Total No. of printed pages = 8

CAI-402/EM&C/4th Sem/2017/N

ELECTRICAL MACHINES AND CONTROL

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

PART – A

For Question Nos. 1–10, choose the most appropriate option. Each question carries one mark. 1×10=10

1. Does the electric current always produce a magnetic field ?

   (a) No, only large currents produce a magnetic field.

   (b) No, a magnetic field is produced only in the presence of an iron core.

   (c) No, a magnetic field is produced only in the presence of a coil.

   (d) Yes, the electric current always produced a magnetic field.

[Turn over

2. The back emf in a DC motor

   (a) opposes the applied voltage

   (b) aids the applied voltage

   (c) aids the armature current

   (d) None of the above.

3. A two winding transformer, operates at maximum efficiency when its

   (a) hysteresis loss equals to eddy current loss

   (b) copper loss equals to iron loss

   (c) primary resistance equals to secondary resistance

   (d) voltage regulation is minimum.

4. The coupling field between electrical and mechanical systems of a DC machine is

   (a) electric field

   (b) magnetic field

   (c) Both electric and magnetic fields

   (d) None of the above.

5. When the speed of a DC motor increases, the armature current

(a) increases

(b) decreases

(c) remains constant

(d) None of the above.

6. DC series motors are used in those applications where

(a) constant speed is required

(b) low no-load speed is required

(c) high starting torque is required

(d) there is no practical application of DC series motors.

7. A DC motor takes a large current at starting because

(a) the armature resistance is high

(b) back emf is low

(c) shunt field is producing weak field

(d) None of the above.

8. In star-delta starting method of 3-phase induction motors

   (a) the stator is connected in star during the starting period

   (b) the stator is connected in delta during the starting period

   (c) all the three windings of stator are connected in series during the starting period

   (d) all the three windings of stator are connected in parallel during the starting period.

9. The conjugate of $(-4+j3)$ is

   (a) $4-j3$

   (b) $-4-j3$

   (c) $4+j3$

   (d) $-j3$

10. In R-L-C series AC circuit, the current

   (a) is always in phase with the applied voltage

   (b) always lags behind the applied voltage

   (c) always leads the applied voltage

   (d) None of the above.

For Question Nos. 11–14, choose the most appropriate option. Each question carries two marks. $2 \times 4 = 8$

11. A 6-pole, 3-phase induction motor is connected to a 25Hz supply and at full load the rotor emf makes 105 complete cycles in 2 minutes. The full load percentage slip is

    (a) 3.5% (b) 7.5%

    (c) 1.5% (d) 2.5%

12. Mechanical energy is supplied to a DC generator at the rate of 4200 J/s. The generator delivers 32.2 A at 120 Volt. The energy lost per minute of operation is

    (a) 20160 J (b) 20154 J

    (c) 92 J (d) 336 J

13. The direction of induced emf in a conductor can be found with the help of

    (a) Lenz's law

    (b) Fleming's right hand rule

    (c) Kirchhoff's voltage law

    (d) Laplace's law.

14. The starting torque of a three phase induction motor is

(a) independent of supply voltage

(b) directly proportional to supply voltage

(c) directly proportional to square of supply voltage

(d) inversely proportional to supply voltage.

Fill in the blanks of Question Nos. 15–21. Each question carries one mark. 1×7=7

15. In a balance star-connected system, relation between line and phase voltage is _____.

16. For a pure resistive circuit, power factor is _____.

17. The unit of conductance is _____.

18. In a pure inductive circuit, current lags the voltage by an angle of _____ degree.

19. Open circuit test of a transformer is performed to determine _____ losses.

20. The unit of magnetic flux is _____.

21. A transformer works on _____ only. (AC / DC)

PART – B

Answer any *five* questions. 9×5=45

1. Derive an expression for starting torque of a 3-phase induction motor. Also find the condition for maximum starting torque. 6+3=9

2. (a) What are the main parts of a DC machine ? Write their names. 5

   (b) Derive the emf equation of a DC generator. 4

3. What do you mean by balance and unbalance three phase systems ? For a balance star connected three phase system, derive a relation between line and phase voltage and line and phase currents. 1+8=9

4. Why open circuit test is performed in transformers ? What information can be found from the open circuit test ? Draw a circuit diagram for the open circuit test. 1+5+3=9

5. (a) A 100 kVA, 2200/440V transformer has R_1 = 0.3 ohm, X_1 = 1.1 ohm, R_2 = 0.01 ohm and X_2= 0.035 ohm. Calculate (i) the equivalent impedance of the transformer referred to the primary (ii) total copper losses. 7

(b) What do you mean by full-load current of a transformer ? 1

(c) What will happen if a transformer is connected to DC supply ? 1

6. (a) What is the function of brushes in a DC motor ? 1

(b) What are the different types of DC generators ? Draw neat diagrams for each type and write the voltage equation. 2+(1½×4)=8