Code No: 133AM

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, February -2024
ELECTRICAL MACHINES – I
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A
(25 Marks)

1.a)	What are the main parts of a DC generator?	[2]
b)	What are the conditions for building up of a self-excited shunt generator?	[3]
c)	What are the torque speed characteristics of a DC series motor?	[2]
d)	What is armature reaction in a d.c motor?	[3]
e)	State the advantages and disadvantages of field test?	[2]
f)	What is brake test and where is it used?	[3]
g)	What is stacking factor? What is its approximate value in a transformer?	[2]
h)	What are the advantages of using a transformer in an AC supply?	[3]
i)	State the different forms of connections used in three-phase transformers.	[2]
j)	Discuss why the wattmeter in OC test on transformers reads core loss and that in SC test reads copper loss at full load.	[3]

PART – B
(50 Marks)

2.a) Explain the principle of operation of a dc generator.
b) A separately excited DC generator having constant excitation supplies power to a constant resistance load. It delivers 150 A at 400 V at a speed of 1,000 rpm. If current is reduced to 100 A, determine the speed. Total contact drop of brush is 2 V. Neglect the armature reaction. Armature resistance of the generator is 0.12 Ω. [5+5]

OR

3.a) Explain with neat diagram, the function of commutator in a dc machine.
b) A 40 kW, 400 V, four-pole DC generator has a two-layer simplex lap winding in 30 slots with 12 conductors in each layer. If the brushes are given an actual lead of 10°, calculate the following:
(i) Demagnetizing AT/pole.
(ii) Cross-magnetizing AT/pole.
(iii) Number of turns per pole on the compensating winding if the pole arc to pitch is 0.8 and brushes are placed on geometric neutral plane. [5+5]

4.a) Explain the operation of a three-point starter with the help of a neat diagram.

b) A 400 V DC shunt motor drives a load and takes 25 A from supply mains running at a constant speed. The load torque varies with the square of the speed. If a resistance of 15 Ω is inserted in series with the armature, determine the new speed as a percentage of the original speed. Shunt field resistance of the motor is 200 Ω. Neglect armature resistance. [5+5]

OR

5.a) Derive the condition for maximum efficiency of a DC shunt motor.

b) A 250 V, 15 kW d.c shunt motor has a maximum efficiency of 88% and a speed of 700 rpm when delivering 80% of its rated output. The resistance of the field winding is 100 Ω. Determine the efficiency and speed when the motor draws a current of 78 A from the mains. [5+5]

6.a) Explain how the efficiency of a dc machine is calculated from Swinburne's test. Why can this test not be applied in dc series machines?

b) Hopkinson's test on two identical shunt machines gave the following readings:
Supply voltage = 240 V, field currents = 6 A (generator) and 5A (motor), line current = 40 A, armature current of motor = 240 A, armature resistance of each machine = 0.014 Ω, voltage drop/brush = 1 V. Find the efficiency of each machine. [5+5]

OR

7.a) Describe the Hopkinson's test for determining efficiency of two similar DC shunt machines.

b) In a brake test the effective load on the pulley was 36.5 kg, the diameter of the pulley is 66 cm and the speed 900 rpm. The motor took 60 A at 220 V. Calculate the British Horse Power (B.H.P) and the efficiency at this load. [5+5]

8.a) Explain why the magnetizing current of a transformer is less than that of an equivalent rotating electrical machine.

b) A 50 kVA, single-phase transformer has 500 turns on the primary and 100 turns on the secondary. The primary is connected to 2,500 V, 50 Hz supply. Calculate the following:
(i) The secondary voltage on open circuit.
(ii) The current flowing through the windings on full load.
(iii) The maximum value of flux. [5+5]

OR

9.a) Describe the effect of variations of frequency and supply voltage on iron losses in a transformer.

b) A 30 kVA, 3,000/300 V, 50 Hz, single-phase transformer has the following winding resistances (R's) and leakage reactances (X's):
$R_1 = 2.5\ \Omega$ $R_2 = 0.018\ \Omega$
$X_1 = 3.8\ \Omega$ $X_2 = 0.052\ \Omega$
Calculate the following:
(i) Equivalent resistance, leakage reactance and impedance referred to as high-voltage side.
(ii) Equivalent resistance, leakage reactance and impedance referred to as low-voltage side.
(iii) Total Copper loss of the transformer at full load condition. [5+5]

10.a) Explain how various losses of a transformer can be found out from practical tests without actually loading the transformer.

b) A single-phase 10 kVA, 2,000/200 V, 50 Hz transformer has the following test results:
OC test (LV side): 200 V, 0.8 A, 60 W
SC test (HV side): 40 V, 4 A, 70 W
Calculate the following:
(i) The efficiency of the transformer at half load and 0.8 power factor lagging.
(ii) The load kVA at which maximum efficiency occurs and also the maximum efficiency at 0.8 power factor lagging.
(iii) The voltage regulation at 0.8 power factor leading on full-load condition. [5+5]

OR

11.a) State and explain the various conditions of parallel operation of single phase and three-phase transformers.

b) Three 300 kVA, 1100/230 V, 50 Hz transformers are connected in delta-delta formation to supply a 600 kVA load at 0.8 power factor lagging. One of these single-phase transformers is to be removed for emergency repair, thus making an open delta connection of two single-phase transformers supplying the three-phase load. Calculate the percent increase in load on each transformer when the defective transformer is removed. Also calculate the ratio of rating of open-delta and full-delta connections. [5+5]

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