)

(b) A 250KW,500V,600 rpm dc generator is built an armature diameter of 0.75m and a core length of 0.3m.The lap connected armature has 720 conductors. Using the data obtained from this machine, determine the armature diameter, core length, number of armature slots, armature conductors and commutator segments for a 350KW,440V,720 rpm , 6 pole dc generator. Assume a square pole face with ratio of pole arc to pole pitch equal to 0.66. The full load efficiency is 0.91 and the internal voltage drop is 4 % of rated voltage. The diameter of commutator is 0.7 of armature diameter. The pitch of commutator segments should not be less than 4mm.The voltage between adjacent segments should not exceed 15V at no load. **(16)**

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

(ii) Determine the diameter of core and window foe a 5KVA,50Hz, single phase core type transformer. A rectangular core is used with long side twice as long as short side. The window height is 3 times the width. Voltage per turns =1.8V, window space factor 0.2, **(8)**

$\delta = 1.8$ A/mm^2 , $B_m = 1$Wb/m^2

(OR)

11 (b) The tank of a 1250KVA natural oil cooled transformer has the dimension's length, width and height as 1.55 m X 0.65 m X 1.85 m respectively. The full load loss is 13.1kW. Design suitable number of tubes for this transformer assuming;W/m^2 -°C due to radiation = 6; **(16)**

W/m^2 -°C due to convection = 6.5;improvement in convection due to provision of tubes = 40%. Temperature rise 40°C;

length of each tube 1 m ; diameter of tubes 50 mm. Neglect the top and bottom surfaces of the tank as regards cooling.

12. (a) Estimate the main dimensions, air gap length, stator slots , stator turns per phase, stator conductors and cross sectional area of stator and rotor conductors for a 3 phase, 15KW, 6 pole ,50 Hz, 900 rpm induction motor. The motor is suitable for star-delta starting B_{av}=0.45 Wb/m^2,core length to pole pitch 0.85 power factor 0.85 ,Efficiency 90% , ac 20,000 ampere cond./metre, K_{ws}=0.955.Assume current density in stator conductors 3 A/mm^2, current density in rotor conductors and end rings 4 A/mm^2. **(16)**

(OR)

12 (b) (i) The output co-efficient of 1250 KVA, 300 rpm, synchronous generator is 200 KVA/m^3-rps. **(8)**

(a) Find the values of main dimensions (D,L) of the machine if the ratio of length to diameter is 0.2.Also calculate the value of main dimensions

(b) specific loadings are decreased by 10% each with speed remaining the same in part (a). (c) Speed is decreased to 150 rpm with specific loading remaining the same as in part (a) Assume the same ratio of length to diameter .comment upon the results.

(ii) State and explain the factors to be consider for the selection of armature slots in an alternator. **(8)**