16117

3 Hours / 100 Marks   Seat No.

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) Mobile Phone, Pager and any other Electronic Communication devices are **not** permissible in Examination Hall.

Marks

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

a) Draw the block diagram of DC servo system.

b) State the need of PLC in automation.

c) Define stability and with diagram of root location in s-plane define stable and unstable systems.

d) Draw the block diagram of process control system.

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

a) Explain :

i) Benefits of PLC in automation (3 points)

ii) Scanning cycle.

b) Derive the transfer function of the system as shown in figure 1, using block diagram reduction techniques.
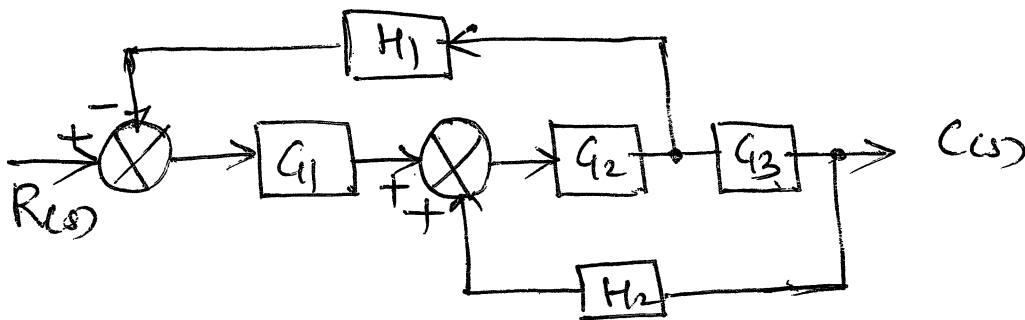

Figure 1

P.T.O.

Marks

2. Attempt **any two** : 16

a) A second order system is given

$$\frac{C(s)}{R(s)} = \frac{6}{s^2 + 5s + 6}$$

Determine :
a) Rise time b) Peak time
c) Settling time d) Peak overshoot.

b) For a given transfer function

$$\frac{C(s)}{R(s)} = \frac{s(s+2)}{(s^2 + 2s + 2)(s^2 + 7s + 12)}$$

Find :
i) Poles ii) Zeros
iii) Pole-zero plot iv) Characteristic equation.

c) Draw ladder diagram for 2 motor operation for following condition
i) Start push button starts motor M_1 after 10 seconds and motor M_2 after 20 seconds.
ii) When stop push button is pressed it stops M_2 and after 15 seconds M_1.

3. Attempt **any four** : 16

a) Define transfer function. Derive an expression for transfer function of closed loop system.

b) Draw the block diagram of PLC and explain its C.P.U. block.

c) State with diagram any four block diagram reduction rules.

d) By means of Routh's criteria determine the stability of the system $s^4 + 2s^3 + 8s^2 + 4s + 3 = 0$.

e) Explain the function and organization of memory in PLC.

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

a) Write the O/P equations and draw the response of PI and PD controller.

b) Explain with diagram concept of sinking and sourcing in discrete input module.

c) Differentiate between fixed and modular PLC (4 points).

d) List different standard test inputs. Draw them and give their laplace transform equations.

B) Attempt **any one** : 6

a) Explain with diagram and waveform of down-counter instructions in PLC.

b) List types of control actions. Give its output equation and corresponding laplace transforms.

Marks

5. Attempt **any two** :   16

   a) Draw the block diagram of analog input module. Explain each block. List its 4 specification.

   b) Derive steady state error and error constants equations for Type-0 and Type-1 systems.

   c) Using Routh's criteria, determine the range of K values for system to be stable

$$G(s)\,H(s) = \frac{K}{s(s+2)\,(s+4)\,(s+5)}.$$

6. Attempt **any four** of the following :   16

   a) Explain w.r.t. proportional action

      i) offset

     ii) proportional band.

   b) State any two advantage and disadvantages of Routh array.

   c) Describe the wiring details of Discrete output module.

   d) Draw electronic PD controller. State its equation and give its two disadvantage.

   e) State with diagram the effect of damping on the response of second order system.