



ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER - 2007
ELECTRICAL MACHINES
SEMESTER - 5

Time : 3 Hours]

[Full Marks : 70

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$
- i) The damping winding in a synchronous motor is generally used to
- a) provide starting torque only
 - b) reduce noise
 - c) reduce eddy current
 - d) prevent hunting and provide starting torque. ☐
- ii) If the field of a synchronous motor is underexcited, the power factor will be
- a) lagging
 - b) leading
 - c) unity
 - d) zero. ☐
- iii) In a synchronous generator operating at zero power factor lagging, the effect of armature reaction is
- a) Magnetising
 - b) Demagnetising
 - c) Cross-magnetising
 - d) Both magnetising and cross-magnetising. ☐
- iv) The positive reactance of an alternator is almost same as
- a) field winding reactance
 - b) total armature reactance
 - c) leakage of field winding
 - d) armature leakage reactance
 - e) none of these. ☐



- v) Which motor has the starting torque proportional to iron loss ?
- a) Stepper motor b) Hysteresis motor
- c) Permanent magnet motor d) Switch reluctance motor.
- vi) 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) either (a) or (b).
- vii) 'Crawling' in an induction motor is due to
- a) time harmonics in supply
- b) slip-ring rotor
- c) insufficient starting torque
- d) space harmonics produced by winding currents.
- viii) Which is responsible for developing electromagnetic torque in doubly excited magnetic system ?
- a) self inductance of stator circuit and mutual inductance between stator and rotor circuit
- b) self inductance of rotor circuit and mutual inductance between stator and rotor circuit
- c) mutual inductance between stator and rotor circuit only
- d) self inductance of stator and rotor circuit only.
- ix) The function of compensating winding in a single phase series motor is to
- a) improve the commutation
- b) reduce the reactance drop and degrade the commutation
- c) reduce the reactance drop and improve commutation
- d) none of these.



- x) A capacitor selected for capacitor-start induction motor should be rated for
- | | |
|--------------------|-------------------|
| a) peak voltage | b) r.m.s. voltage |
| c) average voltage | d) none of these. |
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- xi) The division of active power amongst alternators running in parallel depends upon
- | |
|---|
| a) speed-load characteristics of prime movers |
| b) volt-ampere characteristics of alternators |
| c) excitation <i>emfs</i> of alternators |
| d) all of these. |
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- xii) What type of motor is most suitable for a computer printer drive ?
- | | |
|----------------------|---------------------|
| a) Reluctance motor | b) Hysteresis motor |
| c) Shaded pole motor | d) Stepper motor. |
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GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following questions.

3 × 5 = 15

2. Why is a single phase induction motor not self starting ? Name the various methods of starting and mention which mode of starting will provide high starting as well as running torque.
3. Why are a.c. series motors designed to operate at higher speeds ? Explain by drawing phasor diagram.
4. Explain the difference between cylindrical-rotor theory and two reaction theory.
5. Explain why cylindrical rotor alternators have small diameter and large core length while salient pole alternators have large diameter and small core length ?
6. What is a damper winding ? Why is damper winding used in salient pole synchronous machine ?

**GROUP - C****(Long Answer Type Questions)**Answer any *three* questions. $3 \times 15 = 45$

7. a) Define voltage regulation of an alternator. Is it possible to have the full-load terminal voltage greater than the no-load terminal voltage ? Explain.
- b) A 3- ϕ star connected alternator is rated 1600 kVA, 13500 V. The armature effective resistance and synchronous reactance are 1.5Ω and 30Ω respectively per phase. Calculate the percentage regulation for a load of 1280 kW at a p.f. of (i) 0.8 leading, (ii) unity and (iii) 0.8 lagging. 15
8. a) A 3300 V, star connected synchronous motor has synchronous impedance of $0.4 + j5$ ohm per phase. For an excitation *emf* of 4000 V and motor input power of 1000 kW at rated voltage, compute line current and power factor. 8
- b) A 20 MVA, 3-phase star connected alternator, with an impedance of 5 ohms and a resistance of 0.5 ohm, is operating in parallel with constant voltage 11 kV busbar. If its field current is adjusted to give an excitation voltage of 12 kV, then calculate (i) Maximum power output from the alternator and (ii) Armature current and pf under maximum power condition. 7
9. a) Derive the equations of rotational and transformer *emf* of a single phase commutator machine as produced by the pulsating field.
- b) At synchronous speed show that a.c. commutator motor with a.c. input voltage and brush displaced from neutral position acts as a phase shifter. 15
10. a) A 240 V, single phase induction motor gave the following test results :
Blocked rotor test : 120 V, 9.6 A, 460 W
No-load test : 220 V, 4.6 A, 125 W.
The stator winding resistance is 1.5Ω and during the block rotor test, the starting winding is open. Find equivalent circuit parameters. Also find the core friction and windage losses. 7
- b) Show with the help of phasor diagrams that a compensated series motor possesses better speed-torque characteristics, better power factor and improved commutation as compared to an uncompensated series motor. 8



11. a) What is Park's Transformation Matrix. Convert a synchronous machine and a induction machine to Kron's Primitive machine using the concept of generalized theory. 9
- b) Explain the principle of operation of Linear Induction motor. 6
12. a) Explain the transformation from axis (a, b, c) to axis ($\alpha, \beta, 0$). Explain transformation from rotating to stationary axis. 9
- b) Obtain transform impedance matrix and new voltage matrix using generalized theory. 6

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