MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : EE-501

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 shaded pole motor, shading coils are used to
      a) reduce windage losses
      b) reduce friction losses
      c) produce rotating magnetic field
      d) protect against sparking.

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

   iii) A 230V DC series motor is connected to 230 V AC supply
      a) the motor will vibrate violently
      b) the motor will run with less efficiency and more sparking
      c) the motor will not run
      d) the fuse will be blown.

   iv) A 3 phase induction motor, while supplying a constant load, has the fuse of one line suddenly blown off. The motor will run as single phase induction motor with line current nearly increased to
      a) $\sqrt{3}$ times b) 3 times
      c) 5 times d) 6 times.

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

   vi) Armature reaction mmf for a synchronous machine cross magnetizes the field mmf in
      a) ZPF lagging b) ZPF leading
      c) UPF d) 0.

vii) In case of synchronous generator electromagnetic torque and prime mover torque are in

a) same direction b) reverse direction

c) not produced d) none of these.

viii) The expression for power (with reference to Power Angle characteristics) for a cylindrical pole rotor synchronous machine is given by

a) $\frac{E_f V_t}{X_s} \sin \delta$ b) $\frac{E_f V_t}{X_s} \cos \delta$

c) $\frac{E_f V_t X_s}{\cos \delta}$ d) $\frac{E_f V_t X_s}{\sin \delta}$.

ix) The speed of an alternator is

a) always same as synchronous speed

b) less than synchronous speed

c) above synchronous speed

d) none of these.

x) Damper winding is used

a) for starting a synchronous generator

b) for starting a synchronous motor

c) not at all

d) in DC machine.

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xi) V-curve of a synchronous motor is the curve between

a) armature current *vs* field current

b) power factor *vs* field current

c) excitation voltage *vs* armature current

d) excitation voltage *vs* field current.

xii) Distributing winding

a) gives reduction of harmonics

b) gives mechanical strength

c) gives increased harmonics

d) both (a) and (b).

GROUP – B

(Short Answer Type Questions)

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

2. "A single phase induction motor when excited by a single phase supply produces two equal and opposite revolving fields." – Justify the statement.

3. Why are *ac* series motors designed to operate at higher speed ? Explain it by drawing phasor diagram.

4. What methods are adopted to start a single phase induction motor ? Explain with the help of connection diagram and phasor diagram, the principle of operation of capacitor start & run motor.

5. How does the synchronous motor start ? Explain clearly.

6. A 3-phase, wye-connected, round-rotor synchronous generator rated at 10 kVA, 230 V has a synchronous reactance of 1.2 Ω per phase and an armature resistance of 0.5 Ω per phase. Calculate the per cent voltage regulation at full-load with 0.8 lagging power factor.

GROUP – C

(Long Answer Type Questions)

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

7. a) Explain why single phase induction motor has no starting torque. 3

   b) Why shaded pole motor has starting torque although it has only main winding ? 3

   c) The resistance and total inductance of single phase fractional series motor are 30 ohm and 0.5 ohm respectively. It draws 0.8 A current and runs at 2000 rpm when connected to 250 V DC supply. Calculate the speed and power factor when connected to a 250 V, 50 Hz supply. Calculate the speed and power factor when connected to a 250 V, 50 Hz supply and takes same load current. How much voltage is required for getting 2000 rpm with AC supply ? Assume resistance and reactance remain constant. 5

   d) Write down a short note on 'reluctance motor'. 4

8. a) For single phase induction motor, derive the condition for maximum starting torque during resistor split phase motor. 8

   b) Describe the principle of operation and torque-speed characteristic of induction generator. 4

   c) Will a DC shunt motor operate when energized from alternating voltage supply ? Explain. 3

9. a) Clearly explain space phasor diagram and time phasor diagram under lagging power factor load of a cylindrical rotor synchronous generator. State clearly how the armature reaction mmf affects the field mmf. 8

   b) Draw the phasor diagram of a round rotor alternator on short circuit. Discuss why short circuit characteristics is a straight line whereas open circuit characteristics is a curve. 7

10. a) Draw the phasor diagram of a salient pole synchronous generator based on two reaction theory. 7

    b) A 20 MVA, 3 phase star connected alternator with an impedance of 5 ohm and a resistance of 0.5 ohm, is operating in parallel with constant voltage 11 kV busbars. If its field current is adjusted to give an excitation voltage of 12 kV, then calculate (i) the maximum power output from the alternator (ii) the armature current. 8

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11. [redacted]**hort** notes on any *three* of the following : 3 × 5

[redacted]**ulsion** type motor

[redacted]**steresis** motor

[redacted]**r** induction motor

[redacted]**no-generator**

[redacted]**nchronous** condenser

[redacted]**curve** of a synchronous motor.

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