National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Branch	: EEE	**Semester**	: VII
Title of the Course	: Electrical Drives	**Course Code**	: EEB 401

Time: 3 Hours   Maximum Marks: 50

Section A

Each question carry 01 mark each and all parts are compulsory.

Q 1.   [10 × 1=10]

i) A single motor which actuates several machines is called
   a. group drive   b. individual drive   c. multi-motor drive   d. active drive

ii) The regenerative braking is not possible in
   a. DC series motor   b. induction motor   c. DC shunt motor   d. DC separately excited motor

iii) The plugging in induction motor occurs when
   a. rotor and stator magnetic field move in opposite directions
   b. rotor and stator magnetic field move in same direction   c. slip becomes greater than unity.
   d. both a and c

iv) Which operation is not possible for semi-converter fed DC drive system?
   a. II quadrant   b. III quadrant   c. IV quadrant   d. All of these

v) A motor has a thermal heating time constant of 50 mm. When the motor runs continuous of full scale,
   its final temperature rise is 80° C, what would be the temperature rise after 1 hour, if the motor runs
   continuously on full load?
   a. 55.9   b. 58   c. 56   d. 60

vi) A four quadrant operation requires
   a. two full converters in series.   b. two full converters connected in parallel.
   c. two full converter connected in back to back.   d. two semi converters connected in back to back.

vii) Speed control by variation of field flux results in
   a. constant power drive.   b. constant torque drive.   c. variable power drive.   d. none of these.

viii) High braking torque produced in
   a. plugging.   b. dynamic braking.   c. regenerative braking.   d. none of above.

ix) A 3 - Φ induction motor draws an electric current of 50 A from mains when starts by direct switching.
   If an auto transformer with 60 % tapping is used for starting the electric current drawn from the mains
   will be
   a. 18   b. 36   c. 50   d. 80

x) The power input to a 3 - Φ induction motor is 60 kW and stator loss is 1 kW the rotor cu loss per phase is
   a. slip × 50 / 3.   b. slip × 59 / 3.   c. slip × 69 / 3.   d. 1.

Section B

Each question carry 05 marks each and any four (04) are to be attempted.   [5×4=20]

Q 2. i) Deduce the expression for the equivalent moment of inertia of motor-load system and equivalent torque components referred to motor shaft with load having rotational and translational motion. [3]

ii) A motor operates on a periodic duty-cycle in which it is clutched to its load for 10 min and declutched to run on no-load for 20 mins. Minimum temperature rise is 40^0 C. Heating and cooling time-constants are same and have a value of 60 mins. When load is declutched continuously the temperature rise is 15^0 C. Determine:

   a.   Maximum temperature during duty cycle.

   b.   Temperature when the load is clutched continuously.   [2]

Q 3. i) Deduce the expression of temperature rise, minimum and maximum temperature in terms of heating time constant. Also, draw the heating and cooling time curves.   [3]

ii) A constant speed drive has the following duty cycle:

   (1) Load rising from 0 to 400KW in 5 min.

   (2) Uniform load of 500 KW in 5 min.

   (3) Regenerative power of 400 KW returned to the supply in 4 min.

   (4) Remains idle for 2 min.

Estimate the power rating of the machine.   [2]

Q 4. i) With the help of relevant torque-speed characteristics, discuss motoring and regenerative braking of chopper controlled separately excited DC motor.   [3]

ii) A 230 V, 960rpm and 200A separately excited DC motor has an armature resistance of 0.02Ω. the motor is fed from a chopper which provides motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction and motor operating in dynamic braking with resistance of 2Ω.

   i.   Calculate duty ratio of chopper for a motor speed of 600rpm and braking torque of twice the rated value.

   ii.   What will be the motor speed for a duty ratio of 0.6 and motor torque equal to twice its rated torque?   [2]

Q 5. i) Explain different methods of speed control for induction motor drives.   [3]

ii) A three phase, 440V, 1000rpm slip ring induction motor is operating with 4% slip. Stator current is 30A. Calculate the stator current if the speed of the motor is reduced to 500rpm using stator voltage control method.

[2]

Q 6. A 100kW, 1000rpm DC shunt motor is controlled at its armature by a 400V, three phase full converter. Find the triggering angle and power factor at rated speed. What is the value of the triggering angle at 50% of the rated speed. Assume the input AC supply to be 415V.

[5]

Section C

Each question carry ten (10) marks each and any two (02) are to be attempted.   [2 × 10=20]

Q 7. Write short note on

    a) Starting of induction motor

    b) Chopper control of DC drives   [3]

    c) Closed loop control of drives   [3]

[4]

Q 8. i) Explain the principle of slip power recovery scheme of controlling the speed of induction motor, using static Kramer drive.

[4]

    ii) A 440 V, 50Hz, 970rpm, 6-pole, Y-connected, 3-phase wound rotor induction motor has following parameters referred to the stator:

$R_s = 0.1\Omega$, $R_r = 0.08\Omega$, $X_s = 0.3\Omega$ and $X_r = 0.4\Omega$

The stator to rotor turns ratio is 2. Motor speed is controlled by Static Scherbius drive. Drive is designed for a speed range of 25% below the synchronous speed. Maximum value of firing angle is 165°. Calculate

a) transformer turns ratio

b) torque for a speed of 780rpm and firing angle is 140°

c) firing angle for half the rated motor torque and speed of 800rpm.

DC link inductor has a resistance of 0.01Ω

[6]

Q 9. Explain V/F method for controlling speed of induction motor. Also, explain VSI, cycloconverter and CSI control of induction motor drives.

[10]