

17538

16172

3 Hours / 100 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.
  - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
  - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

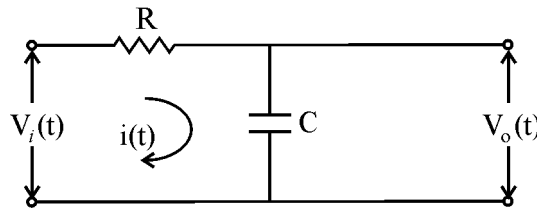
**Marks**

1. (A) Attempt any THREE : **4 × 3 = 12**
- (a) Sketch the diagrams of the four standard test signals.
  - (b) Define the following terms related with frequency response :
    - (i) Resonant Frequency
    - (ii) Cut-off frequency
    - (iii) Gain margin
    - (iv) Phase margin
  - (c) Define stable, unstable, critically stable & conditionally stable system.
  - (d) Differentiate between P and I control actions (Any four points).

(B) Attempt any ONE :

1 × 6 = 6

(a) Find the transfer function of the given R-C circuit :



(b) For the given function  $F(S)$ , find the poles & Zeros present and mark them on the S-plane :

$$F(S) = \frac{(S + 2)(S + 3)}{(S + 4)(S + 1 + j)(S + 1 - j)}$$

2. Attempt any TWO :

8 × 2 = 16

(a) The characteristics equation of two systems are given. Construct the Routh's Hurwitz table & comment on the stability of the systems :

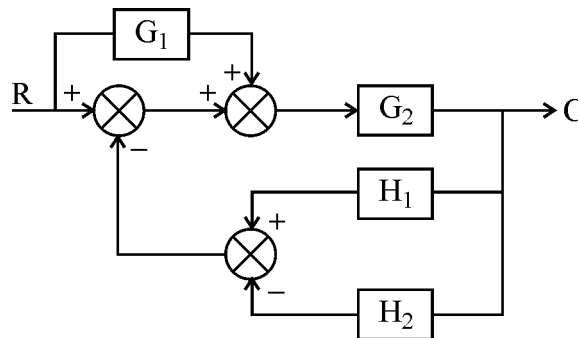
(i)  $S^3 + 4S^2 + 8S + 12 = 0$

(ii)  $S^4 + S^3 - S - 1 = 0$

(b) (i) Describe the working of variable reluctance stepper motor with neat diagram.

(ii) Draw the characteristics of AC servomotor. In what way it is different from normal two phase induction motor.

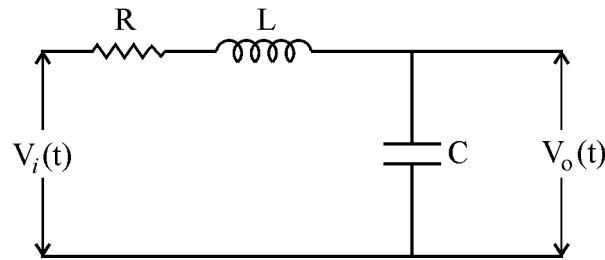
(c) Derive the transfer function of the system shown in the following fig. using block diagram reduction method.



## 3. Attempt any FOUR :

4 × 4 = 16

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



- (b) Compare stepper motor and DC servomotor (Any four points).  
 (c) Derive the unit step response of first order system. Draw its response.  
 (d) State the concept of neutral zone & proportional band.  
 (e) Draw the diagram of potentiometer as error detector and describe its working.

## 4. (A) Attempt any THREE :

4 × 3 = 12

- (a) Draw the block diagram of process control system & explain each block.

- (b) For the given transfer function

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

Find (i) Poles, (ii) Zeros, (iii) Characteristics equation & (iv) Order of the system.

- (c) State two advantages & disadvantages of frequency domain analysis. (response).  
 (d) Draw the diagram of synchro. as error detector & describe its working.

## (B) Attempt any ONE :

1 × 6 = 6

- (a) For the given differential equation

$$\frac{d^2y}{dt^2} + 2 \frac{dy}{dt} + 4y(t) = 4x(t)$$

Where  $y = o/p$  &  $x = i/p$

Find (i) Settling time, (ii) Rise time, (iii) peak time, (iv) peak overshoot.

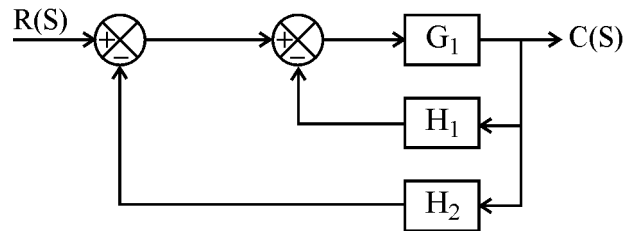
- (b) Draw the block diagram of AC and DC servosystem & describe its working principle.

P.T.O.

## 5. Attempt any FOUR :

4 × 4 = 16

- (a) Determine the overall transfer function of the given block diagram :



- (b) Draw electronic PI controller. State the components used & write equation.
- (c) Describe the concept of stability with respect to absolute, relative and marginal stability.
- (d) Draw characteristics of DC servomotor. In what way it is different from normal DC motor ?
- (e) Draw the labelled time response of second of second order under damped control system.
- (f) A second order system is given by

$$\frac{C(S)}{R(S)} = \frac{25}{S^2 + 6S + 25} \text{ find.}$$

- (i)  $r_e$  (ii)  $w_n$  (iii)  $t_p$  (iv)  $t_s$

## 6. Attempt any FOUR :

4 × 4 = 16

- (a) Whether toaster is open loop or closed loop system, justify it with the help of control action.
- (b) Draw the diagram for stability of the system w.r.t. root location in S plane.
- (c) Consider 4<sup>th</sup> order system with characteristic equation given by

$$S^4 + 2S^3 + 8S^2 + 4S + 3 = 0$$

Determine the stability using Routh's criterion.

- (d) Explain ON-OFF controller. Give example.
- (e) A unity feedback system has

$$G(s) = \frac{40(S + 2)}{S(S + 1)(S + 4)}$$

Determine : (i) The type of system

- (ii) All error co-efficients