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10EE54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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. With usual notations, derive the emf equation of a DC generator. **(06 Marks)**
  b. Explain lap and wave windings briefly. Indicate the differences between them. **(06 Marks)**
  c. In a 120V, compound wound DC generator, the resistances of armature, shunt and series windings are 0.06Ω, 25Ω and 0.04Ω respectively. If the load current is 100A at 120volts, find the induced emf and armature current when it is connected as a short shunt generator. **(08 Marks)**

2 a. With usual notations, derive the torque equation for the DC motor. **(06 Marks)**
  b. Compare the characteristics of a DC series motor and a DC shunt motor. Indicate the applications of each. **(06 Marks)**
  c. With a neat diagram, explain the working of a 3-point starter. **(08 Marks)**

3 a. Define the efficiency of a DC generator. Derive the condition for maximum efficiency. **(06 Marks)**
  b. With a diagram, explain the power flow diagram for a DC generator. **(06 Marks)**
  c. A shunt generator has a full load current of 150A at a terminal voltage of 200V. The stray losses are 700W and the field resistance is 50Ω. If the full load efficiency is 90%, find the armature resistance and the load current corresponding to maximum efficiency (neglecting field current). **(08 Marks)**

4 a. Compare direct and indirect methods of testing DC machines. **(04 Marks)**
  b. Explain Hopkinson's test briefly why a diagram. Why is it called a back to back test? **(10 Marks)**
  c. Briefly explain Swinburne's test. What are its limitations? **(06 Marks)**

PART – B

5 a. Derive the emf equation of alternator with usual notations. **(06 Marks)**
  b. Indicate the differences between salient pole alternators and round rotor alternators. **(06 Marks)**
  c. A 3-phase, 8-pole, 750rpm synchronous generator has 72 slots. Each slot has 12 conductors and winding is short pitched by 2 slots. Flux per pole is 0.06Wb. Find pitch factor, breadth factor and induced emf per phase. **(08 Marks)**

6   a.   Describe mmf method of finding the regulation of an alternator for a leading power factor.
(06 Marks)

    b.   Compare emf method, mmf method and zpf methods of finding regulation of an alternator. Comment on the accuracy of these three methods.
(06 Marks)

    c.   A 3-phase, 6000V, 2000KVA, star connected alternator has the following O.C.C at rated speed.

I_{field} amps	14	18	23	30	43
V_t volts	4000	5000	6000	7000	8000

It takes 17A of field current to circulate rated current on short circuit and 42.5A of field current to generate rated voltage on zero power factor loading. Calculate the value of leakage reactance X_L for this machine.
(08 Marks)

7   a.   With a neat diagram, explain the process of synchronizing an alternator with infinite bus.
(10 Marks)

    b.   Explain the power angle characteristics of round rotor and salient pole alternators with neat diagrams.
(10 Marks)

8   a.   Explain briefly why a synchronous motor is not self starting.
(06 Marks)

    b.   Briefly explain V and inverted V-curves of a synchronous motor.
(06 Marks)

    c.   A 1000KVA, 11000V, 3-ϕ, star connected synchronous motor has an armature resistance of 3.5Ω and reactance of 40Ω (both per phase values). When the motor is fully loaded at 0.8pf leading, determine the induced emf and load angle.
(08 Marks)

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