

CS/B.TECH/EE/ODD SEM/SEM-7/EE-701/2016-17



**MAULANA ABUL KALAM AZAD UNIVERSITY OF  
TECHNOLOGY, WEST BENGAL**

**Paper Code : EE-701  
ELECTRIC DRIVES**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

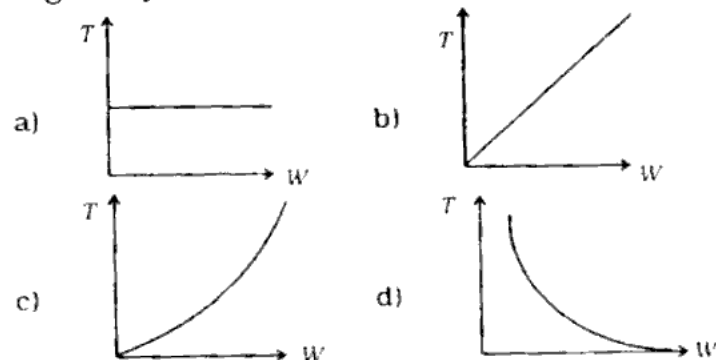
Candidates are required to give their answers in their own words as far as practicable.

**GROUP - A**

**( Multiple Choice Type Questions )**

Choose the correct alternatives for any ten of the following :  $10 \times 1 = 10$

i) The speed torque characteristics of a fan type load is given by



[ Turn over

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ii) The range of slip of regenerative braking of a polyphase induction motor remains between

- a)  $s = 1$  to  $s = s_m$       b)  $s = 1$  to  $s = -s_m$   
c)  $s = s_m$  to  $s = 0$       d)  $s = 0$  to  $s = -s_m$

where  $s_m$  is the slip at maximum torque.

iii) For slip power recovery method of speed control, power is injected to the rotor of the induction motor. The induction motor will run at a speed

- a) higher than rated speed  
b) lower than the rated speed  
c) at the rated speed  
d) of zero speed

iv) The heating time constant of an electrical machine gives an indication of its

- a) cooling      b) rating  
c) overload capacity      d) short time rating.

v) The zone below base speed of an electric drive is known as

- a) constant power zone  
b) constant torque zone  
c) constant voltage zone  
d) constant current zone.

vi) A crane is used to move material horizontally and vertically. The type of drive used is

- a) multimotor      b) group  
c) individual      d) both (a) and (c).

- vi) The regenerative braking is not possible in
- DC series motor
  - Induction motor
  - DC shunt motor
  - DC separately excited motor.
- viii) For increasing the speed of an induction motor, the frequency of the supply is increased by 20%. In order to operate the motor at the same flux, the supply voltage must
- remain constant
  - be reduced by 10%
  - be reduced by 20%
  - be increased by 20%.
- ix) In case of rotor resistance control of induction motor drives, for the same torque
- speed falls with an increase in rotor resistance
  - speed increased with an increase in rotor resistance
  - speed falls with fall in rotor resistance
  - speed increases with fall in rotor resistance.
- x) A typical active load is
- |          |           |
|----------|-----------|
| a) Hoist | b) Blower |
| c) Pump  | d) Fan.   |

- xi) During dynamic braking employed for DC series motors,
- armature current is reversed
  - field winding is reversed
  - field current direction is unchanged
  - both (a) and (c).
- xii) A four quadrant operation requires
- two full converters connected in series
  - two full converters connected in parallel
  - two full converters connected in back to back.
  - two semi-converters connected in back to back.

### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following.  $3 \times 5 = 15$

- A weight of 500 kg is being lifted up at a uniform speed of 1.5 m/s by a winch driven by motor running at a speed of 1000 rpm. The moment of inertia of the motor and winch are  $0.5 \text{ kgm}^2$  and  $0.3 \text{ kgm}^2$  respectively. Calculate the motor torque and the equivalent moment of inertia referred to the motor shaft. In the absence of weight motor develops a torque of 100 Nm when running at 1000 rpm.
- "A motor of smaller rating can be selected for intermittent duty." Justify the statement with proper analysis.

4. Deduce the expression for energy lost during starting of induction motor with no load.
5. With appropriate diagram, discuss the four quadrant operation of a hoist drive.
6. Why VVVF method of speed control of a polyphase induction motor is preferable over frequency control method ? Draw the relevant torque-frequency characteristics.

### GROUP - C

#### ( Long Answer Type Questions )

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) What are the various factors that influence the choice of electric drives ?
- b) Derive the heating and cooling characteristics of an electric motor.
- c) The temperature rise of motor when operating for 25 min on full load is  $25^{\circ}\text{C}$  and becomes  $40^{\circ}\text{C}$  when the motor operates for another 25 min on the same load. Determine heating time constant and the steady state temperature rise.  $4 + 6 + 5$
8. a) With the help of relevant circuit diagram explain different methods of dynamic braking for a polyphase induction motor.

- b) A 3-phase, 440V, 50 Hz, 6 pole, Y-connected IM has the following parameters referred to the stator :  $R_s = 0.5 \Omega$ ,  $R_r' = 0.6 \Omega$ ,  $X_s = X_r' = 1 \Omega$ . Stator to rotor turns ratio is 2.

The motor is running on no load. The plugging is used to stop the motor.

- (i) Determine the maximum braking current and initial and final braking torque when no external braking resistance is used.
- (ii) Calculate the additional braking resistor to be inserted into the rotor circuit so as to limit the maximum braking current to twice the rated value. The motor has a rated speed of 940 rpm.  $8 + 7$
9. a) Draw and explain the scheme for closed loop speed control of a three-phase induction motor by  $V/f$  control.
- b) A 220V, 150 A, 875 rpm separately excited motor has an armature resistance of  $0.06 \Omega$ . It is fed from a single phase fully controlled converter with an ac source voltage of 220 V, 50 Hz. Assuming continuous conduction, calculate —
  - (i) firing angle of converter for motor speed of 750 rpm.
  - (ii) firing angle for rated motor torque ( $\approx 500$ ) rpm.
  - (iii) motor speed and torque for  $\alpha = 160^{\circ}$ .  $7 + 8$

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10. a) Describe briefly the different methods for determination of motor power rating for variable load drives.
- b) A drive has two loads. One has rotational motion. It is coupled to the motor through a reduction gear with gear ratio  $\alpha = 0.1$  and efficiency is 90%. A load has moment of Inertia  $10 \text{ kg-m}^2$  and torque  $10 \text{ N-m}$ . Other load has translation motion and consists of  $1000 \text{ kg}$  weight to be lifted upward at an uniform speed of  $1.5 \text{ m/sec}$ . Coupling between this load and the motor has a efficiency of 85%. Motor rating is  $\omega_m = 1420$  and  $0.2 \text{ kg-m}^2$ . Determine equivalent inertia referred to the motor shaft and power developed by the motor. 8 + 7
11. Write short notes on any *three* of the following : 3 × 5
- a) Self control of synchronous motor
  - b) Vector control of Induction motor
  - c) Drive for paper mills
  - d) Switched reluctance motor.
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