P4/RT-Ex-07-56 ab

B.E. (elect.) VII (Rev)
Control sys. II

29/5/07

Con. 2995-07. [REVISED COURSE] ND-914

(3 Hours) [Total Marks : 100

MASTER

N.B 1) **Q.No.1 is compulsory.**
2) Answer any four out of remaining six questions.
3) Assume any suitable data wherever required but justify the same.
4) Figures to the right indicate marks.

Q.1 Attempt any four: (20)
i) Define controllability and observability. Explain briefly.
ii) Explain the need of full order and reduced order estimator in feedback control
iii) State the conditions for justifying second order approximation of a closed loop system.
iv) Define the stability of a discrete time system.
v) Given a system in state variable form with matrices A, B, C, D, input U and state X, give the state space representation of the system. Also give the expressions for the transfer function, poles and zeros of the transfer function.

Q.2 A)Transfer function of a unity feedback system is given by $G(s)=k/(s(s+2)(s+4))$. Determine the value of k to have 40% overshoot for unit step input using root locus method. (08)
B)Consider a unity feedback control system whose feed forward transfer function is given as $G(s)= 10/(s(s+2)(s+8))$. Design a compensator such that the dominant closed loop poles are located at $-2+j2$ .and K_v=80sec. Use root locus method. (12)

Q.3 Design a lead compensator to yield 20% overshoot and error constant 40 with peak time of 0.1 sec for the system $G(s) =(100\ k)/(s(s+36)(s+100))$. Use frequency response method. (20)

Q.4 A) The transfer function of a system is given by (10)

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

Find state matrices in modal form describing this system.

B) A regulator system has the plant given as follows: (10)

$$x' = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 0 \quad 0]\, x$$

Design a full order observer, where the error poles are required to be located at $-2 \pm j3.464$ and -5

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Q.5 A linear time invariant system is characterized by the homogenous state equation (20)

$$\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(i)Compute the solution of the homogenous equation assuming the initial state vector

$$x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

(ii)Consider now that the system has a forcing function and is represented by the following non homogenous state equation:

$$\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

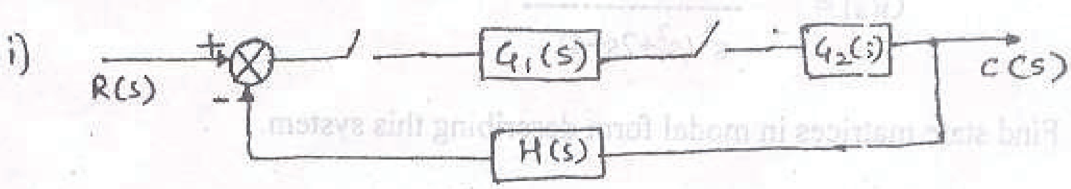
where U is the unit step input. Compute the solution of this equation assuming initial conditions of part (i).

Q.6 A) Design the phase variable feedback gains to yield 9.5% overshoot and a settling time of 0.74 sec for a plant: (10)

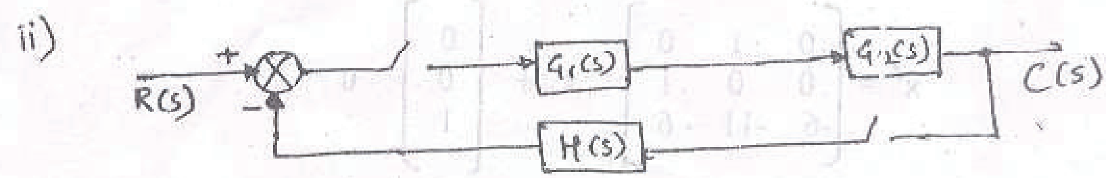
$$G(s) = \frac{20(s+5)}{s(s+1)(s+4)}$$

B) Find T(z)=C(z)/R(z) for each of the systems. (10)

i)



ii)



Q.7 A)What are the methods of discretization of an analog system. Compare the results obtained for the different methods. (10)

B)Write short notes on any two : (10)

i) Word size effects

ii)Anti alias prefilter

iii)Steady state error in digital control system.