Total number of printed pages: 2 **D/4th Semester/DEE401**

2025

ELECTRICAL MACHINES

Full Marks: 100

Time: Three hours

Answer any five questions

1. (a) Derive an expression for the emf induced in a DC generator. [6]

   (b) An 8-pole lap connected armature has 960 conductors a flux of 40 mWb per pole and a speed of 400 rpm. Calculate the emf generated on open circuit. If the armature is wave connected at what speed must it drives to generate 400 V. [6]

   (c) Explain with a neat sketch, the construction of a d.c. machine stating the functions of each part. [8]

2. (a) With a neat figure, explain armature reaction in D.C. machines under normal working conditions. [6]

   (b) Briefly discuss the methods used to reduce the effects of armature reaction. [6]

   (c) A120 V, DC shunt motor has an armature resistance of 0.2 Ω and a field resistance of 60 Ω. It runs at 1800 r.p.m. taking a full load current of 40 A. Find the speed on ¼ load condition. [8]

3. (a) Write and explain the Faraday's law of electromagnetic induction. [5]

   (b) Derive an expression for the emf induced in a transformer winding. [5]

   (c) 100 kVA, 3300/200 V, 50 Hz single-phase transformer has 40 turns on the secondary, calculate (i) the values of primary and secondary currents, (ii) the number of primary turns, and (iii) maximum value of the flux. If the transformer is to be used on a 25 Hz system, calculate (iv) primary voltage, assuming that the flux is increased by 10 per cent and (v) the KVA rating of transformer assuming the current density in the winding to be unaltered. [10]

4. (a) Write the working principle of a transformer. [6]

   (b) Can a transformer work on DC? Justify. [6]

   (c) A 33 kVA, 2200/220 V, 50 Hz single-phase transformer has the following parameter. Primary winding resistance is 2.4 Ω, leakage reactance is 6 Ω, secondary winding

resistance is 0.03 Ω, leakage reactance is 0.07 Ω. Then, find equivalent resistance and reactance (i) referred to primary and (ii) referred to secondary. [8]

5. (a) Draw and briefly explain about the equivalent circuit of Induction motor. [6]

(b) Derive the relation between slip and torque of the induction motor and explain the importance of slip. [6]

(c) A three-phase, 4-pole induction motor is supplied from three-phase, 50 Hz AC supply. Calculate (i) synchronous speed, (ii) rotor speed when slip is 4%, and (iii) rotor frequency when rotor runs at 600 rpm. [8]

6. (a) With a neat figure explain the working principle of a three-phase induction motor. [6]

(b) What do you mean by resistance commutation? Explain it with a neat figure. [6]

(c) A 4-pole DC generator with wave-connected armature has 41 slots, and 12 conductors per slot. Armature resistance is 0.5 Ω; shunt resistance is 200 Ω; flux per pole is 125 mWb; and speed is 1000 rpm. Calculate voltage across 10 Ω load resistance across the armature terminal. [8]