



# 17538

15162

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) Use of Steam tables, logarithmic, Mollier's chart is **permitted**.

Marks

1. A) Attempt **any three**:

12

- a) Define transfer function. Give three advantages of T. F.
- b) Define following term w.r.to time domain response
  - i) Transient response
  - ii) Steady state response
  - iii) Steady state error
  - iv) Time constant.
- c) Define stability. State and explain Routh stability criterion.
- d) Define and give significance of following term w.r.to controller
  - i) Neutral zone
  - ii) Offset

B) Attempt **any one** :

6

- a) Find unit step response of first order R.C. circuit.

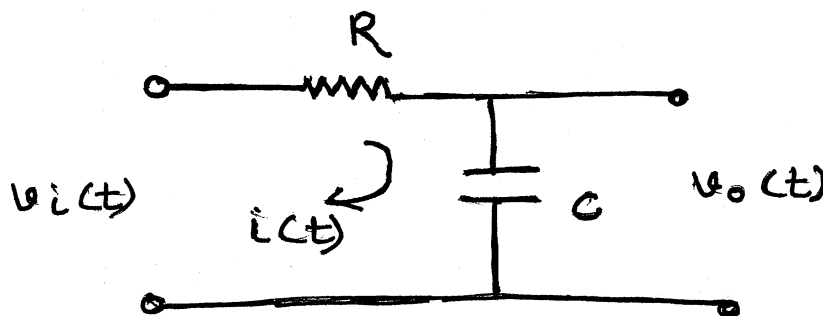


Figure 1

- b) Draw Bode plot for system with open loop transfer function

$$G(s)H(s) = 10/s.$$

P.T.O.



## 2. Attempt any two :

- a) For unity feedback system

$$G(s) = \frac{K}{s(1 + 0.4s)(1 + 0.25s)}$$

Find range of value of K, marginal value of K and frequency of sustained oscillations.

- b) Describe working of synchro as an error detector with neat diagram. State its two application.  
c) Reduce the Block diagram using reduction rule. Obtain  $C(s)/R(s)$ .

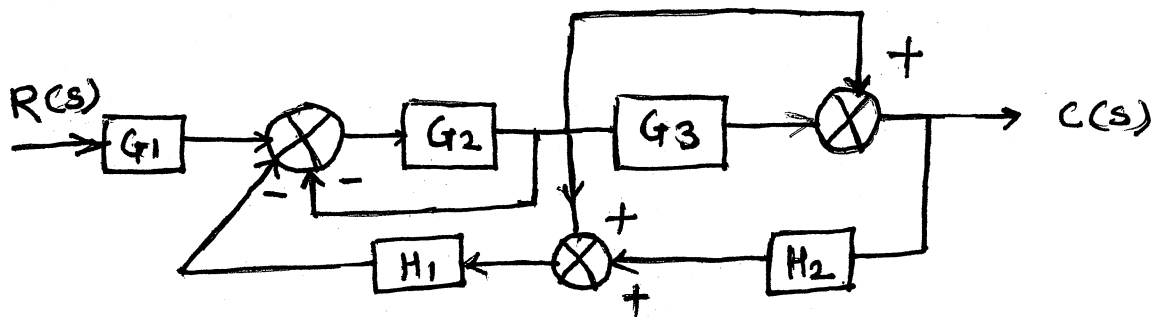


Figure 2

## 3. Attempt any four :

- a) Obtain transfer function of given R.L.C. network.

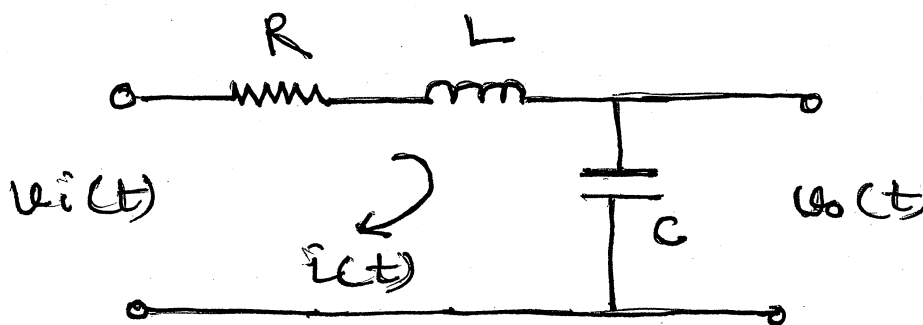


Figure 3

- b) Define and give significance of standard test input signal with their Laplace representation.  
c) Determine stability using Routh criterion for given characteristic equation.  
 $s^4 + 6s^3 + 26s^2 + 56s + 80 = 0$ .  
d) Describe how potentiometer is used as error detector with neat diagram.  
e) What is ON-OFF controller ? Explain its one application in detail.

**4. A) Attempt any three:****12**

- a) Draw electronic op-amp based PID controller circuit diagram.
- b) State two advantages and two disadvantages of frequency response analysis.
- c) For given TF determine
  - i) Poles
  - ii) Zeros
  - iii) Characteristic equation
  - iv) Order of sys.

$$T(s) = \frac{2(s+1)^2 (s+2)(s^2 + 2s + 2)}{s^3(s+4)(s^2 + 6s + 25)}.$$

- d) Define servo system. Explain in brief AC servo system with neat diagram.

**B) Attempt any one :****6**

- 1) Give three comparison point between stepper motor and DC servo system.

2) A second order system is given by  $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$ .

Find  $T_r$ ,  $T_p$ ,  $\gamma \cdot M_p$  and  $T_s$  if subjected to unit step input.

**5. Attempt any four :****16**

- a) Explain DC servo system with neat diagram.
- b) Draw electronic PI controller. State its advantages, characteristics and write its equation.
- c) Define following term w.r. to stability :
  - i) Relative stable system
  - ii) Conditionally stable system.
- d) Explain effect of damping on performance of second order system.
- e) Derive derivation of steady state error state on which factor  $e_{ss}$  depends.
- f) State condition of stable, unstable, marginal stable based on gain margin and phase margin.

**6. Attempt any four :****16**

- a) Draw labelled time response of second order under damped control system.
  - b) Define following term w.r.t. second order system
    - i) Settling time
    - ii) Rise time
    - iii) Peak overshoot
    - iv) Delay time.
  - c) A unity f/b system has  $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$ . Determine
    - i) Type of system
    - ii) All error coefficient i.e.  $K_p$ ,  $K_v$  and  $K_a$ .
  - d) For given ch<sup>r</sup> eq<sup>n</sup>  $s^4 + 22s^3 + 10s^2 + s + k = 0$ . Find  $K_{\max}$ .
  - e) Examine stability by Routh criterion for Ch<sup>r</sup> eq<sup>n</sup>  $s^4 + 10s^3 + 35s^2 + 50s + 24 = 0$ .
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