Q.1 Attempt any four questions:-

a) Define open loop system and explain with one example. (5)

b) Find the Transfer functions of Electrical networks shown in figure. (5)

\[ G(s)H(s) = \frac{K}{S(S+4)(S^2+4S+10)} \]

\[ \text{root locus for } G(s)H(s) = \frac{K}{S(S+4)(S^2+4S+10)} \]

Q.2 a) Obtain \( C(s)/R(s) \) using block diagram reduction rules. (10)

b) Sketch the root locus for \( G(s)H(s) = \frac{K}{S(S+4)(S^2+4S+10)} \). (10)
Q.3 a) Draw Bode plot and find gain margin and phase margin for

\[ G(s)H(s) = \frac{64(s + 2)}{S(S + 0.5)(s^2 + 3.2s + 64)} \]  

(10)

b) For a system shown in fig. with unity feedback, find time domain specifications when a step input is applied

\[ \frac{20}{s^2 + 5s + 4} \]  

(10)

Q4 a) Find Transfer function of

\[ \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} r(t) ; \ y = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \]  

(10)

b) Obtain the state model for the system with transfer function

\[ \frac{Y(s)}{U(s)} = \frac{3s + 4}{s^2 + 5s + 6} \]  

(10)

Q5 a) The open loop transfer function of a unity feedback system is given by \( G(s) = \frac{1}{S(S+1)(2S+1)} \). Sketch the polar plot and determine the gain margin and phase margin.

b) \( G(s) = \frac{1}{s^2 + 4s + 8} ; H(s) = 1 \)  

(10)

Q6

Attempt any two from the following

a) Write a short note on Robust control system

(10)

b) Explain the correlations between time and frequency domain specifications of the system

(10)

c) Derive an expression for output response of a second order under damped control system. Assume the input to be unit step signal.

(10)