Total No. of printed pages = 8

END SEMESTER EXAMINATION, 2020

Semester : 4th (Old)

Subject Code : CAI-402

ELECTRICAL MACHINES AND CONTROL

Full Marks – 70

Time – Three hours

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

Instructions :

1. *All* questions of PART–A are compulsory.
2. Answer any *five* questions from PART–B.

PART – A

Marks – 25

1. Fill in the blanks : 1×10=10

   (i) The interpoles are connected in _____ with the armature.

   (ii) The conductors of compensating winding are housed in _____ of the armature.

[Turn over

(iii) In a DC generator, the brushes are shifted from G.N.A in the direction of rotation to _____ sparking.

(iv) The iron-core is used to provide tight _____ of the transformer.

(v) An ideal transformer is one which has no _____ and _____ reactance.

(vi) When the rotor of a 3-phase induction motor is blocked, the slip is _____.

(vii) The rotor of a 3-phase wound rotor is generally _____ connected.

(viii) The purpose of the starting winding in a single-phase induction motor is to produce _____ flux in conjunction with main winding.

(ix) Direction of rotation of motor is determined by _____.

(x) In autotransformer, power is transferred in induction and _____ mode.

2. Write true or false : 1×10=10

(i) A transformer will work on DC only.

(ii) The primary and secondary of a transformer are magnetically coupled.

(iii) The magnetic flux in the core of a single-phase transformer is purely alternating one.

(iv) A capacitor-start, capacitor-run induction motor has low power factor.

(v) The field of an induction motor rotates relative to the stator at rotor speed.

(vi) Autotransformer has only one winding.

(vii) A 50 Hz, 4 pole, single phase induction motor will have synchronous speed of 750 rpm.

(viii) Transformers are rated in kVA.

(ix) In a DC machine, rectification provided with commutator is full wave rectification.

(x) With respect to the direction of rotation, the interpoles on a DC generator have the same polarity as the main poles ahead of them.

3. Choose the correct option : 1×5=5

(i) When a DC generator carries no armature current

(a) M.N.A coincides with G.N.A

(b) M.N.A is behind G.N.A

(c) M.N.A ahead with G.N.A

(d) None of the above

(ii) In a DC generator, the effect of armature reaction on the main pole flux is to

(a) reduce it

(b) both reduce and distort it

(c) distort it

(d) reverse it

(iii) The mechanical power developed in a DC motor is maximum when back emf (E_b) is equal to _____ the applied voltage (V).

(a) twice (b) one-third

(c) half (d) None of these

(iv) DC shunt motors are used in those applications where _____ is required.

(a) high starting torque

(b) practically constant speed

(c) low no-load speed

(d) variable speed

(v) A transformer is so designed that primary and secondary have

(a) high leakage reactance

(b) large resistance

(c) tight magnetic coupling

(d) good electric coupling.

PART – B

Marks – 45

1. (a) Define transformer. Derive the condition for maximum efficiency of a transformer.

(b) A single phase 50 Hz transformer has 20 primary turns and 273 secondary turns. The net cross-sectional area of the core is 400 cm^2. If the primary winding is connected to 230 V supply, find

(i) peak value of the flux density in the core

(ii) voltage induced in the secondary winding.

(c) In a 100 kVA transformer, the iron loss is 1.2 kW and full-load copper loss is 2 kW. If the load p.f is 0.8 lagging, find the efficiency at

(i) full-load and

(ii) half-full load. 3+3+3=9

2. (a) Define DC generator. Describe the working principle.

(b) Describe different types of DC generator with the help of circuit diagram.

(c) A shunt generator supplies 875 A at 200V through feeders of resistance 0.08Ω. The armature and shunt field windings have resistances of 0.04Ω and 80V respectively. Find the terminal voltage and generated emf. 3+3+3=9

3. (a) What do you mean by Geometrical and Magnetic Neutral Axes ? Explain with diagram.

(b) What is Back or Counter EMF in DC Motor ? Derive the voltage equation of DC Motor with the help of circuit diagram.

(c) A 230V DC shunt motor takes 5 A at no load and runs at 1000 rpm. Calculate the speed when loaded and taking a current of 30A. The armature and field resistance are 0.2Ω and 23Ω respectively. 3+3+3=9

4. (a) What do you mean by Sychronous Speed ? What is slip ?

(b) Describe AC series motor.

(c) The frequency of emf in the stator of a 4 pole, 3 phase induction motor is 50 Hz and that in the rotor is 1.5 Hz. Determine

(i) the slip and

(ii) speed of the motor. 3+3+3=9

5. (a) Discuss the star connection of three-phase system with the help of cirucuit diagram.

(b) Derive the relation between line current and phase current in delta connected three phase systems. Draw circuit diagarm and also phasor diagram.

(c) The load in each branch of a delta-connected balanced 3 phase circuit consists of an inductance of 0.0318 H in series with a resistance of $10\,\Omega$. The line voltage is 400V at 50 Hz. Calculate

(i) the line current and

(ii) the total power in the circuit.

3+3+3=9

9. Write short notes on any *three* : 3+3+3=9

(a) Short-circuit test of transformer

(b) Autotransformer

(c) Principle of three-phase induction motor

(d) Capacitor-start capacitor-run motor.