USN | | | | | | | | | |

EE54

Fifth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
DC Machines and Synchronous Machines

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. With the help of figures, explain the phenomenon of armature reaction in a DC machine and how the affect of armature reaction is neutralized? **(12 Marks)**

b. A 230 V, 7.46 kW, 8 pole DC motor has 188 armature conductors. If the brush lead is 7.5° from the GNA, calculate,
   i) Total armature reaction ampere-turns.
   ii) Demagnetizing ampere-turns.
   iii) Cross magnetizing ampere-turns. **(08 Marks)**

2 a. Explain the methods of speed control as applied to
   i) DC shunt motor
   ii) DC series motor **(12 Marks)**

b. A 230 V DC shunt motor with an armature resistance of 0.4 Ω is excited to give constant main field. The motor runs at 500 rpm at full load and takes armature current of 30A. If a resistance 1.1 Ω is placed in the armature circuit, find the speed of the motor at i) Full load torque. ii) 1.5 times full load torque. **(08 Marks)**

3 a. Explain with a circuit diagram how efficiency in determined for DC machines by Hopkinson's test. **(07 Marks)**

b. Explain the construction and speed-torque characteristics of permanent magnet DC motors. **(05 Marks)**

c. A 500 V, DC shunt motor when running on no load takes 5 A. Armature resistance is 0.5 Ω and shunt field resistance is 250Ω. Find the output in kW and efficiency of the motor when running on full load and taking a current of 50A. **(08 Marks)**

4 a. Derive the expression for the emf equation of an alternator having distributed and short pitched winding, with usual notations. **(06 Marks)**

b. For an alternator discuss the following comparisons:
   i) Single layer and double layer windings.
   ii) Concentrated and distributed windings.
   iii) Full pitch and short pitched coils. **(09 Marks)**

c. A 3 phase, 4 pole, 50 Hz star connected alternator has flux per pole of 0.12 wb. The slots per pole per phase is 4 and the number of conductors per slot are 4. If the winding coil span is 150°, calculate the emf generated. **(05 Marks)**

5 a. Define voltage regulation of an alternator. Explain the ampere-turns method of predetermining the regulation of an alternator. **(12 Marks)**

b. A 2300 V, 50 Hz, 3 phase star connected alternator has an effective armature resistance of 0.2 Ω. A field current of 35A produces a current of 150 A on short circuit and an open circuit emf 780 V (line). Calculate the voltage regulation at 0.8 pf lagging and 0.8 pf leading for the full load current of 25A. **(08 Marks)**

6 a. An alternator is supplying constant load. Explain the effect of variation of excitation. **(08 Marks)**

b. A 400V, 7.5 hp, 3 ph, synchronous motor has negligible armature resistance and a synchronous reactance of 10Ω/ph. Determine the minimum current and the corresponding emf for full load condition. Assume a motor efficiency of 85%. **(07 Marks)**

c. Write a note on synchronous condensers. **(05 Marks)**

7 a. Explain the procedure of synchronization of alternators. **(08 Marks)**

b. Two 3 phase 3.3 kW star connected alternators supply a load of 1500 kW at 0.8 pf lagging. The synchronous impedance per phase of machine A is (0.5+j10)Ω and of machine B is (0.4+j12)Ω. The excitation of machine A is adjusted so that it delivers 150 A at a lagging pf and governers are so set that machines share load equally. Determine for each machine the current, power factor, induced emf and load angle. **(08 Marks)**

c. Explain hunting in synchronous motors. **(04 Marks)**

8 a. Explain the slip test on salient pole synchronous machines with a neat circuit diagram and indicate how Xd and Xq can be determined from the test. . **(12 Marks)**

b. A 230 V, 3 phase, 5 KVA star connected salient pole alternator with $X_d = 12\Omega$ and $X_q = 7\Omega$ delivers full load current at unity power factor. Calculate the excitation voltage neglecting resistance. **(08 Marks)**

*****