ELECTRICAL MACHINES
(MECH 3133)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) In Lap winding, the number of brushes is always
(a) double the number of poles (b) same as number of poles
(c) half the number of poles (d) multiple of number of poles.

(ii) The current drawn by a 220V d.c. motor of armature resistance 0.5Ω and back emf 200V is
(a) 20A (b) 220A (c) 240A (d) 5A.

(iii) The insulating material used for the commutator segment is generally
(a) graphite (b) carbon (c) mica (d) insulating varnish.

(iv) Transformers operating in parallel mode of operation will share the load depending upon their
(a) leakage reactances (b) per unit impedances
(c) efficiencies (d) ratings.

(v) For the parallel operation of two single phase transformers it is necessary that they should have
(a) Same efficiency
(b) Same polarity
(c) Same kVA rating
(d) Same number of turns on the secondary side.

(vi) A 200 KVA transformer has an iron loss of 1 KW and full load copper loss of 2 KW. The KVA delivered by the transformer corresponding to maximum efficiency is
(a) 100 KVA (b) 141.4KVA (c) 50KVA (d) 200 KVA.

(vii) An 8-pole, 3-phase, 50 Hz induction motor is operating at a speed of 720 rpm. The frequency of the rotor current of the motor in Hz is
(a) 2Hz (b) 4Hz (c) 3Hz (d) 1Hz.

(viii) Rotor resistance control method of speed control of induction motor is applicable for
(a) slip ring induction motor (b) cage induction motor
(c) both slip ring and cage motor (c) neither slip ring nor cage motor.

(ix) Which of the following are used in preventing the hunting phenomenon in synchronous generators?
(a) damper bars (b) short pitch chords
(c) distributed winding (d) both (a) and (b).

(x) In a synchronous motor the magnitude of the stator back emf depends on
(a) Speed of the motor (b) Load on the motor
(c) Both the speed and rotor flux (d) DC excitation only.

Group – B

2. (a) Derive the emf equation of a dc generator.

(b) A d.c. shunt generator has an induced voltage of 240V. When the machine is loaded the terminal voltage is 220V. Determine the load current if the field and armature resistances are 110Ω and 0.2Ω respectively.

6 + 6 = 12

3. (a) Derive the torque equation of a dc motor.

(b) Draw and explain the speed vs torque and torque vs armature current characteristics of a dc series motor.

6 + 6 = 12

Group – C

4. (a) Derive the EMF equation of a transformer.

(b) The open circuit and short circuit test data for a single phase, 50Hz, 5 KVA, 200/400V transformer is given below:

O.C.Test	200V	1.25A	150W
S.C.Test	20V	12.5A	175W

Determine the equivalent circuit parameters of the transformer.

6 + 6 = 12

5. (a) Draw the phasor diagram of transformer operating under lagging power factor load.

(b) Draw the phasor diagram and connection diagram of a Yd_{11} connected 3 phase transformer.

6 + 6 = 12

Group – D

6. (a) Explain the working principle of a 3 phase induction motor.

(b) A 3 phase, 6 pole, 50 Hz induction motor has a slip of 1% at no load and 3% at full load. Find (i) Synchronous speed, (ii) No Load Speed, (iii) Full load speed, (iv) Frequency of rotor current at standstill, (v) Frequency of rotor current at no load, (vi) Frequency of rotor current at full load.

6 + 6 = 12

7. (a) Derive the torque equation of a 3 phase induction motor.

(b) Draw and explain the torque slip characteristic of a 3 phase induction motor.

6 + 6 = 12

Group – E

8. (a) Derive an expression of induced emf of alternator.

(b) Draw the phasor diagram of alternator operating under:
(i) leading power factor load, (ii) lagging power factor load and (iii) unity power factor load.

6 + 6 = 12

9. (a) Explain why a 3 phase synchronous motor is not a self-starting. Hence explain how starting torque is produced.

(b) Explain with necessary circuit and phasor diagram how power factor of a synchronous motor can be controlled by adjusting its field current.

6 + 6 = 12

Department & Section	Submission link:
ME	https://classroom.google.com/c/MjQ5MzU4ODU0MTgz/a/Mjc0MDMwMjA1Mzg1/details