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RM-7753-R

B. E. IV (Sem. VIII) (Electrical) Examination

April / May – 2010

Electrical Machine Design

Time : **3** Hours] [Total Marks : **100**

Instruction :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 4 (Sem. 8) (Electrical)**

Name of the Subject :

☛ **Electrical Machine Design**

☛ Subject Code No. : **7 7 5 3** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Attempt all questions.
(3) Answer to the **two** sections must be written in **separate** answer books.
(4) Figures to the extreme **right** indicate marks.
(5) Make suitable assumption wherever necessary.
(6) Use of calculator model Fx 100 W or equivalent is permissible.

SECTION - I

1 (a) Do as directed. **10**

(i) Draw the cross-sectional view of a 4-pole d.c. machine and show the flux path.

(ii) How is the overall diameter decreased with increase in number of poles.

(iii) What are the guiding factors for choice of number of poles.

(iv) What is the square pole criteria in d.c machine.

(v) What is the purpose of using compensating winding in case of D.C. Machine ? Where is it located?

(b) What are the factors affecting the size of rotating machine? **4**

(c) A 50 kW, 800 rpm d.c. generator has full load efficiency of 88%. If now another similar d.c. generator having two times the linear dimensions of 50 kW generator is built to work at 800 rpm. Find the output, losses and efficiency of the new generator.Assume the flux density and current densities to be same for two machine. **6**

2 (a) Discuss the factors to be considered when selecting the number of armature slots. **6**

(b) Find the main dimensions and number of poles of a 50 HP, 230 V, 1400 rpm shunt motor so that square pole face is obtained. Specific magnetic loading in the gap is 0.5 wb/m^2 and ampere conductors per metre are 22000. The ratio of pole arc to pole pitch is 0.7. Assume the efficiency of the machine as 90%. **9**

OR

(b) A 350 kW, 500 V generator has 8 poles, an armature diameter of 1.3 m and a core length of 0.35m. A duplex wave winding is accommodated in 114 slots with 6 coil sides per slot. The axial length of commutating poles is 0.2m and the gap length under the commutating poles is 10mm. Find the necessary mmf for each interpole if the specific permeance is 6×10^{-6}. Also find the number of turns. **9**

3 Attempt any **three** : **15**

(a) (i) What is the function of interpole in d.c.machine? How are they wound ?

(ii) in case of motor

(iii) in case of generator ?

(b) A 500 kW, 375 rpm, dc generator is designed with Bav=0.6 wb/m^2 and ac = 35000 ampere conductors per metre and ratio of pole are to pole pitch= 0.66. The armature is lap connected and single turn coils are used. Find suitable values of diameter and length of armature if the maximum value of voltage between adjacent segments is not to exceed 30 V at full load, and the peripheral speed is not to exceed 30 m/s. Assume the maximum value of gap density at full load to be 1.3 times the maximum value of flux density at no load. Efficiency at full load = 0.91

(c) What are the factors affecting the choice of specific electric loading in case of d.c. machine.

(d) State and explain the meaning of straight line commutation, retarded commutation and accelerated commutation.

(e) With the help of neat sketch explain the effect of armature reaction on the airgap flux in a d.c.. machine.

SECTION - II

1 (a) Answer in brief. **6**

(i) Why closed type slots often used for small induction motor?

(ii) Why air-gap between stator core and rotor core of an induction motor is made very small?

(iii) Why are salient-pole alternators more suitable for low speed and non-salient pole for high speed operation? **1**

(b) Fill in the blanks with appropriate words. **4**

(i) An alternator with _____value of SCR has better voltage regulation and higher stability limit.

(ii) Turbo-generators have _____diameter and _____core length.

(iv) A slow speed induction motor has inherently _____power factor

(vi) Small air-gap length in an induction motor yields _____power factor and _____noise level.

(c) State the important features of mush winding. **5**

(d) Find the main dimensions of a 100MVA, 11 kv, 50Hz, 40 poles salient-pole generator assuming air-gap flux density as 0.65 wb/m^2 and ampere conductors per metre length as 40000. The peripheral speed should not exceed 60 m/sec. **5**

2 (a) Derive expression for the rotor bar and end ring current of squirrel cage induction motor. **5**

(b) Discuss the factors influencing the choice of flux density and current density in the design of induction motor. **5**

(c) Discuss the factors which influence the selection of the specific loadings in the design of synchronous machine. **5**

OR

2 (a) A 500 kva, 3.3 kv, 50 Hz, 600 rpm, 3-phase, Salient-pole alternator has 180 turns per phase. Estimate the length of air-gap if the average flux density is 0.54 wb/m^2 . The ratio of pole arc to pole pitch = 0.66 and the gap expansion factor = 1.15. The mmf required for gap is 80% of no load field mmf. Winding factor = 0.995. **5+10**

(b) Determine the main dimensions, turns per phase, number of slots, conductor cross section and slot area of a 250 h.p, three phase 50 Hz., 400 V, 1410 rpm , slip ring induction motor. Assume B_{av} = 0.5Wb/m^2, ac=30000 A/m, efficiency=0.9 and power factor = 0.9, winding factor = 0.955 current density = 3.5A /mm^2. The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.

3 Attempt any **three** : **15**

(i) State different factors which are to be considered while designing slip ring induction motor.

(ii) Define short circuit ratio and explain the method of estimating air-gap length of an alternator.

(iii) State the methods used to reduce harmonic torques in induction motor.

(iv) Define dispersion co-efficient and derive an expression for the same.

(v) A 6 pole, 3-phase squirrel cage induction motor has 72 stator slots with 15 conductors in each slot. There are 55 rotor slots. The coil span is 11 slots and the phase spread is 60^o. Determine the current in rotor bars and end rings if the stator current is 24.1A and the Power factor is 0.83