22429

**23124**

**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.

**Marks**

**1. Attempt any FIVE :** **10**

(a) Define control system with suitable example.

(b) Compare open loop and closed loop control systems.

(c) Define transient and steady state response of control system.

(d) List the standard Test signals. Write Laplace transform of step and ramp signal.

(e) Define Transfer function of control system.

(f) Define poles and zeros of a system.

(g) Define (i) Rise time and (ii) Delay time.

**2. Attempt any THREE :** **12**

(a) Derive the Transfer function of the following RC network :

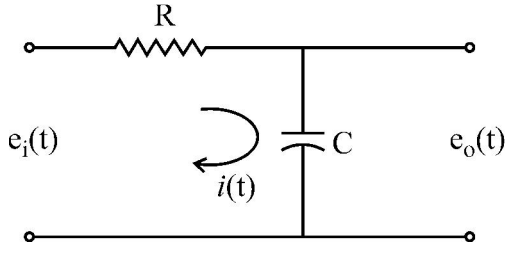



**Fig. 1**

(b) Draw the circuit diagram of PID controller and write its output equation.

(c) Draw neat sketch of unit step response of second order system.

For the condition –

(i) Under damped system

(ii) Over damped system

write the damping ratio range.

(d) Derive the Transfer function of the following block diagram ref. Fig. 2 using block reduction rules :

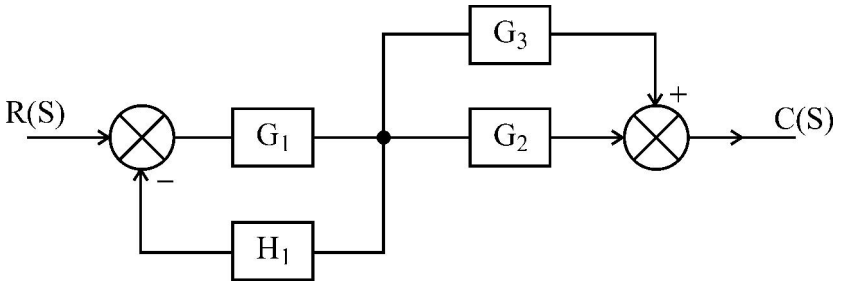



**Fig. 2**

**3. Attempt any THREE :** **12**

(a) Draw the S-plane with closed loop poles location for different stability conditions.

(b) Define Transfer Function. Derive the expression of TF of closed loop system with positive feedback.

(c) For the 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) Characteristic equation

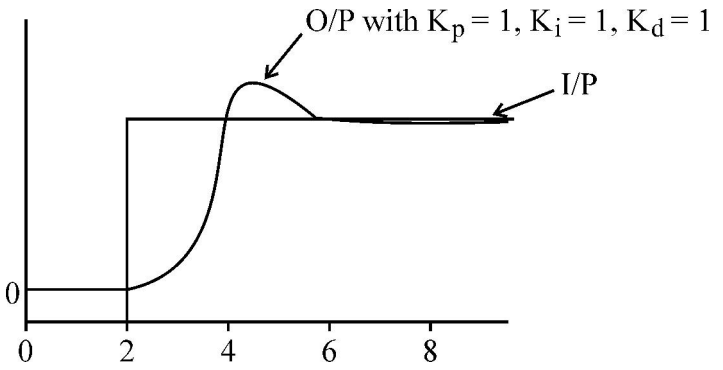
(iv) Pole-Zero plot

(d) Compare time domain analysis and frequency domain analysis in control system.

**4. Attempt any THREE :** **12**

(a) Compare P, I and D control actions on the basis of Nature of input, response to error, mathematical equations and applications.

(b) The Step response of the controller is shown :




Show the effect when $K_i$ value is increased and decreased (Assume suitable $K_i$ values).

(c) Explain in brief ON·OFF control action. Define neutral zone with reference to ON·OFF control action.

(d) Compare AC and DC servomotors (any four points).

(e) Draw block diagram of DC servo system. State the functions of each component.

**5. Attempt any TWO :** **12**

(a) Why Derivative control action is not used alone ? Draw electronic PD controller. State its equation.

(b) For the given characteristic equation

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

Determine stability using Routh's criterion.

(c) Explain AC servomotor operation with neat diagram. Compare AC servomotor with induction motor (any four points).

**6. Attempt any TWO :** **12**

(a) Draw the Bode plot for the T.F. given as

$$\frac{10\,(S + 10)}{S^2 + 3S}.$$

(b) For unity feedback system, open loop TF is

$G(S) = \frac{25}{S\,(S + 6)}$. Determine

(i) Rise time

(ii) Peak time

(iii) Settling time

(iv) Maximum overshoot

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

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