Total number of printed pages = 4



**19/4th Sem/DEE 401**

**2022**

# ELECTRICAL MACHINES

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Derive the equations of e.m.f. induced in the primary and secondary windings of a transformer. 5

   (b) A 100 kVA, 2400/240 V, 50 Hz single-phase transformer has an exciting current of 0.64 A and core loss of 700 watts when its high voltage side is energised at rated voltage and frequency. 5

   (c) A 6300/210 V, 50 Hz single phase transformer has per turn e.m.f. of about 9 volts and maximum flux density of 1.2 T. Find the number of high voltage and low voltage turns. Also find the net cross-sectional area of the core. 10

[Turn over

2. (a) Draw and explain the equivalent circuit of a single-phase transformer. 5

(b) What is eddy current loss ? 5

(c) A 5 kVA, 1000/200 V, 50 Hz single-phase transformer gave the following test results :

Open circuit test (low voltage side) : 200 V, 1.2 A, 90 W

Short circuit test (high voltage side) : 50 V, 5 A, 110 W

Compute the parameters of the approximate equivalent circuit referred to low voltage side. 10

3. (a) Describe the constructional details of a DC machine with a suitable diagram. 10

(b) A DC shunt generator gives an open-circuit voltage of 240 V. When loaded, the terminal voltage falls to 220 V. Determine the load current in case armature circuit and field winding resistances are 0.1Ω and 50 Ω respectively. Neglect the effect of armature reaction. 10

4. (a) Develop the circuit model of a DC machine. 10

(b) A 6 kW, 230 V, 4-pole wave-connected DC motor has 400 armature conductors. At full load the useful flux per pole is 0.02 Wb and rotational losses are 100 W. Find the full load speed. 10

5. (a) What is rotating magnetic field ? Discuss it with proper diagram. 10

(b) What is distribution factor ? Derive it with suitable diagrams. 10

6. (a) Describe the principle of operation of a 3-phase induction motor. 10

(b) A 3-phase, 50 Hz induction motor has a full load speed of 960 rpm. Calculate.

(i) Number of the poles

(ii) Slip frequency

(iii) Speed of rotor field with respect to rotor structure, with respect to stator structure and with respect to stator field. 10

7. (a) Why is capacitance connected to a single phase induction motor ? 5

(b) Why is transformer core laminated ? 5

(c) When a single phase winding is excited by an alternating current, a pulsating mmf wave is produced. Show that this stationary mmf wave can be resolved into two constant amplitude travelling waves rotating in opposite directions at synchronous speed. 10