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10EE54

Fifth Semester B.E. Degree Examination, July/August 2021
DC Machines and Synchronous Machines

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Missing data, if any, may be suitably assumed.

1 a. What is meant by commutation? Explain the process of communication in a DC machine briefly explain the methods to improve the commutation. **(10 Marks)**

b. The open circuit characteristic of a separately – excited dc generator driven at 1000rpm is as follows :

I_f Amps	0.2	0.4	0.6	0.8	1.	1.2	1.4	1.6
Emf volts	30	55	75	90	100	110	115	120

If the machine is connected as shunt generator and driven at 1000rpm and has a field resistance of 100Ω, find :
i) Open circuit voltage and exciting current
ii) Critical resistance
iii) Resistance to induce 115 volts on open circuit. **(10 Marks)**

2 a. Explain the characteristics of DC shunt motor and series motor. **(08 Marks)**

b. Derive an expression for armature torque of a DC motor. **(06 Marks)**

c. A 250V DC shunt motor has an armature resistance of 0.5Ω and a field resistance of 250Ω. When driving a load of constant torque at 600rpm. The armature current is 20A. If it is desired to raise the speed from 600 to 800rpm. What resistance should be insulted in the shunt field circuit? **(06 Marks)**

3 a. What are losses in a DC machine, and derive the expression for condition for maximum efficiency. **(10 Marks)**

b. A shunt generator delivers 195A at terminal p.d of 250V. The armature resistance and shunt field resistance are 0.02Ω and 50Ω respectively. The iron and friction losses equal 950w. find :
i) Emf generated
ii) Cu-losses
iii) Output of the prime motor
iv) Commercial, mechanical and electrical efficiencies. **(10 Marks)**

4 a. Explain the Hopkinson's test to determine efficiency as a motor and generator. **(10 Marks)**

b. When running on no-load, a 400V shunt motor takes 5A. Armature resistance is 0.5Ω and field resistance 200Ω. Find the output of the motor and efficiency when running on full-load and taking a current of 50A. Also, find the % change in speed from 10–load to full–load. [Swinburn's test]. **(10 Marks)**

5 a. Derive an expression for emf equation of an alternator by considering pitch factor and distribution factor. **(10 Marks)**

b. Calculate the RMS value of the induced emf per phase of a 10-pole, 3-phase, 50Hz alternator with 2-slots per pole phase and 4 conductors per slot in two Layer's. The coil span is 150°. The flux per pole has a fundamental component of 0.12wb and 20% third component. **(10 Marks)**

6 a. What is voltage regulation of a 3ϕ sy. generator? Explain MMF method of determining the voltage regulation. **(10 Marks)**

b. Form the following test results, determine the voltage regulation of a 2000V, single phase alternator delivering a current of 100A at i) unity pf. ii) 0.8 leading p.f. iii) 0.71 lagging p.f. Test result : full–load current of 100A is produced on S.C by a field excitation of 25A. An emf of 500V is produced on O.C by the same excitation. The armature resistance is 0.8Ω. **(10 Marks)**

7 a. What are the conditions to be satisfied when two alternator's are connected in parallel. Derive an expressions for synchronous power and torque neglecting the effect of Ra. **(10 Marks)**

b. Two single phase alternator operating in parallel have induced EMF on open circuit of $230\underline{|0}$ and $230\underline{|10}$ volts and respective reactance's of j2Ω and j3Ω. Calculate :
i) terminal voltage ii) currents iii) power delivered by each of the alternator's to a load of impedance 6Ω(resistive). **(10 Marks)**

8 a. Explain why a synchronous motor is not self starting. Briefly explain the following starting methods in detail : i) Auxiliary motor starting ii) Induction motor starting. **(10 Marks)**

b. A 2300V, 3-phase, Star-connected synchronous motor has a resistance of 0.2Ω per phase. The motor is operating at 0.5p.f leading with a line current of 200A. Determine the value of the generated emf per phase. **(10 Marks)**

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