

**ELECTRIC DRIVES & POWER UTILIZATION
(ELEC 4101)**

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) Regenerative braking is not possible in
 - (a) DC Series motor
 - (b) Induction Motor
 - (c) DC Shunt Motor
 - (d) DC separately excited motor.
 - (ii) A four quadrant operation requires
 - (a) two full converter in series
 - (b) two full converters connected in parallel
 - (c) two full converters connected back to back
 - (d) single full converter.
 - (iii) Speed control by variation of field flux results in
 - (a) constant torque drive
 - (b) variable torque drive
 - (c) constant power drive
 - (d) variable power drive.
 - (iv) For slip power recovery method of speed control power is injected to the rotor of induction motor. The induction motor will run at a speed
 - (a) higher than rated speed
 - (b) lower than rated speed
 - (c) at rated speed
 - (d) at zero speed.
 - (v) Power of the supply voltage is reversed in which type of braking
 - (a) regenerative
 - (b) plugging
 - (c) dynamic
 - (d) all of the above.
 - (vi) Which motor is used in tramways?
 - (a) AC single phase capacitor start motor
 - (b) AC three phase motor
 - (c) DC series motor
 - (d) DC shunt motor.

- (vii) The concept of V/f control of inverters driving induction motors results in
 - (a) constant torque operation
 - (b) speed reversal
 - (c) reduced magnetic loss
 - (d) harmonic elimination.
- (viii) Eddy current heating is involved in
 - (a) resistance heating
 - (b) dielectric heating
 - (c) induction heating
 - (d) arc heating.
- (ix) The voltage current relationship of the arc welding is
 - (a) Straight
 - (b) Drooping
 - (c) Exponentially rising
 - (d) Parabolic.
- (x) A 60 W lamp gives a luminous flux of 1500 lumen. Its efficiency is
 - (a) 1500 lumen/watt
 - (b) 250 lumen/watt
 - (c) 25 lumen/watt
 - (d) 2.5 lumen/watt.

Group – B

2. (a) Explain four quadrant operation of a motor driving a hoist load with necessary diagram.
- (b) Derive the equations for calculation of Moment of Inertia (J) and Torque (T) for motor driving loads with rotational and translational motion.
- (c) What do you mean by electric drive? **6 + 5 + 1 = 12**
3. (a) What are the components of load torques?
- (b) Define steady state stability. Explain the same with the help of speed torque characteristics.
- (c) Briefly explain active and passive load torques with examples. **5 + (1 + 3) + 3 = 12**

Group – C

4. (a) Explain in brief different types of braking in dc motor.
- (b) A 220 V, 970 rpm, 100 A dc separately excited motor has an armature resistance of 0.05 Ω. It is braked by plugging from an initial speed of 1000 rpm. Calculate
 - (i) resistance to be added in series with the armature circuit to limit braking current to twice the full load value.
 - (ii) braking torque.

(iii) torque when the speed has fallen to zero.

$$7 + 5 = 12$$

5. (a) Explain the process of plugging in connection to induction motor.
 (b) Explain in brief the operation of VSI fed Induction Motor Drives.
 (c) Compare current source inverter (CSI) and voltage source inverter (VSI) drives.

$$4 + 5 + 3 = 12$$

Group - D

6. (a) Draw and speed time curve of main line service and explain different periods of running.
 (b) Write short notes of Kando system.
 (c) A suburban electric train has a maximum speed of 70 kmph. The schedule speed including a station stop of 30 seconds is 45 kmph. If the acceleration is 1.5 kmphs, find the value of retardation when the average distance between stops is 4 km.

$$3 + 3 + 6 = 12$$

7. (a) An Electric train weighing 300 tonnes runs 1% up gradient with following speed time curve:
 Uniform acceleration of 1.5 kmphs for 30 seconds
 Constant speed for 40 seconds
 Coasting for 30 seconds
 Braking at 2.5 kmphs
 Calculate the specific energy consumption if the tractive effort is 45 N/tonne, rotational inertia effect 10% and overall efficiency of transmission and motor 75%.
 (b) Which type of motor is preferable in electric traction system and why - explain. Mention advantage and disadvantage of induction motor in traction system.

$$7 + (3 + 2) = 12$$

Group - E

8. Write short notes on any two
 (i) Induction heating
 (ii) Dielectric Heating
 (iii) Arc welding.

$$6 + 6 = 12$$

9. (a) Explain the construction and principle of operation of fluorescent lamp using necessary circuit diagram.
 (b) A minimum illumination of 80 lumen/m² is required in a factory shed of 100 m × 10 m. Calculate the number, location and wattage of the units to be used. Assume that the depreciation factor is 0.8, coefficient of utilization is 0.4 and efficiency of the lamp is 40 lumens/watt.

$$6 + 6 = 12$$