Total No. of printed pages = 4

CAI-402/EM&C/4th Sem/2017/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 any *five* questions.

1. (a) Draw a neat diagram of star and delta connected 3-φ system and show the line and phase voltages and line and phase currents for each system. 2+2=4

   (b) For a balance star-connected system, prove that – 7

   $$V_L = \sqrt{3} V_{Ph}$$

   where, V_L = line voltage

   V_{Ph} = phase voltage

   (c) Mention three important advantages of 3-φ system over 1-φ system. 3

[Turn over

2. (a) Derive the emf equation of a 1-φ transformer. Explain the behaviour of a 1-φ transformer on no load and load. 4+4=8

(b) A 230/2300V transformer takes a no load current of 6·5A and absorbs 187W. If the resistance of primary is 0·06Ω,

Find :

(i) the core loss

(ii) no load p.f.

(iii) active component of current and

(iv) magnetising current. 6

3. (a) What are shunt and series DC generators ? Also derive their voltage equations. 3+3=6

(b) A shunt generator supplies 96A at a terminal voltage of 200V. The armature and shunt field resistances are 0·1Ω and 50Ω respectively. The iron and frictional losses are 2500W.

Find :

(i) e.m.f generated

(ii) copper losses

(iii) commerical efficiency. 8

4. (a) On which principle, a DC motor works ? What do you mean by back or counter emf in DC motors ? Explain briefly. 1+4=5

(b) A DC shunt generator delivers an output of 100 kW at 500V when running at 800 rpm. The armature and field resistances are 0·1Ω and 100Ω respectively. Calculate the speed of the same machine when running as a shunt motor and taking 100 kW input at 500V. Allow 1V per brush for contact drop. 9

5. (a) What is the difference between synchronous speed and rotor speed in 3-φ induction motor ? 1

(b) Write a note on the speed control of 3-φ induction motors. 6

(c) Derive an expression for starting torque for 3-φ induction motor. Also find the condition for maximum starting torque. 7

6. (a) Discuss about the losses of a transformer. Also mention the condition for maximum efficiency of a transformer. 5+1=6

(b) A 40 kVA transformer has iron loss of 450W and full-load copper loss of 850W. If the power factor of the load is 0·8 lagging, calculate – 8

(i) full-load efficiency

(ii) the load at which maximum efficiency occurs and

(iii) the maximum efficiency.

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

(a) Universal motors

(b) Speed control of DC shunt motors.

(c) Losses in DC generators.