Total No. of printed pages = 4

CAI-402/EM&C/4th Sem/2013/M

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 question No.1 and any *four* from the rest.

1. Explain why : $2\frac{1}{2}\times4=10$

   (i) The armature core of a DC machine is laminated but the yoke is not.

   (ii) Efficiency of a transformer is high.

   (iii) The wattmeter reads core losses in the open circuit test and copper losses in the short circuit test.

   (iv) Starting torque of a DC series motor is very high.

[Turn over

2. (a) On which principle a DC motor works ? 2

(b) What do you mean by back emf of a DC motor ? Write in brief. 4

(c) A 20 kW, 250V DC shunt generator has armature and field resistances of 0.1Ω and 125Ω respectively. Calculate the total armature power developed when running (i) as a generator delivering 20 kW output (ii) as a motor taking 20 kW output. 9

3. (a) Derive the emf equation of a DC generator. 5

(b) What are the main parts of a DC generator? 3

(c) A 30 kW, 300V DC shunt generator has armature and field resistances of 0·05Ω and 100Ω respectively. Calculate the total power developed by the armature when it delivers full load output. 7

4. (a) With a neat circuit diagram, explain about the open circuit test on a single phase transformer. 5

(b) A single phase transformer on no-load takes 4·5A at a power factor of 0·25 (lag) when connected to a 230V, 50 Hz supply. The number of turns of the primary winding is 250. Calculate (i) the magnetising current (ii) the core loss and (iii) the maximum value of flux in the core. 6

(c) What are the different types of losses in a transformer and where they occur ? 4

5. (a) What are the different types of rotor of a three phase induction motor ? 2

(b) Write the condition for maximum starting torque of a three phase induction motor. 1

(c) The stator winding of a three phase induction motor is connected to three phase 440V, 50 Hz supply. What will be the frequency of rotor induced current if the rotor is stationary. 3

(d) A 6-pole, 3-phase, 50 Hz induction motor is running at full load with a slip of 4%. The rotor is star-connected and its resistance and standstill reactance are 0·25Ω and 1·5Ω per phase respectively. The emf between slip rings is 100V. Find the rotor current per phase and power factor assuming the slip rings are short-circuited. 9

6. (a) What are the advantages and disadvantages of three phase system over single phase ? 5

(b) Derive a relation between line current and phase current in delta connected system. 5

(c) A balanced 3-phase, delta-connected load has per phase impedance of $(25 + j40)\Omega$. If 400V, 3-phase supply is connected to this load, find (i) phase current (ii) line current (iii) power supplied to the load. 5

7. Write short notes on any *three* : $5 \times 3 = 15$

(a) Field system of a DC machine

(b) Speed control of DC motors using flux control method

(c) Short-circuit test on single phase transformer

(d) Universal motors

(e) Capacitor start motors

(f) Auto-transformer starting of three phase induction motors.