15162

3 Hours / 100 Marks Seat No.

Instructions : (1) **All** questions are **compulsory**.
  (2) Illustrate your answers with neat sketches **wherever** necessary.
  (3) Figures to the **right** indicate **full** marks.
  (4) Assume suitable data, if **necessary**.
  (5) Use of Non-programmable Electronic Pocket Calculator is **permissible**.
  (6) Mobile Phone, Pager and any other Electronic Communication devices are **not** permissible in Examination Hall.

Marks

1. A) Attempt **any three** : **12**
   a) Consider a system with characteristic equation $S^5 + 2S^4 + 2S^3 + 4S^2 + 11S + 10 = 0$. Determine stability using Routh's criteria.
   b) List any four advantages of PLC.
   c) Compare open loop and closed loop control system (four points).
   d) Draw block diagram of process control system. Explain the function of each block.

   B) Attempt **any one** : **6**
   a) Explain the memory organization of PLC.
   b) Draw the block diagram of DC servo system. Explain the function of each block.

2. Attempt **any two** : **16**
   a) For the unity Feedback system having open loop transfer function.

   $$G(S) = \frac{K(S+2)}{S(S^3 + 7S^2 + 12S)}.$$

   Determine :
   i) Type of system
   ii) Error constant K_p, K_v and K_a
   iii) Steady state error for unit parabolic input.

   b) Draw the time response of second order system. Explain the effect of damping on the response of second order system.

   c) Draw ladder diagram to verify following logic gates truth table :
   a) NAND gate b) EXOR gate c) NOR gate d) AND gate

P.T.O.

Marks

3. Attempt **any four**:   **16**

a) Compare linear and non-linear system (four points).

b) Explain the functions of output module of PLC.

c) What is Laplace transform ? Explain the significance of Laplace transform in control system.

d) Define :

   i) Stability   ii) Relative stability.

e) Define scan time of PLC. Explain the significance of scan time.

4. A) Attempt **any three**:   **12**

a) Explain the offset in proportional controller. Draw the response of proportional controller.

b) List any four specifications of AC input module.

c) Explain in detail the role of CPU in PLC.

d) Write the Laplace transform for the following input signal.

   i) step   ii) ramp   iii) parabolic   iv) impulse

B) Attempt **any one**:   **6**

a) List the timer instructions of PLC. Explain any one of them in detail.

b) Compare PI, PD and PID controller (four points).

5. Attempt **any two**:   **16**

a) Draw the ladder diagram for 2 motor operation :

   i) When start button is pushed motor M1 and M2 start

   ii) After 10 sec. motor M1 stops

   iii) Motor M2 stops 15 sec. after motor M1 has stopped

   iv) Both M1 and M2 will stop when stop push button is pressed.

b) For a unity feedback system, the open loop TF $G(S) = \dfrac{25}{S(S+6)}$. Determine

   i) Rise time   ii) Peak time   iii) Maximum overshoot   iv) Settling time

c) i) Define critically stable and conditionally stable system.

   ii) For the characteristic equation $S^4 + 20KS^3 + 5S^2 + (10+K)S + 15 = 0$.
       Determine the value of K for stable system.

6. Attempt **any four**:   **16**

a) Explain in brief ON-OFF control action.

b) State Routh's criteria. Describe different cases to find stability of system (any two).

c) With the help of neat diagram explain the concept of sourcing and sinking DC input module of PLC.

d) Explain the derivate control action with equation and response curve. Why derivate action cannot be used alone ?

e) State and explain any two rules of block diagram reduction.

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