WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

ELSADSE03T-ELECTRONICS (DSE1/2)

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP-A

1. Answer any ***five*** questions from the following: 2×5 = 10

(a) A system has a single pole at the origin. Its step response will be (i) Constant, (ii) Ramp, (iii) Decaying exponential. Justify your answer.

(b) In the given system, if an input $x(t) = \sin t\ u(t)$ is applied, find the response $y(t)$ of the system at steady state.

$$X(s) \longrightarrow \boxed{\frac{s}{s+1}} \longrightarrow Y(s)$$

(c) Define transfer function of a system. In force-voltage analogy, coefficient of viscous function is analogous to (i) R, (ii) $1/C$, (iii) L, (iv) None.

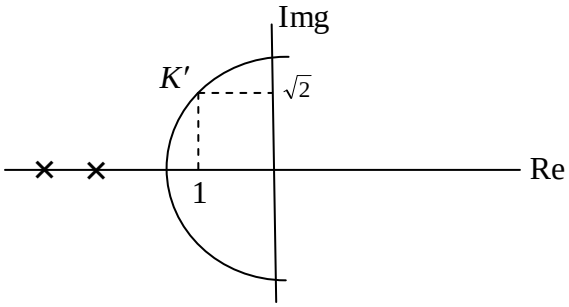
(d) State Mason's Gain formula.

(e) 'All steady state errors are positional in nature' — Explain.

(f) Define the terms:

(i) Relative stability, (ii) Delay time

(g) The root locus plot is shown below. Find the damping ratio of the system at $K = K'$.



(h) Explain observability of a system.

(i) Which of the following points is not on the root locus of a system with open loop transfer function

$$G(s)H(s) = \frac{K}{s(s+1)(s+3)}$$

(i) $s = -j\sqrt{3}$, (ii) $s = -1.5$, (iii) $s = -3$, (iv) $s = \infty$

Justify your answer.

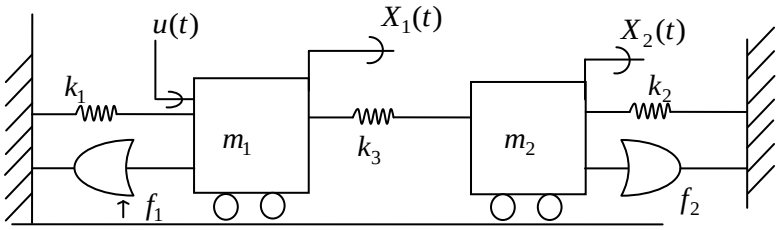
GROUP -B

Answer any *six* questions from the following 5×6 = 30

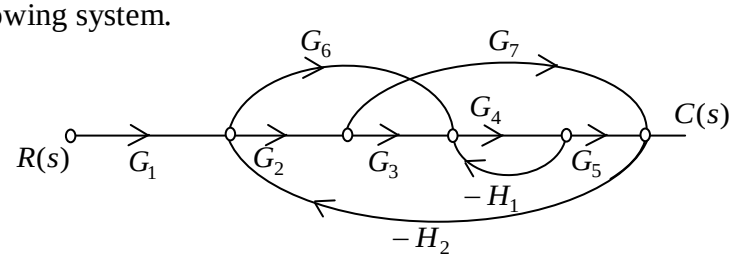
2. (a) Sketch the root locus for a unity feedback system with open loop transfer function. 5

$$G(s)=\frac{K}{s(s^2+8s+32)}$$

(b) Obtain the transfer function $X_1(s)/u(s)$ and $X_2(s)/u(s)$ of the mechanical spring-mass-damper system shown in the figure below. Hence draw the electrical equivalent circuit for the system. 5



(c) Using Mason's gain formula derive the closed-loop transfer function, $C(s)/R(s)$ of the following system. 5



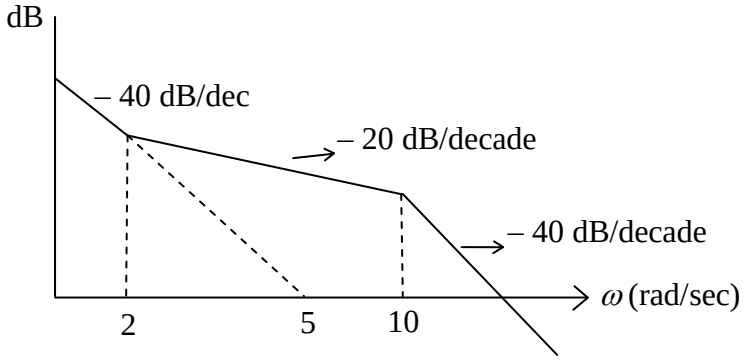
(d) An LTI SISO system has the steady state model given by 5

$$\frac{dx(t)}{dt}=Ax(t)+Bu(t) \quad \text{and} \quad y(t)=Cx(t)$$

where $A=\begin{bmatrix}-3 & 1\\ 0 & -1\end{bmatrix}$, $B=\begin{bmatrix}1\\ 1\end{bmatrix}$ and $C=\begin{bmatrix}1\\ 1\end{bmatrix}^T$

Find the damping ratio of the system.

(e) Determine the transfer function of the unity feedback control system as shown in the figure below. Hence find phase margin of the system. Comment on the stability of the system. 5

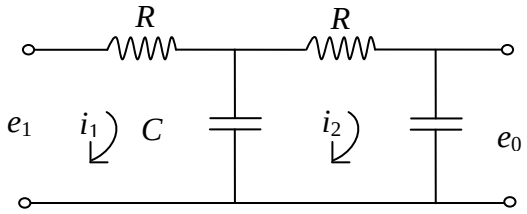


(f) The open-loop transfer function of a unity negative feedback control system is 5

$$G(s)H(s)=\frac{2e^{-sT}}{s(s+2)}$$

Determine the range of T for which the system will be stable.

(g) (i) Find the transfer function of the circuit shown. 3



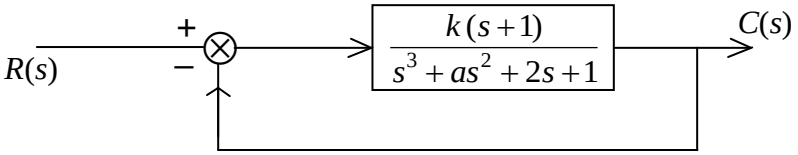
(ii) State the conditions for a mathematical model of a physical system to be linear. 2

(h) The feedback control system shown below oscillates at 2 rad/sec under which of the following condition? 5

(i) $k=2,\ a=0.75,$ (ii) $k=3,\ a=0.75,$

(iii) $k=3,\ a=0.5,$ (iv) $k=2,\ a=0.5,$

Do necessary calculations.



(i) Find the unit step response of a first order control system and draw a neat graph of the response. 5

(j) For a unity feedback system having open loop transfer function 1+2+2

$$G(s)=\frac{k(s+2)}{s^2(s^2+7s+12)}$$

Determine (i) type number of the system,

(ii) error constants,

(iii) steady state error for a parabolic input.

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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