24225

3 Hours / 70 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) Use of Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. Attempt any FIVE of the following : **10**

(a) Define system and control system.

(b) Write any two rule for block diagram reduction technique.

(c) Define transient response and steady state response.

(d) Draw diagram of time response specifications for second order control system.

(e) Define relatively stable system and marginally stable system.

(f) Write the names of different composite controllers.

(g) Define poles and zeros with examples.

2. Attempt any THREE of the following : **12**

(a) Compare open loop and closed loop control system w.r.t. following points :

(i) Feedback (ii) Error detector

(iii) Accuracy (iv) Stability

(b) Draw the block diagram of process control system and write the need for controller.

(c) Find the transfer function of the circuit given below :

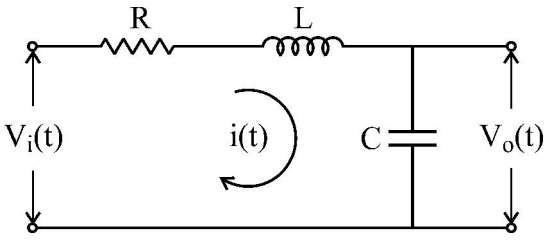

Fig. – 1

(d) Sketch zeros = –3, 3 + j2, 1 – j2 and poles = –4, –j3 –3, –1 –j on S-plane.

3. Attempt any THREE of the following : 12

(a) Define :

(i) Peak time (t_p) (ii) Rise time (t_r)

(iii) Peak overshoot (M_p) (iv) Settling time (t_s)

(b) Find Laplace transform of unit-step function and exponential function.

(c) Explain with neat sketch the working of permanent magnet stepper motor.

(d) Explain ON-OFF control action with simple example. What is neutral zone concept ?

4. Attempt any THREE of the following : 12

(a) Define the following terms :

(i) Resonant frequency

(ii) Gain margin

(iii) Cut-off frequency

(iv) Phase margin

(b) For the given transfer function,

$$\text{T.F.} = \frac{10(s + 8)}{s(s + 4)(s^2 + 6s + 25)}$$

Find :

(i) Poles

(ii) Zeros

(iii) Characteristic equation

(c) For the system to be stable, find the range of 'K' for the characteristic equation given as

$s^4 + 20s^3 + 224s^2 + 1240s + 2400 + K = 0$

(d) Draw and explain potentiometer as error detector.

(e) Find the transfer function of the circuit.

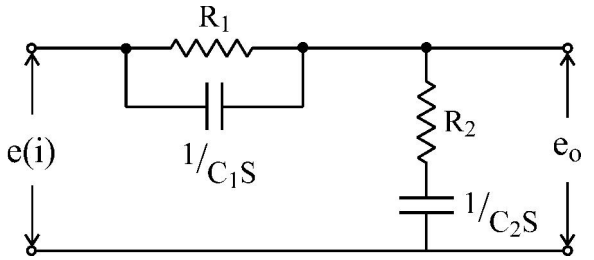

Fig. – 2

5. Attempt any TWO of the following : **12**

(a) Compare P, PI and PD controller w.r.t. following points :

(i) Deviation

(ii) Period of oscillation

(iii) Offset

(iv) Output equation

(v) Limitations

(vi) Time required for oscillations to stop

(b) Determine the transfer function of the block diagram shown below.

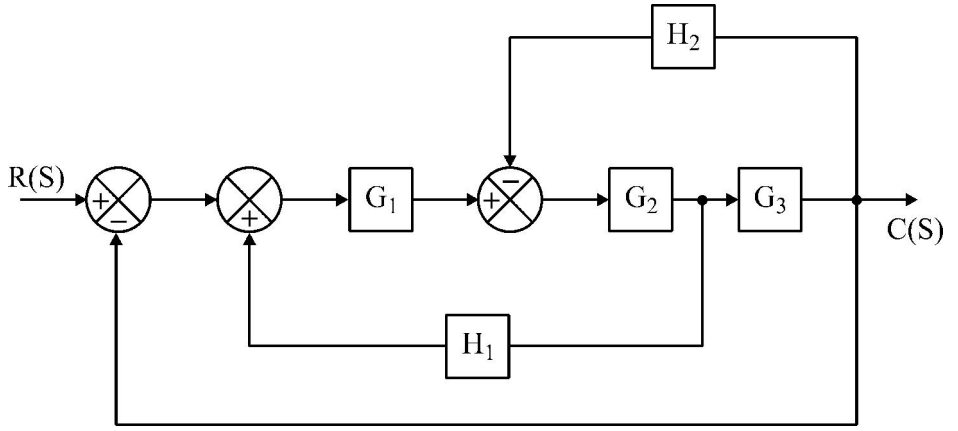

Fig. – 3

(c) A feedback system having transfer function, $G(s) = \frac{16}{s^2 + 4s + 16}$, $H(s) = Ks$

The damping factor of the system is 0.8. Determine (1) Undamped natural frequency (w_n) (2) t_s (3) Peak overshoot (4) t_p (5) w_d.

6. Attempt any TWO of the following : **12**

(a) Determine the stability of the system having characteristic equation

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

Also discuss the type of stability.

(b) Draw circuit diagram of electronic PID controller. Write its output expression. Write one advantage of P, I & D controller.

(c) Draw the diagram of A.C. servomotor. Compare stepper motor with D.C. servomotor w.r.t. following points :

(i) movement (ii) use

(iii) types (iv) noise