

17538

21819

3 Hours / 100 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
  - (2) Illustrate your answers with neat sketches wherever necessary.
  - (3) Figures to the right indicate full marks.
  - (4) Use of Non-programmable Electronic Pocket Calculator is permissible.

**Marks**

1. (A) Attempt any **THREE** of the following : 12

- (a) Define control system. List any two practical example.
- (b) Differentiate between transient & steady state responses. (four points)
- (c) Define :
  - (i) Settling time
  - (ii) Rix time
- (d) Draw block diagram of process control system & explain each block.

(B) Attempt any **ONE** of the following : 6

- (a) List & explain any three rules for block reduction technique.
- (b) Draw bode plot for the system with open loop transfer function :

$$G(S) H(S) = \frac{1}{S(S + 1)(S + 5)}$$

## 2. Attempt any TWO of the following :

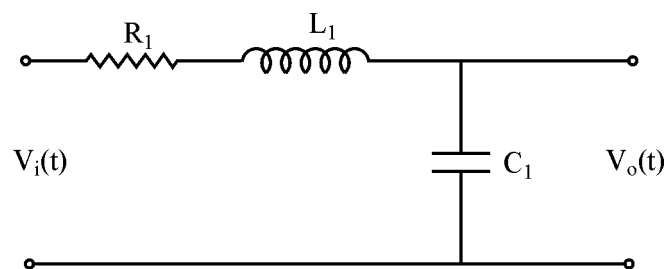
16

- (a) For unity feedback system  $S^4 + 3S^3 + 3S^2 + 2S + K = 0$ , determine  $K_{\max}$  for system to be stable.
- (b) (i) Describe the working of Permanent magnet stepper motor with neat diagram.
- (ii) Draw characteristics of AC servo motor. In what way is it different from normal 2 phase induction motor ?
- (c) Compare PI, PD & PID controller. (four points)

## 3. Attempt any FOUR of the following :

16

- (a) Obtain the transfer function of electrical circuit :



- (b) Draw transient response of second order system for a unit step input.
- (c) Determine the stability by using Routh's Criterion  $S^5 + 6S^4 + 3S^3 + 2S^2 + S + 1$ .
- (d) Draw variable reactance type of stepper motor & explain its working.
- (e) State the concept of neutral tone & proportional band.

## 4. (A) Attempt any THREE of the following :

12

- (a) Draw the circuit diagram of PI controller using op-amp & explain how offset is removed using integral cution.
- (b) List & define any four frequency response specifications.

- (c) For Unity feedback system having open loop, find

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

- (i) Type of system.  
 (ii) All error co-efficients
- (d) Defining potentiometer, draw circuit diagram of potentiometer as an error detector.

**(B) Attempt any ONE of the following :**

**6**

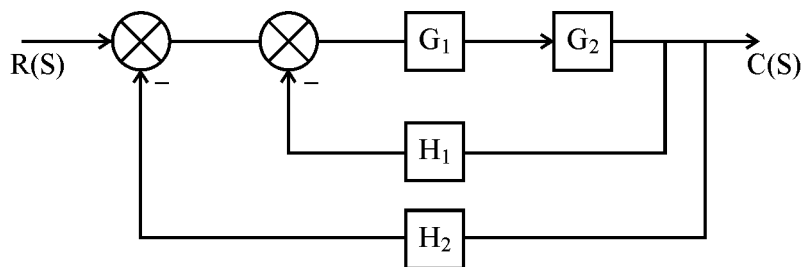
- (a) Which servo component can be used as error detector in ac servo system. Draw & explain it.  
 (b) Find all time domain specifications for unity feedback system having

$$G(S) = \frac{25}{S(S+6)} \text{ with unit step input.}$$

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

**16**

- (a) Draw & explain the working of Synchro as error detector.  
 (b) Draw electronic PI controller. State the components used and write equation.  
 (c) What is Relative stability ? Draw the neat sketch to represent it on S plane.  
 (d) Find transfer function of given block diagram :



**P.T.O.**

- (e) For a system having T.F.  $\frac{64}{S^2 + 5S + 64}$  for unit step input determine :
- (i) Natural frequency of oscillation  $W_n$
  - (ii) Damping Ratio  $\zeta$
  - (iii) Damping frequency  $W_d$
  - (iv) Time for peak overshoot  $T_p$ .
- (f) State the condition of stable, unstable, marginal stable based on gain margin & phase margin.

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

**16**

- (a) Whether Traffic signal is open or closed loop system. Justify it with the help of control action.
  - (b) Define :
    - (i) Steady state error  $e_{(t)}$
    - (ii) Steady state error co-efficient  $e_{ss}$
  - (c) Derive the unit step response of first order system.
  - (d) Explain why derivate action cannot be used atom.
  - (e) Consider 5<sup>th</sup> order system with characteristic equation given by  $S^5 + 2S^4 + 4S^3 + 6S^2 + 2S + 5 = 0$ .  
Determine the stability.
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