Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EEE-OLD)/SEM-6/EEE-601/2013

2013

ELECTRICAL MACHINES-II

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) The slip of 400 V, 3-phase, 50 Hz, 4-pole induction motor when rotating at 1440 rpm is

   a) 2% b) 3%

   c) 5% d) none of these.

   ii) A 50 Hz three phase induction motor has a rated speed of 725 rpm. The number of poles is

   a) 2 b) 6

   c) 4 d) 8.

iii) A cage motor has a starting current of 40 A when switched on directly. Auto transformer with 45% tapping is used. Determine starting current

a) 8·1 A b) 0·45 A

c) 40 A d) 18 A.

iv) The frequency of rotor current at standstill is equal to

a) zero b) $2f$

c) f d) sf.

v) The directo of rotor current produced in an induction motor can be determined by

a) Lenz's law

b) Induction law

c) Fleming's left-hand rule

d) Fleming's right-hand rule.

vi) The torque developed by a 3-phase induction motor is approximately proportional to

a) $\sqrt{s}$ b) s^2

c) s d) $1/s$.

vii) The starting torque of squirrel case induction motor is

a) very large

b) very low

c) slightly more than full load torque

d) zero.

viii) In a 3-phase slip-ring induction motor high starting torque is achieved by

a) increasing supply voltage V

b) increasing supply frequency

c) connecting a capacitor across the motor terminal

d) connecting a star-connected resistance across the slip-ring terminal of the motor.

ix) The torque of a 3-phase induction motor depends on

a) rotor input b) rotor copper losses

c) friction and slip d) all of these.

x) The crawling occurs in induction motors due to

a) low supply voltage

b) over load

c) harmonics developed in the motor

d) jammed bearings.

xi) Crawling of induction motor occurs due to

a) harmonics synchronous torques

b) harmonics induction torque

c) vibration torques

d) both (a) & (b).

GROUP – B

(Short Answer Type Questions)

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

2. How the speed of 3-phase induction motor can be controlled ?

3. A three phase, 415 V, 4 kW delta connected induction motor has a short-circuited line current of 20 A at 200 V. The motor is started by a star-delta starter. If the full load efficiency and power factor are 0·85 and 0·8 respectively. Determine the starting current drawn by the motor and ratio of starting to load current.

4. Define pitch factor and derive an expression for it.

5. What is the drawback of a DOL starter ? Why is Star-Delta method preferred over direct on line starting of an induction motor ?

6. A 10 kW, 400 V, 3-phase, 4-pole, 50 Hz delta connection motor is running at no load with a line current 8 A and an input power of 660 W. At full load, the line current is 18 A and the input power is 11·20 kW. Stator offective resistance per phase is 1·2 ohms and friction, windage loss is 420 W. For negligible rotor ohmic losses at no load, calculate

   i) stator core loss,

   ii) total rotor losses at full load

   iii) total ohmic losses at full load

   iv) full load speed.

GROUP – C

(Long Answer Type Questions)

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

7. a) Draw speed-torque characteristics of 3-phase induction motor.

b) A 5 kW, 4-pole, three phase star connected induction motor has slip ring rotor resistance of 0·05 Ω and standstill reactance of 0·5 Ω for phase. The full load speed is 1450 rpm. Determine the ratio of maximum torque to the full load torque, starting torque to the full load torque.

c) A 440 V, 50 Hz, 8-pole star connected three phase induction motor has the following test result :

No load test : 440 V, 25 A, 2500 W

Blocked rotor test : 150 V, 115 A, 9000 W

Determine the equivalent circuit parameters of the motor when per phase stator resistance is 0·2 Ω.

4 + 5 + 6

8. a) Analytically discuss how rotating field is produced in the induction motor.

b) Draw the equivalent circuit of induction motor ?

c) A three-phase delta connected cage type induction motor when connected directly to a 400 V, 50 Hz supply takes a starting current of 105 A in each stator phase. Find out

i) the line current for DOL starting

ii) line and phase starting currents for *Y*-Δ starting, and

iii) line and phase starting currents for a 70% tapping on auto-transformer starting. 6 + 4 + 5

9. a) What is armature reaction of synchronous generator and discuss the armature reaction of unity power factor and zero power factor.

b) Give the details of voltage regulation in impedance method.

c) In a 50 KVA, star-connected, 440 V, 3-phase, 50 Hz alternator, the effective armature resistance is 0·25 ohm per phase. The synchronous reactance is 3·2 ohm per phase and leakage reactance is 0·5 ohm per phase. Determine at rated load and unity power factor.

i) internal *emf* E_a

ii) no-load *emf* E_0

iii) percentage regulation on full-load

iv) value of synchronous reactance which replaces armature reaction. 6 + 4 + 5

10. a) Explain the starting method of synchronous motor.

b) Explain the various excitation like and also draw the phasor

i) under excitation

ii) over excitation

iii) unity power factor.

c) A 75 kW, 3-phase, *Y*-connected, 50 Hz, 440 V cylindrical rotor synchronous operates at rated condition with 0·8 p.f. leading. The motor efficiency excluding field and stator losses, is 95% and *Xs* = 2·5 ohm. Calculate

i) mechanical power developed

ii) armature current

iii) power angle

iv) back *emf*

v) maximum or pull-out torque of the motor.

5 + 5 + 5

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

a) Starting method of induction motor

b) Repulsion motor

c) Stepper motor

d) Universal A.C. series motor.