Total number of printed pages: 2 **Electrical Machines** UG/4th semester/UEE401
End Term Full Marks: 100
Time: Three Hours Session: Jan-June, 2025

Answer any five

1. a) What is transformer? Transformer can not be connected to DC power supply, explain the reason. [2+3=5]

   b) The nameplate of a single-phase transformer is giving the follwing data: 5 kVA, 400 V/200 V. What informations are obtained from the above? [5]

   c) An ideal transformer has 200 turns in the primary side and 800 turns in the secondary side. The primary is connected to a 240-V, 50 Hz source. The secondary winding supplies a load of 4 A at a lagging power factor of 0.8. determine (i) the primary to secondary turns ratio (ii) the current in the primary (iii) the power supplied to the load and (iv) the flux in the core. [10]

2. a) What is core loss? How can core loss be reduced? [5]

   b) Draw the equivalent circuit of a non-ideal single-phase transformer. Explain the diagram. [5]

   c) A 2.4 kVA, 2400/240 V, 50 Hz, step down transformer has the follwing parameters: R_1=1.5 Ω, X_1=2.5 Ω R_2=0.02 Ω, X_2=0.03 Ω, R_{C1}=6 kΩ and X_{m1}=8 kΩ. It is operating at 80% of its load at unity power factor. Using the exact equivalent circuit embodying the ideal transformer determine the efficiency of the transformer. [10]

3. a) Explain the revolving field of a two-phase motor with proper diagrams. [10]

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

4. a) Why is capacitor connected to singe-phase induction motor? [5]

   b) Derive the equation of rotor frequency of polyphase induction motor. [5]

   c) The power input to a 500 V, 50 Hz, 6 pole, 3-phase induction motor running at 975 rpm is 40 kW. The stator losses are 1 kW and the friction and windage losses are total 2 kW. Calculate (i) the slip (ii) the rotor copper loss (iii) the brake horse power (iv) the efficiency. [10]

5. a) Draw the construction of a 4-pole DC motor. Explain the different parts of it. [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 0.1 Ω and 50 Ω respectively. Neglect the effect of armature reaction. [10]

6. a) Develop the circuit model of a DC machine. [5]

   b) Describe, with relevant diagrams, the different methods of excitation of DC machines. [5]

   c) A 250 V shunt motor on no-load runs at 1000 rpm and takes 5 A. The total armature and shunt field resistances are respectively 0.2 Ω and 250 Ω. Calculate the speed when loaded and taking a current of 50 A if armature reaction weaken the fields by 3%. [10]