Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (EE-OLD)/SEM-4/EE-401/2013

2013

ELECTRICAL MACHINES – I

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) EMF induced in each conductor of a DC machine is

a) an alternating EMF

b) direct EMF

c) pulsating EMF

d) EMF of random wave shape.

ii) The field coil of a DC machine is made of

a) carbon b) copper

c) mica d) steel.

iii) The function of brushes in a DC generator is to

a) collect the current from the commutator and supply it to the external load

b) prevent sparking

c) keep the commutator clean

d) none of these.

iv) An 8-pole D.C. machine has wave winding. The winding is removed and then rewound as lap winding. The induced EMF will

a) increase b) decrease

c) remain unchanged d) none of these.

v) A D.C. series motor is never switched on without load connected at rated voltage source because

a) the field current is initially zero

b) the motor does not accelerate

c) the speed becomes dangerously high

d) none of these.

vi) In an induction motor the air gap flux density is kept low so as to

a) improve efficiency

b) improve power factor

c) reduce machine cost

d) none of these.

vii) The number or parallel paths in an 8-pole D.C. machine, wave wound is

a) 8 b) 4

c) 2 d) none of these.

viii) The torque of a three phase induction motor depends on

a) rotor input b) rotor copper losses

c) friction and slip d) all of these.

ix) Which type of motor is used for lifting purpose in crane ?

a) Shunt motor b) Series motor

c) Induction motor d) None of these.

x) A 1 : 1 transformer is used as

a) pulse transformer

b) isolating transformer

c) potential transformer

d) current transformer.

xi) Tertiary winding is used in case of

a) delta-delta b) star-zigzag

c) star-star d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Draw the torque-speed characteristics of poly-phase induction motor and discuss about the effect of rotor resistance.

3. A d.c. generator has an amature e.m.f. of 100 V, when the useful flux per pole is 20 mWb and the speed is 800 r.p.m. Calculate the generated e.m.f. (i) with same flux and a speed of 1000 r.p.m., (ii) with a flux per pole of 24 mWb and speed of 900 r.p.m.

4. Explain how voltage builds up in a d.c. shunt generator. Also explain what you mean by critical field circuit resistance.

5. Develop the equivalent circuit of a 3-phase induction motor. Show that mechanical power developed can be represented by a pure resistance in the rotor circuit.

6. Draw the connection diagram of a star-delta starter. Show that the line current for star starting is one third of the line current for delta starting.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Derive the expression for developed torque in a 3-phase induction motor and find the condition for maximum torque. 8

   b) The power input to a 6-pole, 50 Hz, 3-phase induction motor is 700 W at no load and 10 kW at full load. The no load copper losses may be assumed negligible, while the full load stator and copper losses are 295 W and 310 W respectively. Find the full load speed, shaft torque and efficiency of the motor, assuming rotational and core losses to be equal. 7

8. a) Explain the amature reaction in a d.c. machine and show how cross magnetizing and demagnetizing *mmf* produced. How can it be reduced ? 9

   b) A 70 kW, 500 V, 4-pole wave-wound d.c. generator has 620 amature conductors. The brushes are given an actual lead of 8° at full load. Calculate (i) cross-magnetizing AT/pole, (ii) demagnetizing AT/pole, (iii) series turns required to neutralize demagnetizing effect. Leakage coefficient = 1·1. 6

9. a) Explain with reasons why a delta-delta transformer cannot be paralleled with a delta-star transformer. 4

b) Show that open-delta connection of a 3-phase transformer delivers only 57·7% of the VA rating of its normal delta-delta connection. 4

c) A balanced 3-phase, 100 kW load at 400 V and 0·8 pf lagging is to be obtained from a balanced two-phase 1100 V lines. Determine the kVA rating of each unit of the Scott connected transformer. 7

10. a) Define Commutation. Explain the process of commutation in a DC generator with proper sketches. Give causes of sparking on a commutator and state how it can be avoided. 9

b) A 6-pole lap connected D.C. Generator having a commutator ring of diameter 45 cm runs at 1000 r.p.m. The brush width is 2 cm and thickness of mica insulation is 0·2 cm. The load current delivered by the generator is 115 A and the shunt field current is 5 A. The self inductance of each coil is 0·1 mH. Determine the reactance voltage if commutation is

i) linear

ii) sinusoidal. 6

11. Write short notes on any *three* of the following : 3 × 5

a) Cogging and crawling in induction motors

b) Different methods of starting in induction motors

c) Determination of external characteristics of separately excited D.C. generator from its open circuit characteristics

d) Oscillating neutral in a transformer.