EE-501

ELECTRIC MACHINES - II

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
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. Answer any *ten* questions. 10×1 = 10

(i) A capacitor start and run single phase Induction motor is basically a

(A) single phase induction motor (B) two phase induction motor
(C) three phase induction motor (D) single phase reluctance motor

(ii) The direction of rotation of a 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) reversing the leads of either main or auxiliary winding

(iii) Usually the starting torque available in various split phase induction motors are the following ascending order

(A) capacitor split, resistor-reactor split, resistor split
(B) resistor split, resistor-reactor split, capacitor split
(C) resistor-reactor split, resistor split, capacitor split
(D) resistor split, capacitor split, resistor-reactor split

(iv) Which one of the statements is true regarding speed and power factor of a single phase ac series motor?

(A) both increase with increase in load torque
(B) both decrease with increase in load torque
(C) the former increases and the latter decreases with increase in load torque
(D) the former decreases and the latter increases with increase in load torque

(v) A compensating winding in a single phase series motor

(A) reduces reactance drop and improves commutation
(B) reduces reactance only
(C) reduces reactance drop but retards commutation
(D) improves commutation only

(vi) In a synchronous generator operating at zero power factors lagging, the effect of armature reaction is

(A) magnetizing
(B) demagnetizing
(C) cross magnetizing
(D) both magnetizing and cross magnetizing

(vii) Zero power factor characteristic for Potier diagram can be obtained by loading the alternator using

(A) lamp load (B) synchronous motor
(C) water load (D) dc motor

(viii) The maximum possible speeds in rpm at which an alternator can be driven to generate voltages at 60Hz and 50Hz are respectively

(A) 2000, 2400 (B) 3000, 3600 (C) 2400, 2000 (D) 3600, 3000

(ix) The power factor of an alternator under short circuit conditions is almost near

(A) zero leading
(B) zero lagging
(C) unity
(D) zero leading or zero lagging depending upon the type of alternator

(x) Potier reactance of an alternator is almost the same as

(A) field winding resistance (B) total armature reactance
(C) leakage reactance of field winding (D) armature leakage reactance

(xi) A three phase synchronous generator is operating at constant load while the excitation is adjusted to give unity pf current. If the excitation is now increased, the pf will

(A) become leading (B) become lagging
(C) remain at unity (D) become zero

(xiii) A three phase synchronous motor is operating on no load at unity power factor. If the field current is now increased, the power factor and armature current will

(A) leading and the current will decrease

(B) lagging and the current will increase

(C) lagging and the current will decrease

(D) leading and the current will increase

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Explain why single phase induction motor (SPIM) is extensively used although its performance figures are not as good as the three phase induction motor. Explain the double revolving field theory. 1+4

3. What methods are adopted to start a single phase IM. Explain with the help of electrical connection diagram and phasor diagram, the principle of operation of capacitor start and capacitor run motor. 2+3

4. What types of alternators are used in Thermal power stations and Hydel power stations? Draw the general phasor diagram of a cylindrical rotor alternator showing various mmf, emf, flux, currents, voltage, voltage drops etc developed in the machine. 1+4

5. Describe the slip test to determine the d-axis synchronous reactance (X_d) and q-axis synchronous reactance (X_q) of a salient pole synchronous machine. 5

6. Explain the constructional feature and operating principle of linear induction motor. State its important application. 4+1

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Explain how the equivalent circuit parameters of a single phase induction motor can be determined experimentally. State the assumptions you have made. 10

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(b) A 230 V, 4 Pole, 50 Hz, single phase induction motor has the following constants and losses: r_1 = 2.3 Ω r_2' = 4.2 Ω X_m = 74 Ω X_1 = 3.2 Ω X_2' = 3.2 Ω

Core loss = 98 watts

Friction and windage loss = 30 watts

If this motor is running with a slip 0.05 at rated voltage and frequency, then compute the (i) Stator current, (ii) pf, (iii) power output, (iv) torque and (v) efficiency with its auxiliary winding open.

8. (a) Show, with the help of phasor diagram, that compensating winding in a large ac commutator motor is a must, for achieving higher power factor, improved commutation and better speed – torque characteristic.

(b) Why commutation of an ac series motor is more complicated than a dc motor? Briefly describe any one method of improvement of commutation in ac series motor.

9. (a) Explain EMF method of calculation voltage regulation of synchronous generator and state why it leads to pessimistic value at lagging power factor load.

(b) The effective resistance of a 3 phase, star connected, 50 Hz, 2200 V, synchronous generator is 0.5 ohms per phase. On short circuit, a field current of 40 A gives full load current of 200 A. An emf (Line to line) of 1100 V is produced on open circuit with the same excitation. Determine synchronous impedance. Hence compute power angle and regulation at full load and 0.8-pf lagging.

10.(a) A 3300 V, star connected synchronous motor has synchronous impedance of (0.4 + j5) ohms per phase. For an excitation emf of 4000V and motor input power of 1000kW at rated voltage, compute line current and power factor.

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

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

(a) Hunting

(b) Induction generator

(c) Switched reluctance motor

(d) Stepper motor

(e) Synchronous condenser