PART C — (1 × 15 = 15 marks)

16. (a) A 500 V shunt motor takes 8 A on no load. The armature and field resistances are 0.2 Ω and 250 Ω respectively, when measured at room temperature. Neglect the change in resistance due to temperature variation. Find the efficiency of the machine. (15)

(i) While running as a motor taking a line of 80 A at 500 V.

(ii) While running as a generator delivering a current of 90 A at 500 V. Assume the stray load losses to be 1.2% of the output power.

Or

(b) Calculate the values of equivalent circuit parameters referred to LV side of a single phase 3 kVA, 220/440 V, 50 Hz transformer with the following test results. (15)

Open circuit test (HV open): 220 V, 1 A, 100 W

Short circuit test (LV short): 20 V, 9 A, 75 W

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30149

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Electrical and Electronics Engineering

EE 3303 — ELECTRICAL MACHINES – I

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate statistically induced EMF from dynamically induced EMF. Give one example for each.

2. Why it is named as leakage flux?

3. Draw the pictorial view of armature flux and field flux positions in the air gap during demagnetizing and cross magnetizing situations of DC machine.

4. List the role of inter-poles in the DC machine.

5. Write the reason for higher starting current in DC motors.

6. Compare brake test with Swinburne's test of DC machine.

7. Sketch the phasor representation of ideal transformer on No load.

8. Name the major components (in practical setup) required to separate the components of core loss of the transformer.

9. List the drawback of autotransformer by comparing two winding transformer.

10. Write the advantages of three phase transformer.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the expression for the energy in singly excited magnetic field system. (7)

(ii) Write a technical note on doubly excited magnetic field system. (6)

Or

(b) (i) Develop the mathematical expression for the force and torque developed in the singly excited system. (7)

(ii) The magnetic circuit has dimensions, cross sectional area of core = cross sectional area of air-gap = 8 cm^2, air-gap length = 0.055 cm, mean core length = 30 cm and N = 520 turns. Assume the value, μ_r = 65,000 for core material. Find (1) the reluctances of the core and air-gap, for the condition that the magnetic circuit is operating with flux density in the core = 1.0 T, (2) the flux and (3) the current. (6)

12. (a) (i) Explain, why EMF is induced in the DC machine. Draw the wave shape of the EMF induced in the machine with split-ring and with slip-ring assembly. Also derive the mathematical expression for the EMF induced in the DC machine. (7)

(ii) A DC generator has an EMF of 100 V, when the useful flux per pole is 20 mWb and the speed is 800 rpm. Calculate the generated EMF (1) with same flux and a speed of 1000 rpm; (2) with a flux per pole of 24 mWb and a speed of 940 rpm. (6)

Or

(b) (i) Draw and explain the magnetization and load characteristics of separately excited DC machine and self-excited DC machine. (7)

(ii) Two shunt generators running in parallel with a load current of 3000 A. The generators have armature resistances 0.05 Ω and 0.03 Ω. The field resistances are 30 Ω and 25 Ω. The induced EMFs are 400 V and 380 V. Calculate

(1) current supplied by each generator;

(2) bus-bar voltage and

(3) kW output of each generator. (6)

13. (a) (i) Derive the expression for the torque developed in the DC machine. Also list the factors affecting the torque developed. (7)

(ii) The armature resistance of a 200 V DC shunt motor is 0.12 Ω. It runs at 600 rpm at constant torque load and draws a current of 21 A. Calculate its new speed if the field current is reduced to 10%. (6)

Or

(b) (i) From the basic principles, derive the condition for the maximum efficiency in the DC machine. (7)

(ii) Two DC generators A and B are connected to a common load. Machine A had a constant EMF of 400 V and internal resistance of 0.25 Ω, while the machine B has a constant EMF of 410 V and internal resistance of 0.4 Ω. Calculate the current and power output from each generator if the load voltage is 390 V. What would be the current and power from each machine and the terminal voltage if the load was open circuited? (6)

14. (a) (i) Draw the per phase equivalent circuit (exact and approximate circuit) of single phase transformer with necessary assumptions by indicating different steps. (7)

(ii) Consider a 20 kVA, 2000/200 V, 50 Hz transformer. The SC test results are as follows: *SC test*: 80 V, 10 A, 290 W (HV side)

Determine the regulation at full load and half full load,

(1) 0.7 pf lag and

(2) 0.7 pf lead. (6)

Or

(b) (i) Write a technical note on the parallel operation of single phase transformer. (7)

(ii) A 5 kVA distribution transformer has a full load efficiency of 90 % at which copper loss equals Iron loss. The transformer is loaded 24 hours as given below. No load for 9 hours, 25% of full load for 6 hours, 50% of full load for 6 hours, and full load for 3 hours. Calculate all day efficiency of the transformer. (6)

15. (a) (i) Explain the construction and working of auto-transformer with neat sketches. (7)

(ii) With necessary circuit and derivation, prove that the Scott connection is used to convert three phase AC to two phase AC, if the phase angle between two phase is 90°. (6)

Or

(b) Elucidate the following phasor group of three phase transformer.

(i) any one arrangement for zero-degree phase displacement (7)

(ii) any one arrangement for 180° phase displacement. (6)