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Roll No.

National Institute of Technology Hamirpur(H.P.)
EC-411 Control Systems

Note: Attempt all questions

Time: 3 Hours Maximum Marks: 50

Q.1 (a) Derive the expression for closed loop transfer function.
(b) What will be the nature of response of a second order system with different types of damping?
(c) What are the time domain specifications?
(d) Write the procedure to sketch the polar plot. (2.5x4=10)

Q.2 (a) What are the properties of State Transition Matrix (STM)?
(b) A SISO system having following coefficient matrices:

$$A=\begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix}, B=\begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \text{ and } \quad C^T=\begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}$$ (2.5x2=5)

Test the system for controllability and observability.

Q.3 Determine the stability of a system having characteristic equation as

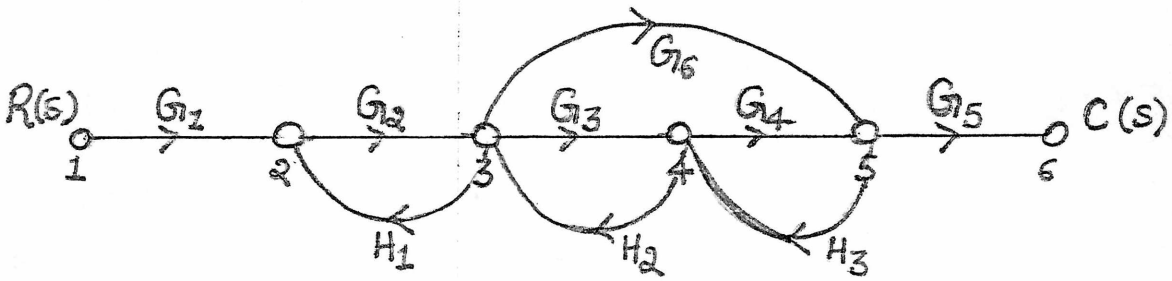
$$s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0.$$

Also find the frequency of sustained self-oscillations. (5)

Q.4 Sketch the root loci for the system whose open loop transfer function is $G(s)H(s)=\frac{K}{s(s+2)(s+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5. (5)

Q.5 (a) What are the advantages of state space analysis?
(b) Determine the canonical state space model of the system, whose transfer function is $T(s)=\frac{2(s+5)}{(s+2)(s+3)(s+4)}$. (2.5x2=5)

Q.6 The signal flow graph for a feedback control system is shown below. Determine the closed loop transfer function C(s)/R(s). (5)



Q.7 A unity feedback system has open loop transfer function $G(s)=\frac{50}{(s+1)(s+2)}$. Sketch Nyquist plot for the system and comment upon the closed loop stability of the system. (5)

Q.8 Write short note on **any two** of the following:
(i) Synchro transmitter-receiver pair (ii) A.C. Servomotor (iii) Stepper motor (iv) Potentiometer (v) PID controller (5+5=10)