Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(EE)/SEM-5/EE-501/2009-10

2009

ELECTRIC 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) In a double revolving field theory, the slip of the forward motor is S, then the slip of the backward motor is

   a) $2S$ b) S

   c) $2-S$ d) $S-2$.

   ii) In a shaded pole motor, shading coils are used to

   a) Reduce winding losses

   b) Reduce friction losses

   c) Produce rotating magnitic field

   d) Protect against sparking.

   iii) A universal motor is one which has

   a) constant speed

   b) constant output

   c) capability of operating both on a.c. and d.c. with comparable performance

   d) maximum efficiency.

iv) The maximum possible speed at which an alternator can be driven to generate 50 Hz and 4000 V is
   a) 4000 r.p.m. b) 3600 r.p.m.
   c) 3000 r.p.m. d) 1500 r.p.m.

v) The direction of rotation of single-phase induction motor can be reversed by
   a) reversing the leads of the main winding
   b) reversing the leads of the auxilliary winding
   c) reversing the supply leads
   d) either (a) or (b).

vi) A capacitor start and capacitor run induction motor is supplied from
   a) single-phase supply b) 2-phase supply
   c) 3-phase supply d) none of these.

vii) The electrical angle, β between adjacent slots in a 4-pole alternation with 36 slots is in electrial degree
   a) 9° b) 10°
   c) 20° d) 90°.

viii) Which of the following motors will give relatively high starting torque.
   a) capacitor start motor b) capacitor run motor
   c) split phase motor d) shaded pole motor.

ix) In single-phase repulsion motor, power factor is
   a) always leading b) always unit
   c) always lagging d) none of these.

x) Induction generator runs at
   a) supersynchronous speed
   b) sub-synchronous speed
   c) synchronous speed
   d) none of these.

xi) When the synchronous motor runs at synchronous speed, the voltage induced in the damper winding is
   a) maximum b) minimum
   c) zero d) none of these.

GROUP – B

(Short Answer Type Questions)

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

2. Explain the double revolving field theory as applied to a single-phase motor.
3. Explain why in a universal motor, the performance of the machine is better under d.c. than in a.c. operation.
4. What is hunting in an alternator ? Explain how hunting can be minimised ?
5. Explain the operating principle of a stepper motor.
6. Why are synchronous motor not self-starting ?

GROUP – C

(Long Answer Type Questions)

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

7. a) Describe the armature reaction of an alternator for zero *p.f.* lagging, 1 zero *p.f* leading and unity *p.f.* load.

   b) Describe any synchronising method of an alternator with infinite bus. 7 + 8

8. a) Draw & explain the phasor diagram of salient pole alternator supplying full-load lagging power current. Show that the power output per phase is given by

$$P = \frac{EV}{X_d} \sin \partial + \frac{V^2}{2} \left[\frac{1}{X_q} - \frac{1}{X_d} \right] \sin 2\partial$$

   b) A 150 kVA, 4000 V, 50Hz, 3-phase star-connected alternator has effective armature resistance of 0·3 ohm. The field current of 40 A produces short-circuit current of 200 A and an open circuit e.m.f. of 1080 V (line value). Calculate the full-load regulation at 0.8 *p.f.* lagging and 0.8 *p.f.* leading. 8 + 7

9. a) Draw and explain phasor diagram of a single-phase series motor.

   b) What are uncompensated & compensated single-phase series commutator motors ? Develop their performance equation. 7 + 8

10. a) Explain why a single-phase single winding induction motor produces no starting torque. 3

    b) Why is a shaded pole motor recommended over a resistance start for the same applications ? 3

    c) Why are high speed often desirable in the operation of universal motors ? What limits the speed ? 4

    d) The resistance and total inductance of a single-phase fractional horse power series motor are 30 Ω and 0·5 H respectively. It draws 0·8 A current and runs at 2000 r.p.m. when connected to a 250 V d.c. supply. Calculate the speed and power factor when connected to a 250 V, 50 Hz supply and takes the same load current. How much voltage is required for getting 2000 r.p.m. with a.c. supply ? Assume resistance and reactance remains constant. 5

11. Write short notes on any *three* of the following : 3 × 5 = 15

    a) Stepper motor and "microstepping"

    b) Brushless DC motor

    c) Servomotor

    d) Induction regulator

    e) Resolver.