ELECTRICAL MACHINES AND CONTROL

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

Answer any *five* questions.

1. (a) What is transformer ? What is ideal
      transformer ?   4

   (b) Draw the phasor diagram of an ideal
       transformer for inductive load.   3

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

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

       Compute core loss resistance and magnetizing
       reactance.   7

2. (a) Derive the relation between phase voltage and line voltage for star-connection. Also draw the phasor diagram. 7

   (b) Three load impedances, each $(8+6j)\Omega$, are connected in star and fed from 3-phase, 230V, 50 Hz supply mains. Calculate phase current, line current, power factor, apparent power, active power and reactive power. 7

3. (a) Give the constructional details of DC machine. 7

   (b) A DC shunt generator gives an open circuit voltage of 240V. When loaded, the terminal voltage falls to 220V. Determine the load current in case of armature circuit and field winding resistances are 0.1Ω and 50Ω respectively. Neglect the effect of armature reaction. 7

4. (a) Explain why the rotor of a polyphase induction motor can never attain synchronous speed. 5

   (b) A 400V, 3 phase, 6 pole, 50 Hz induction motor draws a power of 2 kW at no-load and at rated voltage and frequency. At a full load slip of 3% the power input to motor is 50 kW and the stator ohmic loss is 1.5 kW.

Neglect I^2R loss at no-load. If the stator core loss and mechanical losses are assumed equal, then at a slip of 3% calculate :

(i) rotor ohmic loss

(ii) shaft power or output power

(iii) shaft torque. 9

5. (a) Draw the phasor diagram of synchronous generator. 7

   (b) A 3-phase, 17.32 kVA, 400V, star-connected alternator is delivering rated load at 400V, and at 0.8 power factor lag. Its synchronous impedance is $(0.2+2j)\Omega$ per phase. Find the load angle at which it is operating. 7

6. (a) Draw the equivalent circuit diagram of a single phase induction motor. Explain the diagram. 7

   (b) Describe various losses in a transformer and explain how each loss varies with the load current. 7

7. Write short notes on any *two* : 7×2=14

   (a) Reluctance motor

   (b) V-curves

   (c) Brushes and commutator of DC machine.