



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 121656

Roll No.

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B. Tech.

**(SEM. VI) THEORY EXAMINATION, 2014-15
SPECIAL ELECTRICAL MACHINES**

Time : 3 Hours]

[Total Marks : 100

- 1 Attempt any four parts of the following : **5×4=20**
- (a) Explain the e.m.f. injection in rotor circuit of slip ring induction motor by means of suitable phasor diagram.
 - (b) A three phase 400 V double-cage induction motor has per-phase standstill leakage impedance of $2+j2.5 \Omega$ and $0.5+j10 \Omega$ for its two cages. Find the relative values of torques given by each cage.
 - (i) At starting
 - (ii) At 5% slip
 - (c) Explain the Leblanc constant power drive system with suitable diagram.
 - (d) Explain the principle of operation of double-cage induction motor and also draw the equivalent circuit.

- (e) A 20 kW, three-phase 400V, 4-pole, 50 Hz squirrel cage induction motor when working at rated voltage and frequency develops a full load torque at 1470 rpm. If the motor is fed from 40 Hz source with its voltage adjusted to give the same air flux as at 50 Hz, then calculate the magnitude of the 40 Hz voltage source.
- (f) A three-phase 500 kW, 50 Hz, induction motor has a full load slip of 2.1%. The rotor circuit has standstill impedance of $0.3 + j1.8 \Omega$ per phase. If an external resistance of 1.5Ω per phase is inserted in each of rotor circuit, determine the slip and power output when the stator current has its full load value. Neglect stator impedance and rotational losses.

2 Attempt any two parts of the following : **10×2=20**

- (a) Explain the working principle of capacitor start capacitor run induction motor with suitable phasor diagram. The following data is obtained from a 230 V, 50 Hz, capacitor start single phase induction motor at standstill.

Main winding : 100V, 2A 40W

Auxiliary winding: 80V 1.0 A 50W

Determine the value of capacitor for attaining the value of maximum torque.

- (b) Explain the principle of operation, of two phase servo motor with the help of neat illustrations. Also mention its advantages.

- (c) A 230 V, 4-pole 50 Hz, single-phase induction motor has the following data :

$r_1 = 2.3 \Omega$, $r_2 = 4.2 \Omega$, $x_1 = 3.2 \Omega$, $x_2 = 3.2 \Omega$,

$X_m = 74 \Omega$, core loss = 98 watts, friction and windage

loss = 30 watts. If the motor is running with a slip 0.05 at rated voltage and frequency, compute the following :

- (i) Stator current
- (ii) Power factor
- (iii) Power output
- (iv) Torque
- (v) Efficiency with its auxiliary winding open.

3 Attempt any two parts of the following : **10×2=20**

- (a) Explain the principle of operation of 6/4 pole variable reluctance stepper motor. What is the motor torque required to accelerate the initial load of $10^{-4}/\text{gm}^2$ from $\omega_1 = 200$ and $\omega_2 = 300$ rad/sec. Frictional load torque is 0.06 N-m.
- (b) Explain the principle of operation and operating modes of switched reluctance motor.
- (c) Write the short notes on the following :
 - (i) Split power supply converter.
 - (ii) Clamic converter

4 Attempt any two parts of the following : **10×2=20**

- (a) Explain the principle of operation and torque production of three-phase three-pulse brushless DC motor. Also mention the advantages of brushless DC motor over the conventional DC motor.
- (b) A three-phase four pole brushless DC motor has 36 stator slots, each phase winding is made up of three coils per pole with 20 turns per coil. The coil span is 7 slots. If the fundamental component of magnetic flux is 1.8 m Wb. Calculate the open circuit phase e.m.f. (E_g) of 3000 rpm.

- (c) Write the short notes on any two of the following :
- (i) Static and Dynamic characteristic of stepper motor.
 - (ii) Hysteresis motor
 - (iii) Single phase reluctance motor.

5 Attempt any two parts of the following : $10 \times 2 = 20$

- (a) Explain the operation of DC series motor when connected to an AC source and also draw the phasor diagram of a single-phase series motor. A series motor has a total resistance of 25Ω and a total inductance of 0.2 H . The motor runs at 1000 rpm when it draws 1 A from 220 V DC source. Calculate the speed and power factor when it draws the same current from 220 V , 50 Hz source.
- (b) Four pole lap connected armature has 450 turns and rotates at 1200 rpm in a sine distributed pulsating flux of frequency of 50 Hz and of amplitude 0.018 Wb per pole. Calculate the voltage and frequency of the e.m.f. at the brushes if the brush axes are
- (i) 90° away from the field axes.
 - (ii) aligned along the field axis and
 - (iii) 30° away from the field axes.
- (c) Write the short notes on the following :
- (i) Linear induction motor
 - (ii) Improving commutation method.