# 11920 3 Hours / 100 Marks

Seat No.								
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#### Instructions:

- (1) All Questions are *compulsory*.
- (2) Answer each next main Question on a new page.
- (3) Illustrate your answers with neat sketches wherever necessary.
- (4) Figures to the right indicate full marks.
- (5) Assume suitable data, if necessary.
- (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
- (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

#### 1. (A) Attempt any THREE:

12

- (i) State need of PLC in automation. List any four benefits of PLC in automation.
- (ii) Draw the Block diagram of DC output module and explain threshold detector block in it.
- (iii) List the timer instructions of PLC. Explain any one of them in detail.
- (iv) Write the expression of proportional controller and define:
  - (1) Proportional Band
  - (2) Offset

#### (B) Attempt any ONE:

6

- (i) Derive the expression for steady state error (ess). State two factors on which it depends.
- (ii) Compare fixed and modular PLC. (any six points)

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#### 2. Attempt any TWO:

**16** 

- (a) Derive an expression for unit step response of first order system. Draw its response curve.
- (b) For given differential equation

$$\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} + 4\frac{\mathrm{d}y}{\mathrm{d}t} + 8y(t) = 8x(t)$$

where y = output and x = Input

Find:

(i) Settling time

(ii) Rise time

(iii) Peak time

- (iv) Peak overshoot
- (c) Draw ladder diagram for 3 motor operation for following conditions:
  - (i) State push button starts motor  $M_1$ ,  $M_2$  and  $M_3$ .
  - (ii) Stop push button, stops motor  $M_1$  first, after 10 seconds motor  $M_2$  and after 20 seconds motor  $M_3$ .

### 3. Attempt any FOUR:

16

- (a) Explain any two logical instructions in PLC.
- (b) Draw block diagram of process control system. Explain the functions of each block.
- (c) The control system having unity feedback has

$$G(S) = \frac{20}{S(1+4S)(1+S)}.$$

Find:

- (i) Type of system
- (ii) Static error coefficients

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(d) For close loop system with positive feedback, show that

$$\frac{C(S)}{R(S)} = \frac{G(S)}{1 - G(S) H(S)}$$

- (e) Identify given field devices as input and output devices of PLC. State their use:
  - (i) Solenoid valve
- (ii) Proximity switch

(iii) Level sensors

(iv) Heater coil

# 4. (A) Attempt any THREE:

12

- (i) Explain scan cycle of PLC with neat diagram.
- (ii) Give the principle of derivative control action. Write its standard equation.
- (iii) Determine the stability of given system by Routh's array method having characteristic equation as

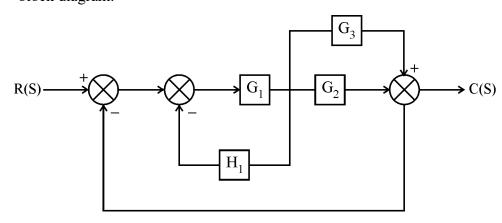
$$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$$

(iv) Define servo system. Draw and explain block diagram of servo system.

#### (B) Attempt any ONE:

6

(i) Define transfer function. Derive the transfer function of the following block diagram.



(ii) Find the range of K for stability of a unity feedback system with characteristic equation.

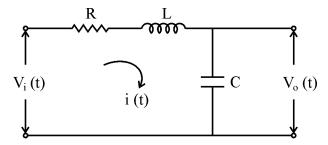
$$G(S) = \frac{K}{S(S+2)(S+4)(S+6)}$$

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# 5. Attempt any FOUR:

16

- (a) Define stable and unstable system with its response and locations of roots in S-plane.
- (b) List different standard test signals. Draw them and give their Laplace representation.
- (c) Explain in brief ON-OFF control action.
- (d) Derive the transfer function of given electrical circuit.



(e) Draw the ladder diagram for (i) NAND gate, (ii) NOR gate.

#### 6. Attempt any FOUR:

16

- (a) Describe sinking and sourcing concept in DC input module with neat diagram.
- (b) Draw the block diagram of PLC and explain each block in it.
- (c) Explain PI control action. State its equation. State limitations of PI controller.
- (d) Define with example:
  - (i) Linear and Non-linear system.
  - (ii) Time varying and Time in varying system.
- (e) Explain Routh's stability criterion for two different cases.
- (f) Draw block diagram of DC input module. Draw typical wiring diagram of it.