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10EE54

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
DC Machines and Synchronous Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Mention the types of armature windings and derive the EMF equation of a d.c. generator. **(06 Marks)**

b. With neat diagrams, explain the process of commutation in d.c. machines. **(08 Marks)**

c. A lap wound d.c. generator has 1000 armature conductors and 10 poles. The rated armature current is 800 A. Find the number of conductors of compensating winding per pole to give full armature reaction compensation, if the pole face covers two-third of pole pitch. **(06 Marks)**

2 a. With neat diagrams, explain the characteristics of a d.c. series motor. **(06 Marks)**

b. With the help of a neat diagram, explain the Ward-Leonard method of speed control. **(07 Marks)**

c. A 4-pole series wound fan motor draws an armature current of 50A, when running at 2000 rpm on a 230 V dc supply with four coils connected in series. Now these coils are connected in two parallel groups of two coils in series. Assuming the flux per pole to be proportional to the exciting current and load torque proportional to the square of speed, find the new speed and armature current with armature resistance of 0.2 Ω and resistance of each field coil is 0.05 Ω. **(07 Marks)**

3 a. Draw and explain the power flow diagram and derive the condition for maximum efficiency in a d.c. motor. **(06 Marks)**

b. Explain the brake test to determine the efficiency of a d.c motor and mention its demerits. **(07 Marks)**

c. A d.c. shunt motor rated at 12.5 kW output runs at no-load at 1000 rpm from a 250 V supply consuming an input current of 4 A. The armature resistance is 0.5 Ω and shunt field resistance is 250 Ω. Calculate efficiency of the machine when delivering full load output of 12.5 kW while operating at 250 V. **(07 Marks)**

4 a. With a neat diagram, explain the field's test on d.c series motors. **(06 Marks)**

b. What are the merits and demerits of Hopkinson's test? **(06 Marks)**

c. The Hopkinson's test on two similar d.c. shunt machines gave the following full load data: Line voltage = 110 V, Line current = 48A, Motor armature current = 230 A, Field currents are 3 A and 3.5 A. The armature resistance of each machine is 0.035 Ω. Calculate the efficiency of each machine assuming a brush contact drop of 1 V per brush. **(08 Marks)**

PART – B

5 a. Define pitch factor and distribution factor. What are the effects of distribution and chording of winding? **(07 Marks)**

b. Explain the armature reaction in a synchronous machine with different power factor loads. **(06 Marks)**

c. A three phase, 16 pole, star connected alternator has 192 slots with 8 conductors per slot. The coil span is 160° (ele), speed of the alternator is 375 rpm and flux per pole is 55 mWb. Calculate the phase and line voltages. **(07 Marks)**

6 a. Define voltage regulation of a 3ϕ alternator and explain the ZPF method of determining the voltage regulation for lagging p.f. load. **(10 Marks)**

b. A 415 V, 30 kVA, 50 Hz, 3ϕ star connected alternator has the following O.C. test data:

I_f in Amps	6	12	18	24	28
E_L in Volts	282	408	435	459	474

An excitation of 8A produced full load current in the armature on short circuit. If R_a = 0.5 Ω/phase, calculate the voltage regulation at full-load, 0.707 p.f. lagging by a) EMF method and b) MMF method. **(10 Marks)**

7 a. Explain slip test for the determination of direct axis and quadrature axis reactances. **(06 Marks)**

b. Derive the power flow equations including armature resistance and draw power angle characteristics of a synchronous machine. **(07 Marks)**

c. Two, 15 kVA, 400 V, 3ϕ alternators in parallel supply a total load of 25 kVA at 0.8 p.f. lagging. If one alternator shares half the power at unity p.f., determine the p.f. and kVA shared by the other alternator. **(07 Marks)**

8 a. With phasor diagram, explain the effect of operation at constant load with variable excitation of a synchronous motor. **(07 Marks)**

b. Explain the V and inverted V curves of a synchronous motor. **(06 Marks)**

c. A 20 MVA, 3ϕ, star connected, 11 kV, 2 pole, 50 Hz salient-pole synchronous motor has reactances of X_d = 5 Ω, X_q = 3 Ω. At full-load, unity p.f. and rated voltage find the excitation voltage and the active power. **(07 Marks)**

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