Total No. of printed pages = 6

CAI-402/EM&C/4th Sem/2018/M

ELECTRICAL MACHINES AND CONTROL

Full Marks – 70

Time – Three hours

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

PART–A

1. Fill in the blanks : 5×2=10

   (a) An electric generator is a machine that converts _____energy into _____energy.

   (b) An ideal transformer is one which has no _____ and _____reactance.

   (c) Mechanical power developed by motor is _____when back e.m.f is equal to _____applied voltage.

   (d) In d.c generators armature reaction is produced by _____.

   (e) A transformer transfers electrical energy from primary to secondary usually with a change in _____.

[Turn over

2. Fill up the gaps from the options given below : $5 \times 2 = 10$

(a) A 4-pole d.c machine has _____ magnetic circuits.

(i) 2 (ii) 4

(iii) 8 (iv) None of the above

(b) If W_c is the constant loss and R_a is the armature resistance of a d.c generator, then load current I_L corresponding to maximum efficiency is _____.

(i) $I_L = \sqrt{\frac{R_a}{W_c}}$

(ii) $I_L = \frac{R_a}{\sqrt{W_c}}$

(iii) $I_L = \frac{W_c}{\sqrt{R_a}}$

(iv) $I_L = \sqrt{\frac{W_c}{R_a}}$

(c) The value of back e.m.f (E_b) in a d.c motor is maximum at _____.

(i) full-load

(ii) no-load

(iii) half full-load

(iv) None of the above

(d) The winding of the transformer with greater number of turns will be _____.

(i) High voltage winding

(ii) Low voltage winding

(iii) Either high or low voltage winding

(iv) None of the above

(e) The relation among synchronous speed (N_s), rotor speed (N) and slip (s) is _____.

(i) $N = (s-1) N_s$

(ii) $N = (1-s) N_s$

(iii) $N = (1+s) N_s$

(iv) $N = sN_s$

2. 3. Match the following : 5×1=5

(i) Pole – pitch	(a) $\frac{N_2}{N_1}$
(ii) E.M.F of generator (E_g)	(b) $\cos\left\{\tan^{-1}\left(\frac{\sqrt{3}(W_1 - W_2)}{(W_1 + W_2)}\right)\right\}$
(iii) Voltage transformation ratio (K)	(c) $\frac{P\varnothing ZN}{60A}$
(iv) Power factor	(d) $\frac{\text{Number of armature conductors (Z)}}{\text{Number of poles(P)}}$
(v) Synchronous speed (N_s)	(e) $\frac{120f}{P}$

PART – B

1. (a) Derive the relation between line voltages and phase voltages and also the expression for power in star-connection or Y–connection in three phase system.

(b) A balanced star-connected load of $(8+j6)\Omega$ per phase is connected to a balanced 3 – Ø, 400V supply. Find the line current, power factor, power and total volt-amperes.

5+5=10

(a) Define transformer. Describe the working principle of transformer. 1+3=4

(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. 4

(c) Define all-day efficiency of a transformer. What is the condition for maximum efficiency of a transformer ? 1+1=2

3. (a) Draw the power stages in a d.c motor. 3

(b) What is the relation between speed and back emf in a d.c shunt motor and a d.c series motor. 2

(c) A 10 kW d.c shunt generator has the following losses at full-load :

Mechanical losses = 290W;

Iron losses = 420W; Shunt Cu loss = 120W ;

Armature Cu loss = 595W.

Calculate the efficiency at (i) no-load, (ii) 25% of full-load. 5

4. Write short notes on any *three* : 5×3=15

(a) Power measurement in 3-phase circuits by two wattmeter method

(b) Direct-on-line starting of three-phase induction motor

(c) Capacitor-start capacitor run motor

(d) Autotransformer

(e) Open-circuit or no-load test of transformer.