* R N - 8 2 0 1 / 4 0 0 *

RN-8201

B. E. - II (Sem. - IV) (Elect./EC/IC) Examination

May / June – 2010

Control Theory

(New Course)

Time : **3** Hours] [Total Marks :

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - 2 (SEM. - 4) (ELECT./EC/IC)

Name of the Subject :

☛ CONTROL THEORY (NEW)

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

Seat No. :

Student's Signature

(2) Answer all the questions.

(3) Use semilog / graph papers wherever necessary.

(4) Assume suitable data wherever necessary.

(5) Figures to the right indicate full marks.

SECTION – I

1 (a) Attempt the following :

(i) The time needed for the response to reach 50% of the final value is termed as peak time. (True/false) **1**

(ii) The response of the second order control system subjected to unit step input at $\rho = 1$ is _____. **1**

(iii) Define open loop control system and closed loop control system. **2**

(iv) With reference to state space representation of the equation $\frac{d^2 y(t)}{dt^2} + 2\frac{dy(t)}{dt} + 3y(t) = u(t)$ the matrices A and B are. **2**

(v) Draw the signal flow graph for the block diagram of system shown in **fig. 1**. **1**

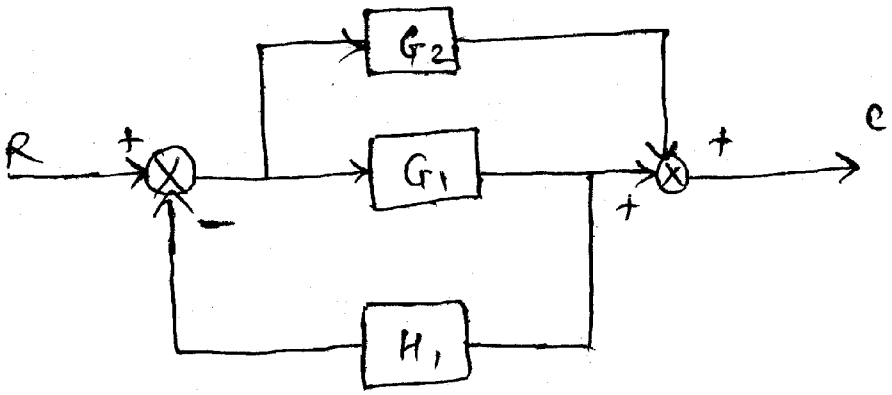

Fig. 1

(vi) Define signal flow graph. **1**

(vii) Define transfer function. **2**

(b) Determine the overall transfer function c(S)/R(s) for the system represented by the block diagram shown in **fig. 2**. **10**

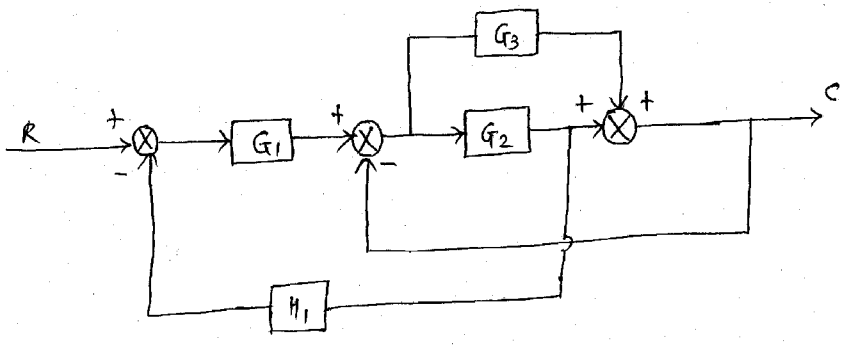

Fig. 2

2 (a) Obtain the transfer function $X_0(S) / X_1(S)$ for the mechanical system shown in **fig. 3**. **10**

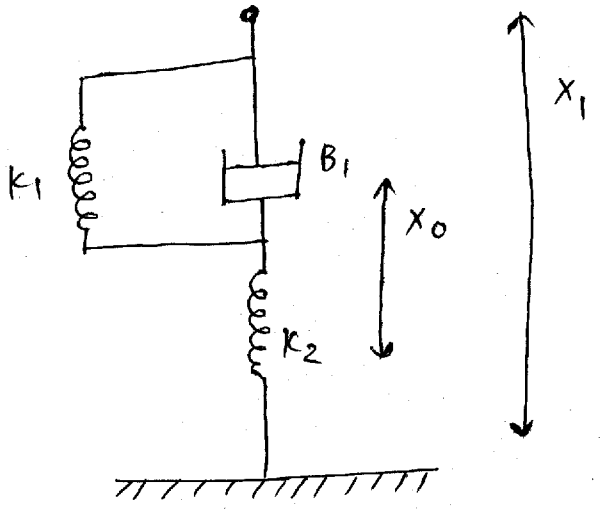

Fig. 3

(b) Explain the Mason's gain formula to obtain the transfer function of the system from SFG. **5**

OR

2 (a) Obtain the state equation for the differential equation given by **8**

$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 4y = \frac{du}{dt} + 3u$$

(b) Derive the expression for the unit step response of second order system with constant oscillators. **7**

3 Attempt any **three** out of the following : **15**

(i) Explain the rise time, peak time, peak overshoot, and settling time to the second order under damped system subjected to unit step input signal.

(ii) For the given transfer function $\frac{C(S)}{R(S)} = \frac{K}{S^2 + KK, S + K}$

detrmine the value of K and K_1, so that the maximum overshoot in unit step response is 25 per cent and peak time is 2 second.

(iii) Determine the overall tranfer function C/R for the signal flow graph shown in **fig. 4.**

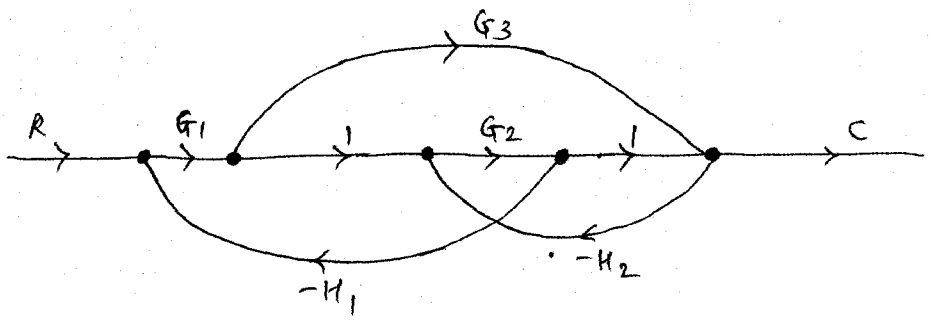

Fig. 4

(iv) Determine the overall transfer function for the block diagram shown in **fig. 5.**

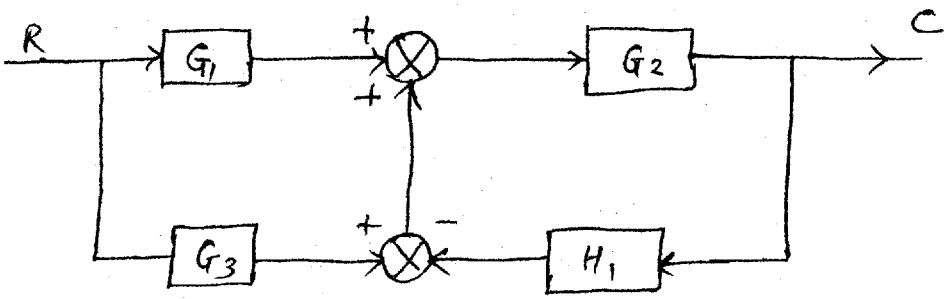

Fig. 5

(v) For the second order control system $\rho = 0.6, w_n = 5\ rad/\text{sec}$ obtain the values t_r, t_p, M_p, t_s subjected to unit step input signal.

SECTION - II

4 (a) Fill in the blanks : **5**

(i) The frequency at which Nyquist diagram crosses the negative real axis is known as _____.

(ii) Routh Hurwitz criteria is a _____ domain approach.

(iii) Root locus ends at zero. At every zero value of K is _____.

(iv) The slope of the magnitude curve of the Bode Plot of G (jw) at the gain crossover usually given an indication of _____ stability. (relative/absolute)

(v) In a linear system if output approaches infinity, the system is _____.

(b) True/False questions : **5**

(i) Relative stability can be obtained from R H Criteria.

(ii) If any odd or even power of 's' is present in system characteristic equation polynomial, then system has sustained oscillation.

(iii) M and N circles are applicable to non unity feedback system.

(iv) When one or more non repeated roots of the system are on imaginary axis then system is marginally stable.

(v) If there are three zeros and two poles of GH(S), then there will be three root loci.

(c) Discuss the stability of the system whose charaacteristic equation **4**

$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

(d) Determine the range of K for the system to be stable 4

$S^4 + 5S^3 + 5S^2 + 4S + K = 0$

(e) Write down the limitation of Hurwitz's Criterion. 2

5 (a) Discuss in brief procedure of obtaining Nichol's Chart from N-circles and M circles. 6

(b) A unity feedback system has a frequency transfer 9

function $G(S) = \dfrac{10}{S(1+0.1S)(1+0.5S)}$

Plot the necessary data of this system on Nichol's chart and hence obtain the following :

(i) phase margin and gain margin

(ii) Gain and phase cross over frequencies

(iii) Bandwidth

OR

5 (a) State the frequency domain specification and explain their correlation with the time-domain specifications. 6

(b) Draw the bode diagram of the open loop transfer 9

given as $G(S) = \dfrac{64K(S+2)}{S(S+0.2)\left(S^2+3.2S+64\right)}$

(i) Determine gain margin, phase margin and the corresponding cross over frequencies with K = 1.

(ii) Determine gain margin and phase margin for K=10.

6 (a) For a unity feedback control having open loop transfer function 7

$$G(S) = \frac{10(S+0.5)}{S(S-1)(S+2)}$$

Draw the Nyquist plot and hence comment on the stability of the system.

(b) The open loop transfer function of a unity feedback control systems is given by : 6

$$G(S) = \frac{(S+2)}{(S+1)(S-1)}$$

Using Nyquist criterion check the system stability.

(c) Define gain margin and phase margin with respect to Nyquist plot. 2

OR

6 (a) Describe the all steps for constructing Root Locus. 7

(b) Draw the shape of root locus for the open loop transfer function. 8

$$G(S)H(S) = \frac{K}{S(S+4)\left(S^2+4S+8\right)}$$