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**Fifth Semester B.E. Degree Examination, December 2010**  
**D.C. Machines and Synchronous Machines**

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part.**  
**2. Draw phasor diagrams and figures neatly wherever required.**

**PART – A**

- 1
  - a. Explain the critical field resistance in a d.c. shunt generator and the method of determining it. (06 Marks)
  - b. Compare Lap and Wave winding. (04 Marks)
  - c. The brushes of 4 – pole, 48 kW, 400V wave connected d.c. generator are shifted from the geometrical neutral axis by 4 mechanical degrees. If the generator has 720 conductors and delivers full load current, find :
    - i) Demagnetizing ampere – turns/pole and
    - ii) Cross – magnetizing ampere – turns/pole. (10 Marks)
  
- 2
  - a. With the help of a neat diagram, explain the Ward – Leonard method of speed control. (07 Marks)
  - b. Derive an expression for the torque of a D.C. motor. (05 Marks)
  - c. A D.C. shunt motor runs at 1000 rpm on 200 V supply. Its armature resistance is  $0.8\Omega$  and the current taken is 40 Amps, in addition to field current. What resistance must be connected in series with the armature, to reduce the speed to 600 rpm, the armature remaining same? Neglect the armature reaction. (08 Marks)
  
- 3
  - a. Explain how will you obtain the efficiency of a D.C. series machine, by conducting the field test. (10 Marks)
  - b. A retardation test is carried out on a 1000 rpm d.c. machine. The time taken for the speed to fall from 1030 rpm to 970 rpm is,
    - i) 40 seconds with no excitation.
    - ii) 20 seconds with full excitation.
    - iii) 9 seconds with full excitation and the armature supplying an extra load of 10 amp. at 225 V.
 Calculate :
    - i) The moment of inertia of the armature in  $\text{kg} - \text{m}^2$
    - ii) Iron losses
    - iii) The mechanical losses at the mean speed of 1000 rpm. (10 Marks)
  
- 4
  - a. List the advantages and disadvantages of permanent magnet motors. (08 Marks)
  - b. Describe briefly the process of commutation in D.C. machines. (06 Marks)
  - c. A 4 – pole D.C. shunt motor takes 22 Amp. from 220 V supply. The armature and shunt field resistances are  $0.5 \Omega$  and  $100 \Omega$  respectively. The armature is lap connected with 300 conductors. If the flux/pole is 20 m Wb, calculate the speed and the developed torque. (06 Marks)

**PART – B**

- 5 a. List the differences between salient type and non salient type of rotor construction. (04 Marks)  
 b. Explain the slip test on salient pole synchronous machine, with a neat circuit diagram and indicate how  $X_d$  and  $X_q$  can be determined from the test. (10 Marks)  
 c. A 4 – pole, 3 – phase, 50 Hz, star – connected alternator has 60 slots, with 4 conductors/slot. The coils are short pitched by 3 slots. If the phase spread is  $60^\circ$ , find the line voltage induced for a flux/pole of 0.943 Wb, sinusoidally distributed in space. All the turns per phase are in series. (06 Marks)
- 6 a. Describe the synchronous impedance method to determine regulation of an alternator for lagging and leading power factor. (10 Marks)  
 b. The following test results are obtained on a 6600 V alternator :
- |                     |      |      |      |      |      |
|---------------------|------|------|------|------|------|
| O.C. voltage .....  | 3100 | 4900 | 6600 | 7500 | 8300 |
| Field current ..... | 16   | 25   | 37.5 | 50   | 70   |
- A field current of 20 Amp is found necessary to circulate full load current. Calculate by m.m.f. method, the full load regulation at 0.8 p.f. lag. Neglect armature resistance and leakage reactance. (10 Marks)
- 7 a. List the conditions to be fulfilled to connect two alternators, in parallel. (03 Marks)  
 b. Describe a method of synchronizing a 3 -  $\phi$  synchronous machine, to the infinite bus bars, by “two bright one dark lamp” method, with the relevant circuit diagram. (09 Marks)  
 c. A 3 – phase star connected synchronous generator supplies current of 10 Amp. having phase angle of  $20^\circ$  lagging at 400V. Find the load angle and components of armature current  $I_d$  and  $I_q$  if  $X_d = 10\Omega$  and  $X_q = 6.5\Omega$ . Assume armature resistance to be negligible. (08 Marks)
- 8 a. Write explanatory notes on the following topics :  
 i) Hunting in synchronous machines.  
 ii) V – curves and inverted V – curves of synchronous machines. (10 Marks)  
 b. A 400V, 3 – phase, star connected synchronous motor has an armature reactance of  $0.2\Omega$  per phase. While driving a certain load, it takes 25 Amp. from the supply. Calculate the back emf induced in the motor, if it is working with i) 0.8 lagging ; ii) 0.9 leading ; iii) Unity power factor conditions. (10 Marks)

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