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10EE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
DC Machines and Synchronous Machines

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. Explain armature reaction effect in DC machines with relevant diagrams. How is it minimized? **(08 Marks)**

b. Define critical resistance. What is its significance? **(04 Marks)**

c. An 8 pole wave wound DC generator has 480 armature conductors. The armature current is 200 A. Find the armature reaction demagnetizing and cross magnetizing ampere turns per pole, if (i) brushes are on GNA and (ii) brushes are shifted by 6°e from GNA. **(08 Marks)**

2 a. Explain load test of a dc shunt generator and determination of load characteristics. **(08 Marks)**

b. What is back emf? What is its significance? **(04 Marks)**

c. A 100 hp, 500 V shunt M has 4 poles and a 2-circuit armature winding with 492 conductors. The flux/pole is 50 mWb and the full load efficiency of 92%. The armature resistance is 0.1Ω and shunt filed resistance is 250 Ω. Calculate for full load (i) speed (ii) useful torque. **(08 Marks)**

3 a. Explain T-I_a and N-I_a characteristics of dc shunt and series motor. **(04 Marks)**

b. What are the limitations of armature voltage speed control of dc shunt motor? Justify Ward-Leonard method of speed control of a dc shunt motor instead of armature voltage control. **(08 Marks)**

c. In a differentia test of 2 series motors the readings were: motor supply voltage is 500 V, generator voltage 427 V, load current 72 A, input current 9A more. Find the stray losses per machine and motor efficiency, given the motor resistance to be 0.575Ω. **(08 Marks)**

4 a. What is retardation test? By applying retardation test separate out the stray losses of a dc shunt machine by elimination method. **(10 Marks)**

b. Following results are obtained while back-to-back tests was performed on two shunt machines:
Supply voltage = 240 V
Field current of motor = 2A
Field current of generator = 3A
Armature current of generator = 60A
Current from mains = 16A
Armature resistance of each machine = 0.2 Ω
Determine the stray loss/machine and hence the efficiency of motor and generator on FL. **(10 Marks)**

PART – B

5 a. Analyze the merits of stationary armature over rotating armature type of construction for alternators. **(08 Marks)**

b. Derive an expression for the emf equation of an 3ϕ alternator having distributed, short pitched winding. **(06 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. If the winding coil span is 150°, calculate the emf generated per phase. **(06 Marks)**

6 a. Define voltage regulation of an alternator. Describe synchronous impedance method to determine regulation of an alternator for lagging, upf and leading power factors. Compare its merits over mmf method. **(12 Marks)**

b. A 3300V, 200 kVA, 3 phase star connected alternator has an armature resistance of 0.6Ω/ph and synchronous reactance of 6 Ω/ph. Calculate the percentage regulation when the rated output at 0.8 lagging pf is switched off. **(08 Marks)**

7 a. If two synchronous machine having different impedances and different induced emfs are connected in parallel, explain with equations, how they share a common load and what will be its common terminal voltage? **(10 Marks)**

b. Two three phase 6.6 KV star connected alternators supply a load of 3000 KW at 0.8 pf lagging. The synchronous impedance per phase of these machines are respectively (0.5 + j10)Ω and (0.4 + j12)Ω. The excitation of one machine is adjusted so that it delivers 150A at lagging pf and the governors are set so that the load is shared equally between the machines. Determine: (i) The current (ii) Power factor (iii) Induced emfs (iv) Load angle of each machine. **(10 Marks)**

8 a. Obtain an expression for the power-angle equation of a salient pole alternator connected to infinite bus. Sketch the characteristics and comment on its shape. **(10 Marks)**

b. A 1800 KVA, star connected, 6.6 KV salient pole synchronous motor has X_d = 23.25 Ω and X_q = 14.5 per phase. Its effective resistance is zero. Calculate the excitation emf and when the motor is supplying rated load of 0.8 pf leading. If the excitation is cut off, find the maximum load that the motor can supply. **(10 Marks)**

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