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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Electrical Electronics and Engineering

Semester End Examination; Dec. - 2019

Electrical Machines - II

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. With usual notation, derive the EMF equation of a DC generator. 5

b. List the classification of DC generators. Write the circuit diagram for each. 7

c. The induced EMF in a DC machine while running at 750 rpm is 220V. Calculate;
i) Assuming constant flux the speed at which the induced EMF will be 250 V
ii) Percentage increase in the field flux for an induced EMF of 250 V and a speed of 700 rpm 8

2 a. Explain what is meant by critical field resistance in a DC generator? Explain the method of determining it. 4

b. Explain the methods of improving commutation in DC machines. 8

c. A 40 kW, 4 poles 200 V, wave wound DC generator has 420 armature conductors. When delivering full load the brushes are displaced from the geometrical neutral axis by 5 commutator segments? Calculate the demagnetizing ampere turns per pole if the shunt field resistance is 40 Ω. Also calculate the extra shunt field turns / pole to neutralize the demagnetization. 8

UNIT - II

3 a. What is back EMF? What is its significance? 5

b. With usual notations, derive the torque equation of a DC motor. 5

c. A series motor drives a fan for which the torque varies as square of the speed. Its resistance between the terminals is 1.2 Ω on 220 V, it runs at 350 rpm and takes 30 A current. The speed is to be raised to 450 rpm by increasing the voltage. Find the voltage assuming the flux to vary directly as current. 10

4 a. Give the torque-speed relations and draw the torque-speed characteristics for the following case:
i) DC shunt motor ii) DC series motor iii) DC compound motor 6

b. A 250 V DC shunt motor has an armature current of 20 A, when running at 1000 rpm developing full load torque. The armature resistance is 0.5 Ω. What resistance must be in series with the armature to reduce the speed to 500 rpm developing the same torque? What will be the speed if the torque is halved with this resistance in the circuit? Assume constant air gap flux. 10

c. List the applications of DC motors. 4

UNIT - III

5 a. Mention various methods of testing DC machines. Discuss the advantages and limitations of each of the methods. 10

b. The following results were obtained while back to back test was performed on two shunt machines:
Supply voltage = 240 V, Field current of motor = 2 A, Field current of generator = 3A, Armature current of generator = 60 A, Current from supply mains to motor generator set = 16 A, Armature resistance of each machine = 0.2 Ω
Calculate the efficiency of motor and generator on full load. 10

Contd…2

6 a. Explain how the moment of inertia of a DC motor can be estimated? 5

b. Explain the construction and operation of a permanent magnet DC motor. 5

c. A 500 V shunt motor takes 8 A on no load. The armature and field resistance are 0.2 Ω and 250 Ω respectively when measured at room temperature. Neglect the effect of temperature rise find the efficiency of the machine when, 10

i) Machine runs as a motor taking a line current of 90 A at 500 V

ii) Machine runs as a generator delivering a line current of 90 A at 500 V.

Stray load losses are about 1.2% of the output

UNIT - IV

7 a. Discuss the various measures adopted in practice to make the waveform of large alternators to be closely sinusoidal. 10

b. A 3 ϕ, 10 pole, 600 rpm star connected alternator has 12 slots per pole with 8 conductors per slots and the winding is short chorded by 2 slots. The flux per pole contains a fundamental of 0.09 *wb* a third harmonic of 20% and fifth harmonic of 10% of the fundamental. Determine the rms values of phase and line voltages. 10

8 a. With usual notations with Phasor diagram and figures explain armature reaction in alternators for lagging and leading power factor loads. 10

b. A 6600 V alternator gave the following test results on OC and SC test :

OC voltage: V	3100	4900	6600	7500	8300
Field current: A	16	25	37.5	50	70

A field current of 22 A is found necessary to circulate full load current on short circuit of the armature. Calculate the full load regulation at 0.8 pF lagging by, 10

i) Ampere turn method

ii) Synchronous impedance method

UNIT - V

9 a. List the conditions to be satisified for successful parallel operation of 3ϕ alternators. 3

b. What are V and ^ curves? How to obtain them? Explain their significance. 7

c. A 2000 V , 3φ , star connected synchronous motor runs at 1500 rpm. The excitation is constant and the corresponding open circuit voltage is 2 kV. The resisitance is negligible and the synchronous reactance is 3.5 Ω per phase . for an armature current of 200 A determine; 10

i) Power factor

ii) Power input

iii) Torque developed

10 a. With usual notations, derive an expression for the power output of a syllindrial rotor altenator connected to an infinite bus in terms of excitation voltage, bus voltage and load angle . Draw the phasor diagram. 10

b. Two identical 2000 kVA altenators operate in parallel. The governor of first machine is such that frequency drops uniformly from 50 Hz on no load to 48 Hz at full load, the corresponding speed drop is second machine is 50 Hz to 47.5 Hz 10

i) How will the two machines share a load of 3000 kW?

ii) What is the maximum load at unity power factor that can be delivered without over loading either machines?

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