2551

JANUARY 2026

509/4E (N)

INDUSTRIAL DRIVES

Time Allowed: 2.5 Hours *Full Marks: 60*

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.
Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): 2x10=20

i) In four quadrant motor drive operation fourth quadrant belongs to– a) forward braking, b) reverse motoring, c) reverse braking, d) forward motoring.

ii) The ratio of the starting line current for star connection to the starting line current for delta connection of a three phase squirrel cage induction motor is – a) 0.333, b) 0.667, c) 0.577, d) 0.866.

iii) The purpose of thermal overload in AC induction motor magnetic control circuit is to protect against – a) short circuit, b) prolonged over current, c) over voltage, d) all of a, b, c.

iv) In a dual converter with circulating current mode SCR triggering angle of one of the converters is 45^0, the triggering angle of the other converter is – a) 60^0, b) 135^0, c) 180^0, d) 145^0.

v) Speed of three phase slip ring induction motor obtained using rotor resistance control – a) up to synchronous speed, b) only sub-synchronous speed, c) only super-synchronous speed, d) both sub-synchronous and super-synchronous speed.

vi) Variable DC supply can be obtained using – a) DC chopper, b) SCR converter, c) PWM converter, d) all of a, b, c.

vii) According to IEC standard water pump motor belongs to the duty class – a) S1, b) S2, c) S3, d) S4.

viii) Which of the following device can be used for speed detection of motor – a) tachogenerator, b) rotary encoder, c) hall sensor, d) all of a, b, c.

ix) In a semi-converter drive, output voltage is – a) bidirectional and controllable, b) unidirectional and controllable, c) unidirectional and uncontrollable, d) bidirectional and uncontrollable.

x) For stable operating region of a three phase induction motor torque will be – a) directly proportional to slip, b) inversely proportional to slip, c) directly proportional to speed, d) independent of slip.

xi) Power supply required for dynamic braking of three phase induction motor is – a) three-phase AC supply, b) DC and three-phase AC supply, c) DC supply, d) DC and Single phase AC supply.

xii) Type of filter used in Phase Locked Loop control is – a) high pass filter, b) low pass filter, c) band pass filter, d) band reject filter.

xiii) If E_m is the maximum value of AC input applied to a single phase full-controlled SCR converter with resistive load, average DC output of the converter with triggering angle 'α' is – a) $[2E_m(1+\cos\alpha)]/\pi$, b) $E_m\cos\alpha/2\pi$, c) $[E_m(1+\cos\alpha)]/\pi$, d) $2E_m\cos\alpha/\pi$.

xiv) Microcontroller based DC drive is preferable over analog systems for – a) real time data acquisition, b) higher precision, c) self-diagnostics, d) all of a, b, c.

xv) Hall sensors are used in BLDC motor to – a) detect rotor position, b) help in electronic commutation, c) detect motor speed, d) all of a, b, c.

GROUP-B

Answer any Five (05) questions. (8x5)

2. a) Briefly describe an electric drive system with necessary block diagram.
   b) How electric drive is more advantageous than mechanical drive?
   c) Classify duty class of motor. (4+2+2)

3. a) Draw and explain the Speed vs. Torque characteristics of a DC series motor.
   b) Describe any one starting method of synchronous motor.
   c) Differentiate between short term duty and intermittent duty class of motor with example. (3+3+2)

4. a) Describe the operating principle of stepper motor with suitable diagrams for certain step angle.
   b) Explain with diagram the operating principle of Brushless DC motor with electronic commutation. (4+4)

5. a) Describe with diagram speed control of a separately excited dc motor using full controlled SCR converter. Draw the necessary input and output waveforms.
   b) Describe the operating principle of dual converter for DC motor speed control. (4+4)

6. a) Differentiate between Voltage Source Inverter and Current Source Inverter.
   b) Explain with block diagram how super synchronous and sub-synchronous speed of induction motor can be obtained using slip power recovery scheme. (3+5)

7. a) Explain with diagram speed control method of three phase induction motor using variable voltage variable frequency drive.
   b) Describe using block diagram Phase Locked Loop in dc motor speed control. (4+4)

8. a) Differentiate between power circuit and control circuit of 3-phase induction motor starter.
   b) Draw and explain the operation of control and power circuits of <u>any ONE</u> of the following:
   i) Forward and Reverse direction of rotation of three phase induction motor with Interlocking system.
   ii) Automatic sequential control of three phase induction motors A, B and C, such that 'B' will start after 15sec of 'A' and 'C' will start after 20sec of 'B'. (2+6)

9. a) Describe the operation of microcontroller-based DC motor drive system.
   b) Explain the operation of ON-delay and OFF-delay timer in magnetic control circuit. (5+3)

10. Write short notes on <u>any TWO</u> of the following: (4x2)
    a) Construction and working of DC servomotor.
    b) Dynamic braking method of three phase Induction motor.
    c) Working of Hall-effect sensor and its application.
    d) Automatic Star-Delta starter of Induction motor with power circuit and control circuit.