



AS09-9/23

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10EE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023  
**D.C. 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. What are lap and wave windings? How do they differ from each other? (04 Marks)  
b. With usual notation, derive the expressions for demagnetizing and cross magnetizing ATs/pole. (08 Marks)  
c. An 8 pole wave connected DC generator has 480 armature conductors. The armature current is 200A. Find the armature reaction demagnetizing and cross magnetizing ampere turns per pole. If : i) brushes are on G.N.A ii) brushes are shifted  $6^\circ$  electrical from G.N.A. (08 Marks)
- 2 a. Draw and explain the various characteristics of DC shunt motor and DC series motor. (06 Marks)  
b. With the help of a neat diagram, explain the Ward-Leonard method of speed control. Write its advantages and disadvantages. (07 Marks)  
c. A DC shunt motor runs at a speed of 1000 rpm, on no load taking a current of 6A from the supply, when connected to 220V DC supply. Its full load current is 50A. Calculate its speed on full load. Assume  $R_a = 0.3\Omega$  and  $R_{sh} = 110\Omega$ . (07 Marks)
- 3 a. Explain the various losses in a DC machine and also derive the condition for maximum efficiency. (08 Marks)  
b. Draw and explain the power flow diagrams of DC generator and motor. (04 Marks)  
c. A 6 pole, 500Volts, wave connected shunt motor has 1200 armature conductors and useful flux/pole of 20mWb. Armature and field resistances are  $0.5\Omega$  and  $250\Omega$ . What will be the speed and torque developed by the motor when it draws 20Amp from supply. Neglect armature reaction. If magnetic and mechanical losses are 900 watts. Find :  
i) Back emf ii) Speed iii)  $T_a$  iv)  $T_{sh}$  v) efficiency. (08 Marks)
- 4 a. With a neat diagram, explain back to back test on two shunt connected DC machines. Also mention its advantages. (10 Marks)  
b. A test on two coupled similar from way motors, with their fields, connected in series, gave the following results when one machine acted as a motor and other as a generator.  
Motor : Armature current = 56A, Armature voltage = 590V voltage across the field winding = 40V  
Generator : Armature current = 44A, Armature voltage = 400V, field voltage drop = 40V  
Resistance of each armature =  $0.3\Omega$   
Calculate the efficiency of the motor and generator at this load. (10 Marks)

**PART – B**

- 5 a. Explain the construction of salient type and non salient type of rotors. (06 Marks)  
b. Derive the emf equation of synchronous generator. (07 Marks)  
c. A 3 phase, 4 pole, 50 Hz star connected alternator has flux per pole of 0.12Wb. The slots per pole per phase is 4 and the number of conductors per slots are 4, if the winding coil span is  $150^\circ$ . Estimate the rms value of resultant voltage per phase and the line voltage. (07 Marks)

- 6 a. With the help of neat sketches, how the voltage regulation can be determined using EMF method from the O.C. test and S.C. test results. (10 Marks)
- b. A 3 phase, star connected alternator is rated at 1600KVA, 13500 volts. The armature resistance and synchronous reactance are  $1.5\Omega$  and  $30\Omega$  respectively per phase. Calculate the percentage regulation for a load of 1280KW at  
i) U.P.f    ii) 0.8 p.f. lag    iii) 0.8 p.f. lead. (10 Marks)
- 7 a. What are the conditions to be satisfied, when two alternators are connected in parallel? Derive the expression for synchronizing power and torque neglecting the effect of  $R_a$ . (10 Marks)
- b. Two single phase alternators operating in parallel have induced emf's on open circuit of  $220\angle 0^\circ$  and  $220\angle 10^\circ$  V and reactance's of  $j3\Omega$  and  $j4\Omega$ . Calculate :  
i) Terminal voltage  
ii) Currents  
iii) Power delivered by each of the alternators to a load of resistance  $6\Omega$ . (10 Marks)
- 8 a. Explain Hunting in synchronous motor. (04 Marks)
- b. Explain V-curve and inverted V – curves of synchronous machines. (06 Marks)
- c. Explain why a synchronous motor is not self starting. Briefly explain the following starting method :  
i) Auxiliary motor starting  
ii) Induction motor starting. (10 Marks)

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