



RN-6809

B. E. - III (Sem. V) (Ele.) Examination

May / June - 2010

Control System - I

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दर्शायेव निशानियाणी विगतो उत्तरवडी पर अवश्य लपवी.  
 Fillup strictly the details of signs on your answer book.

Name of the Examination :  
 B. E. - 3 (Sem. 5) (Ele.)

Name of the Subject :  
 Control System - 1

Subject Code No. : 6 8 0 9 Section No. (1, 2,.....): 1&2

Seat No. :

Student's Signature

- (2) Attempt all questions.
- (3) Answer to both section must be written in separate answer book.
- (4) Assume suitable data if required.
- (5) Support your answers with neat sketches.
- (6) Figures to the right indicate full marks.

SECTION - I

- 1 (a) Attempt all questions :
  - (1) Differentiate open loop system and closed loop system. 2
  - (2) Equivalent of the block diagram shown in fig.1 is \_\_\_\_\_. 1

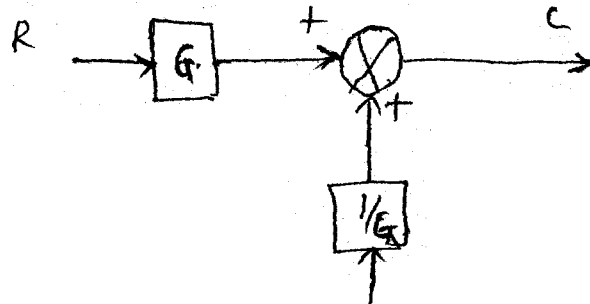


Fig. 1

- (3) Define the impulse function. 1
- (4) For a second order system with  $\rho=1$  the roots of second order control system lies on negative real axis. (True/False) 1
- (5) Define ramp function. 1
- (6) Match list-I and list-II. 4

**List-I**

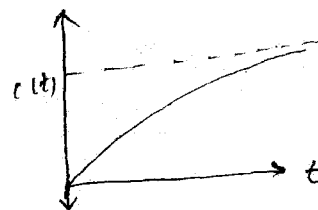
(Name of response)

**List-II**

(Wave form of the response)

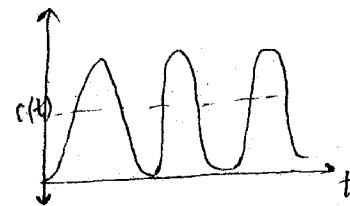
(a) Over damped response

(a)



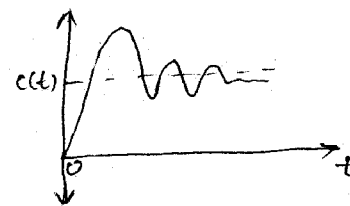
(b) Under damped response

(b)



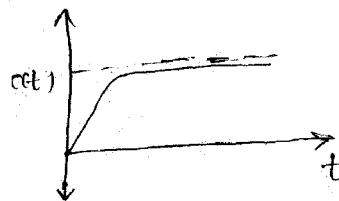
(c) Sustained oscillation

(c)

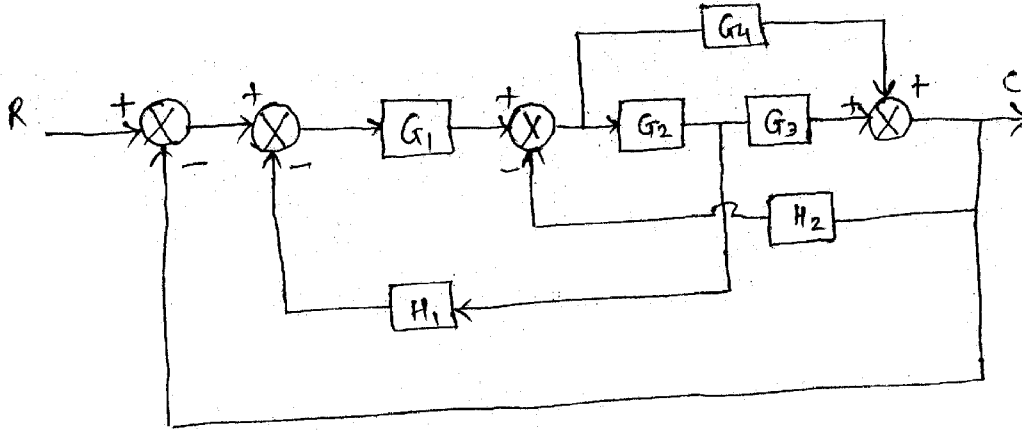


(d) Critical damped response

(d)



- (b) Using block diagram reduction techniques, find the closed loop transfer function for the system whose block diagram is given in **fig.2**. 10



**Fig. 2**

- 2 (a) Define and derive the generalized dynamic error coefficients and hence write the expression for the generalized error series. 8
- (b) A unity feedback system has open loop transfer 7

$$\text{function } G(s) = \frac{25}{s(s+5)}.$$

Find :

- (i) Natural undamped frequency ( $w_n$ ).
- (ii) Damping ratio ( $\rho$ ).
- (iii) Damped frequency of the system ( $w_d$ ).
- (iv) Peak overshoot.
- (v) Steady state error.

OR

2 (a) Explain the transient response specifications for the second order control system subjected to unit step input. 7

(b) For a unity feedback system  $G(s) = \frac{10}{s(s+5)(s+10)}$ . 6

Determine the steady state error when excited with :

(1) Unit step function

(2) Unit ramp function.

(c) Compare the settling time of two systems whose 2

overall transfer function  $C(s)/R(s)$  is given :

(1)  $\frac{4}{s^2 + 2s + 4}$

(2)  $\frac{10}{s^2 + 10s + 20}$

3 Attempt any **three** : 15

(1) Explain the Mason's gain formula with one example

(2) Synchros

(3) Explain the method of zeroing a synchro transmitter

(4) Magnetic amplifier

(5) Reluctance stepper motor.

## SECTION - II

4 (a) Fill in the blanks : 5

(1) In bode plot the frequency at which two asymptotes meet is called \_\_\_\_\_ frequency. (corner, crossover)

- (2) For a second order system Mr(asonant peak) is a function of \_\_\_\_\_ only. (( $\delta, w_n$ )
- (3) Nyquist plot is a locus of \_\_\_\_\_ transfer function plotted on complex plane. (open loop, closed loop)
- (4) In a linear system output increases infinitely for \_\_\_\_\_ system. (stable, unstable)
- (5) M and N circles ae drawn on log-megnitude versus \_\_\_\_\_ graph.
- (b) State whether following sentences are true or false : **5**
- (1) One of the advantage of bode plot is that the relative stability of closed loop control system can be determined quickly and compensation can be carried out easily.
- (2) Bode phase plot is independent of gain K.
- (3) In nyquist plot, phase crossover frequency occurs when phase is  $-180^\circ$ .
- (4) Damped freqnecy is same as natural frequency for second order control system.
- (5) The  $G(j\omega)$  locus drawn on the Nichol's chart gives both the gain characteristics and phase characteristics of closed loop transfer function at the same time.
- (c) Define the term stability of a control system. **2**
- (d) A sartain the stability of the system whose characteristic equation is : **6**
- $$s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0$$
- Also find roots of the equation.
- (e) List some advantages of Routh's criterion. **2**

- 5 (a) Using Nyquist criterion, examine closed loop stability of a system whose open loop transfer function is given by : 8

$$G(s)H(s) = \frac{50}{(s+1)(s+2)}$$

- (b) The specification given on a certain second order feedback control system is that the overshoot of step response should not exceed 25%. 7
- (i) What are the corresponding value of damping ratio ( $\delta$ ) and peak resonance ( $M_r$ ).
- (ii) Determine resonance frequency ( $\omega_r$ ) and time to reach peak overshoot when  $\omega_n = 10 \text{ rad/sec}$ .

**OR**

- 5 (a) Plot the open loop response on Nichol's chart for a unity feedback system whose open loop transfer function is 8

$$G(s) = \frac{1}{s(s+1)(0.1s+1)}$$

Determine phase margin, gain margin, resonant peak and resonant frequency.

- (b) Derive expression for constant M circle and constant N circles.
- 6 (a) The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{20(0.5s+1)}{s(1+0.2s)(1+0.1s)(1+0.25s)}$$

Find gain margin, phase margin and corresponding crossover frequencies.

(b) Write procedure for constructing bode plot. 6

**OR**

**6** The open loop transfer function of a unity feedback control system is given by :

$$G(s) = \frac{K(2s+1)}{s(s+1)(0.5s+1)(0.2s+1)}$$

Draw bode plot and determine :

(i)  $w_{cg}$ ,  $w_{cp}$ , GM and PM for  $K=10$ . 9

(ii) For  $K=0.5$  find GM. 3

(iii) Find  $K$  for  $PM=20^\circ$ . 3

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