SE(Biomed)/Sem-IV/Choice Based

**Paper / Subject Code: 40105 / Signals and Control Systems**

29/5/19

( 3 Hours ) (Total Marks : 80)

**N.B.:** **Please check whether you have got the right question paper.**
1) **Question No.1 is compulsory.**
2) Attempt **any three** from remaining **five** questions.
3) Assume any **data** if **needed, justify.**
4) Use graph paper for root locus problem and semi log graph paper for bode plot.



1. Attempt **Any Five :** (20)

a) Check whether the following signal is energy or power signals. Justify.

i) $x(t) = e^{-4t}$

ii) $x(t) = 3\cos\left(2\pi t + \pi/3\right)$

b) Check whether the system described by input $x(t)$ and output $y(t)$, by the relation $y(t) = 6\cos\left[x(t)\right]$ is linear or not, Time invariant or not, justify.

c) Determine the Fourier transform of the signal $x(t) = te^{-at}u(t)$

d) Determine the initial and find value of the signal if the transform is given by $X(s) = \dfrac{7s+10}{S(s+2)}$

e) Differentiate open loop and closed loop control system.

f) Using Routh array method find whether the system given by characteristics poly nominal $A(s) = s^4 + 3s^3 + 7s^2 + 2s + 10$ is stable or not.

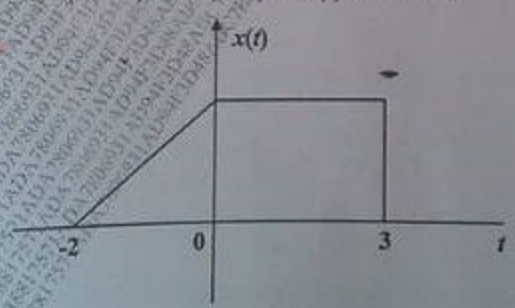
2. a) Sketch the signal (04)
$x(t) = u(t) - r(t-2) + r(t-3)$

b) Check whether the following signal is periodic or not, if periodic find the period (04)

i) $x(t) = e^{j(\pi t + \pi/4)}$

ii) $x(t) = 4\sin\left(\dfrac{2\pi t}{7}\right) - 2\cos\left(\dfrac{3\pi t}{7}\right)$

c) Find the signal i) $x(2t+3)$, ii) $x(2-t)$ if $x(t)$ is given by (04)




d) Let $x(t) = e^{-t}u(t)$, $h(t) = u(t) - u(t-4)$ find $x(t) * h(t)$ sketch the output. (08)

3. a) Let a system is given by the input output relation $y(t) = t^2 x(t)$, where $y(t)$ is the output and $x(t)$ is the input. Check whether the system is BIBO stable or not, causal or not, time in variant or not. (06)

b) Find the trigonometric Fourier series of the half wave rectified sine wave of amplitude A given by (08)

$$x(t) = A\sin(2\pi t) \quad 0 \le t \le 0.5$$
$$= 0 \quad 0.5 \le t \le 1$$

$x(t) = x(t+k)$ for all integer '$k$'.

c) Explain Dirichlet's condition for existence of Fourier series of continuous time signal. (02)

d) Find Fourier transform of the signal (02)

$$x(t) = t \; ; \; |t| \le 1$$
$$= 0 \; ; \; |t| > 1$$

4. a) Prove the convolution property of Fourier transform. (06)

b) Use the Laplace transform to find the output of the system described by the differential equation $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t)$ in response to the input $x(t) = 3e^{-4t}\,u(t)$ with zero initial conditions. (08)

c) Prove the time scaling property of Laplace transform. (06)

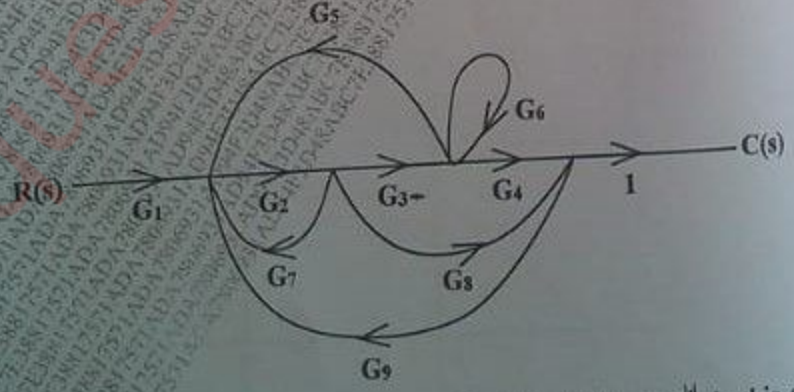
5. a) Consider a linear feedback system with its loop transfer function defined by (05)

$$G(s)H(s) = \frac{0.2k(s+5)}{(s+1)^3}$$

i) Find the value of $k$ for which the system is on the verge of instability

ii) Corresponding pair of roots on the $j\omega$ axis of the S-plane.

b) Using Mason's Gain formula find $\frac{C(s)}{R(s)}$ (10)




c) Consider a system with impulse response given by $h(t) = 7e^{-4t}$ is this system BIBO stable or not.

6. a) Draw the bode plot and comment on the stability of the system if the loop gain of the system is given by $G(j\omega)H(j\omega) = \frac{10^4}{j\omega(j\omega+10)(j\omega+10^2)}$ (10)

b) Draw the root locus of the system with loop transfer function given by $G(s)H(s) = \frac{6K}{(s+1)(s+2)(s+3)}$. (10)