Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2023

ELECTRICAL MACHINERY-I [ELE 2123]

REVISED CREDIT SYSTEM

Time: 3 Hours **05 December 2023** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. A 500 kVA, 11,000 / 415 V, 50 Hz, single-phase transformer has 100 turns on the secondary winding. 3

Determine the following:

a) On full-load, primary and secondary currents.
b) Primary turns.
c) Based on answers to (a) and (b), comment on the physical dimensions of the conductors used in primary and secondary windings.
d) If a tap-changer has to be installed, where will it be connected? With suitable reasoning, justify your answer.

1B. The following data were obtained on a 7.5 kVA, 500 / 250 V, 50 Hz single-phase transformer: 4
Open-circuit test: 250 V, 1.25 A, 150 W (on low voltage side)
Short-circuit test: 22.5 V, 15 A, 180 W (on high voltage side)
Determine the following:

a) kVA load for maximum efficiency.
b) Value of maximum efficiency for unity power factor load.
c) Analyze why the value of maximum efficiency will be lower for load power factor values other than unity.

1C. A 100 kVA, 11,500 / 2,300 V, 50 Hz, single-phase, two-winding transformer should be connected as autotransformer. Draw the various connections possible for the autotransformer. Also, determine the corresponding voltage ratios and the kVA ratings. 3

2A. Three identical single-phase transformers each of rating 10 kVA, 200 V/100 V, 50 Hz are available. It is proposed to form a 3-phase transformer bank using these. Input line voltage of the transformer bank is $200\sqrt{3}$ V and the expected output line voltage is 100 V. 3

a) Choose a suitable combination for the connections of primary and secondary windings of the transformer bank.
b) Draw the connection diagram of the bank and analyse your choice.

c) Determine the line currents on primary and secondary sides when this bank supplies full load.

2B. A 3-phase, 400 V, 50 Hz, 4 pole induction motor is rated for an output of 15 HP at 1,440 rpm. When supplying rated load, its stator losses are 800 W and 5 N-m of torque meets friction and windage losses. Determine the following for this loading: 4

a) Slip
b) Rotor copper loss
c) Input to the motor
d) Efficiency

2C. A three-phase squirrel cage induction motor is required to be used as a three-phase generator. Explain how this can be achieved. Draw and explain the torque-slip characteristics for the entire operation indicating salient points. 3

3A. How is torque produced in a capacitor start single phase induction motor. Is there any need for this capacitor after starting? Explain. 3

3B. A 415V, 3 phase, 50 Hz squirrel cage motor draws 5 times its full load current during starting. Which of the following starters you would recommend? 3

a) Direct Online starter
b) Star- Delta starter

Give sufficient reasons. Also, draw the connection diagram of the motor and starter to the supply.

3C. A 4kW, 400V, 50Hz, 3 phase, 4 pole delta connected induction motor has stator resistance of 0.36 Ω per phase and rotor resistance of 0.06 Ω per phase. The no load and blocked rotor test data are as follows: 4

No load test: 400 V, 3.3 A, p.f =0.174

Blocked rotor test: 210V, 16A, p.f =0.45

Estimate the single-phase equivalent circuit of the induction motor.

4A. Explain and describe the effect of armature m.m.f. on the main field flux with the help of magnetization curve of a DC generator. 3

4B. A 200V DC shunt motor takes 27A at rated load and runs at 800 rpm. Its field resistance is 100 Ω and armature resistance is 0.5 Ω. Compute the power and torque developed by the motor at rated speed. 3

4C. With neat diagrams explain the process of commutation in DC machines. 4

5A. A 230V DC shunt motor is taking 5A during Swinburne's Test. The armature resistance is 0.2 Ω and the filed circuit resistance is 115 Ω. If this motor is loaded such that it draws 72A on full load, Determine the efficiency of the motor. 3

5B. The speed of a 240V DC shunt motor must be increased above its base speed for a particular application. Explain how this can be achieved? 3

5C. Design the resistance section of a three-point starter to be used with a DC shunt motor of 220V, 1500 rpm. The maximum allowable starting current is 60A and the rated current is 30A. Consider the starter has 5 studs and the armature resistance is 0.5 Ω. 4