

22429

12425

3 Hours / 70 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.

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

- (a) Define transfer function of control system. Write its equation for positive feedback closed loop control system.
- (b) State the block diagram reduction rule for :
  - (i) blocks in series and
  - (ii) blocks in parallel.
- (c) Determine the type and order of a control system whose open-loop transfer function is  $G(S) H(S) = \frac{1}{S(S + 1)}$
- (d) Find the poles and zeroes of a system whose transfer function is –
 
$$T.F. = \frac{3(S + 3)}{(S + 4)(S + 7)}$$
- (e) Draw the block diagram of process control system.
- (f) Define ON-OFF controller. State one example of the same.
- (g) List two advantages of Frequency response analysis in control system.



2. Attempt any THREE of the following :

12

- (a) Obtain the transfer function for Fig.-1 using block diagram reduction rules.

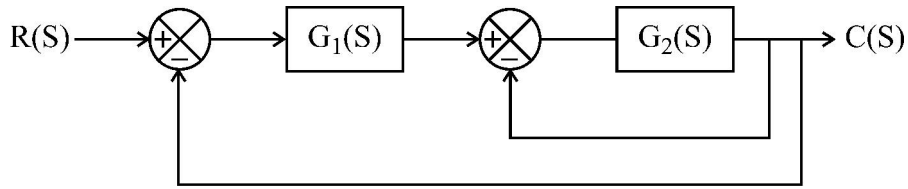


Fig. – 1

- (b) Write the effect of P controller and I controller on rise time and overshoot.  
 (c) Draw the output of P, I, D and PID controller for the input shown in Fig.-2.

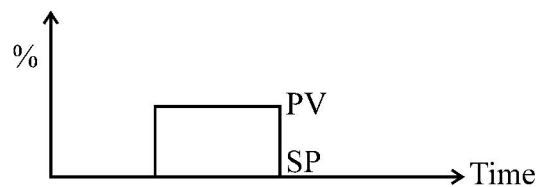


Fig. – 2

- (d) Find the transfer function of the circuit shown in Fig.-3.

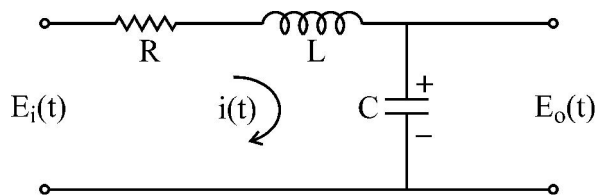


Fig. – 3

3. Attempt any THREE of the following :

12

- (a) Decide the stability of the control system whose characteristic equation is given as  $S^5 + 2S^4 + 24S^3 + 48S^2 - 25S - 50 = 0$ .  
 (b) Obtain  $C(S)$  for the control system shown in Fig.-4.

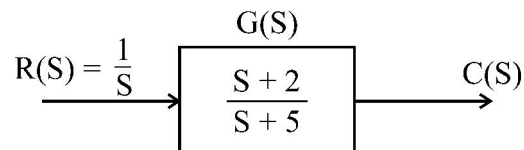


Fig. – 4

- (c) Obtain the unit step response of a first order control system.
- (d) Sketch and state the standard test signals in control system.

**4. Attempt any THREE of the following :**

**12**

- (a) (i) State the need for controller.  
(ii) List the examples of continuous and discontinuous modes of controllers.
- (b) Write the output equation of PI and PID controller in time domain and Laplace domain.
- (c) Sketch the circuit diagram of PID controller and label it.
- (d) Draw the block diagram of DC servo motor and comment on torque and power in DC servo motor.
- (e) Draw the diagram of AC servo motor and state the function of servo amplifier.

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

**12**

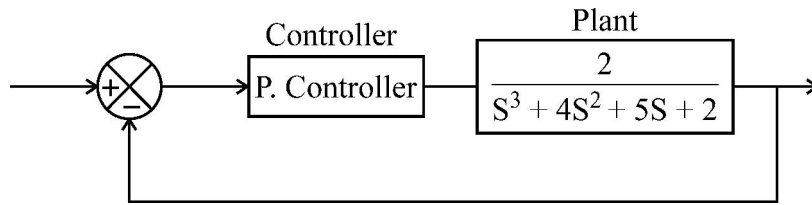
- (a) Comment on PI and PD controller effect : (i) For PI controller-rise time, steady state error and speed of response (ii) For PD Controller – Overshoot, Oscillations in output and speed of response.
- (b) A second order control system is subjected to unit step input, the value of  $C_s = 0.5$  and  $W_n = 6$  rad/sec. Determine the rise time, peak time, settling time and % overshoot or peak overshoot.
- (c) Sketch the diagram of Synchro as an error detector. Describe the working of it.

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

**12**

- (a) Calculate the steady state error for unit step input to a control system whose open loop transfer function is given as  $G(S) H(S) = \frac{(S + 3)}{(S + 1)(S + 2)}$ .

- (b) Determine the range of  $K_p$  for stability of a control system with proportional controller as shown in Fig.-5.



**Fig. – 5**

- (c) Define stability, define unstable, critically stable and conditionally stable systems.
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