6TH SEM/ ETC & TELECOMM./ETC & COMMUNICATION/2022(S)

TH2 Control Systems & Component

Full Marks: 80 Time- 3 Hrs

Answer any **Five** Questions including Q No.1& 2
Figures in the right-hand margin indicates marks

1. Answer **All** questions 2 x 10

a. Write the effects of negative feedback on gain, bandwidth, stability and sensitivity of a control system.

b. Define transfer function of a SISO system. Write any two properties of transfer function.

c. Determine the type and order of unity feedback system with loop transfer function

$$G(s) = \frac{25(s+3)}{s^3(s+1)(s^2+s+2)}.$$

d. Determine time constant and 2% settling time of the system whose time response is given by $c(t) = 10(1 - e^{-0.5t})u(t)$.

e. What are the conditions for an LTI system to be BIBO (bounded input bounded output) stable?

f. For the system with loop transfer function $G(s)H(s) = \frac{10}{s(s+2)}$ **f**ind

I. Centroid
II. Number of asymptotes.

g. Define Nyquist stability criterion.

h. Plot the poles and zeros of $G(s) = \frac{(s+1)}{s(s^2+4)}$ on s plane.

i. Write the effects of adding poles and zeros to the loop transfer function on root loci.

j. Find the impulse response of a system with transfer function $G(s) = \frac{2}{s+3}$.

2. Answer **Any Six** Questions 6 x 5

a. Define the standard test signals used in control system. Write their Laplace Transforms.

b. Determine the stability of a system using Routh Hurwitz (RH) criteria whose characteristics equation is given by

$$2s^4 + s^3 + 3s^2 + 5s + 10 = 0$$

c. The open loop transfer function of a unity feedback system is given by

$$G(s)\frac{120}{s^2(s+4)(s^2+3s+12)}$$

Determine the following

I. Static error coefficients
II. Steady state error of the system for an input $r(t) = 2 + 5t + 2t^2, t \geq 0$

d. Realize a PI controller using OPAMP and write its features.

e. Differentiate between open loop and closed loop control system.

f. Calculate the phase margin (PM) of a system having loop transfer function $G(s)H(s) = \frac{2\sqrt{3}}{s(s+1)}$

g A network is described by the state model as

$$\dot{x}_1 = 2x_1 - x_2 + 3u$$
$$\dot{x}_2 = -4x_2 - u$$
$$y = 3x_1 - 2x_2$$

Find the transfer function $H(s) = \frac{Y(s)}{U(s)}$

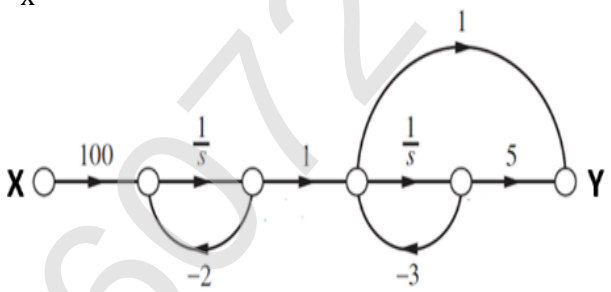
3 For a unity feedback system, the loop transfer function is given by 10

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

I. Plot the root locus for $0 < K < \infty$

II. Comment on closed loop stability of the system

4 Determine $\frac{Y}{X}$ using Mason's gain formula for the Signal Flow Graph given below 10



5 The loop transfer function of a system is given by $G(s) = \frac{K}{s(1+s)(1+2s)}$ 10

I. Draw the Nyquist plot for $-\infty < \omega < \infty$

II. Comment on closed loop stability of the system

6 Derive the expressions for rise time and peak overshoot for unit step response of the under damped second order prototype system. 10

7 Find the transfer function, $\frac{E_0(s)}{E_i(s)}$ of the network shown below. 10