WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2020, held in 2021

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.

SECTION-A

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

(a) Differentiate between transient response and steady state response.

(b) For a unity feedback system the OLTF is $G(s) = \dfrac{(s+1)}{s^2(s+2)(s+3)}$. What is the steady state error if the input $r(t) = (2 + 3t + 4t^2)\, u(t)$?

(c) Find the gain and phase margin of $\dfrac{1}{s}$.

(d) Why Bode plots are commonly used in the frequency domain design?

(e) Define the term-Relative stability and Absolute stability.

(f) Compare the bandwidths of two systems having transfer function as –
$G_1 = \dfrac{1}{1+2s}$ and $G_2(s) = \dfrac{1}{1+5s}$ Justify your answer.

(g) Write Mason's Gain formula.

(h) The forward path transfer function of a unity feedback control system is given by $G(s) = \dfrac{2}{s(s+3)}$. Obtain the expression for unit step response of the system.

SECTION-B

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

2. (a) Find the state equation for the system in Fig. 1. 5

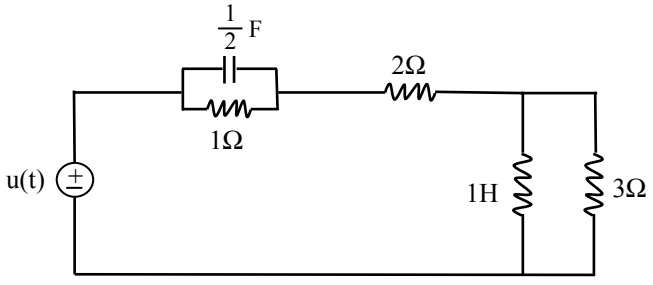

Fig. 1

(b) Obtain the state equation for the following RLC network. Output is taken across the capacitor. 5

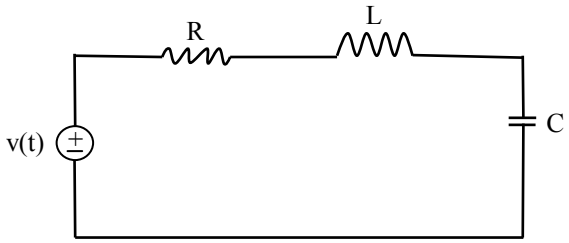

Fig. 2

(c) Consider the system described by following set of linear equations. Construct the Signal flow graph and find $\frac{C}{R}$. 5

$$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4$$
$$x_3 = a_{23}x_2$$
$$x_4 = a_{24}x_2 + a_{34}x_3 + a_{44}x_4$$
$$x_5 = a_{25}x_2 + a_{45}x_4$$

(d) A second order unity feedback control system having open-loop transfer function $\frac{\omega_n^2}{s(s+2\varsigma\omega_n)}$ is subjected to an unit step input. Now, by using derivative control of transfer function $(1+sk_D)$, the % M_P (Maximum overshoot) is to be made 8.12% from 52.6%. Find the value of ς, ω_n and K_D. Hence realize the controller using OP-AMPs. Given t_P (peak time) and % M_P of the system without derivative control are 0.8 and 52.6% respectively. Consider, $C_D = 0.1\,\mu F$. 5

(e) An unity feedback control system is represented by the transfer function given below $\frac{Y(s)}{U(s)} = \frac{(s+5)}{(s+2)(s+3)}$. Determine the state transfer matrix and zero state response for $u(s) = \frac{1}{s}$. Hence draw the state block diagram using parallel decomposition method. 5

(f) An LTI SISO system has the state space model given by $\dot{x}(t) = Ax(t) + Bu(t)$ and $y(t) = Cx(t)$, 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. 5

(g) Why PI controller is superior than integral controller alone? Write down some disadvantages of using PD controller. Draw the circuit diagram of a PID controller in parallel mode using OP-AMPs. Derive its transfer function. 1+1+1+2

(h) Using Block diagram reduction techniques, find the closed-loop transfer function of the following system 5

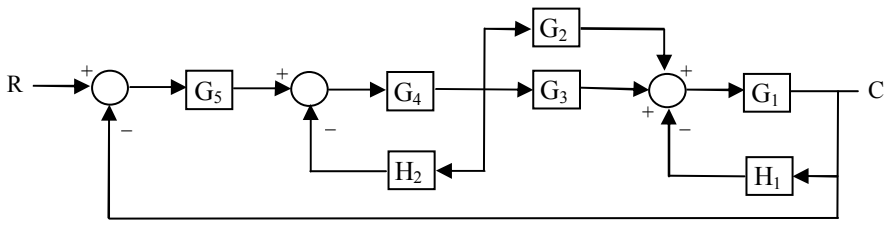

Fig. 3

(i) Using Block diagram reduction techniques, find the closed-loop transfer function of the following system. 5

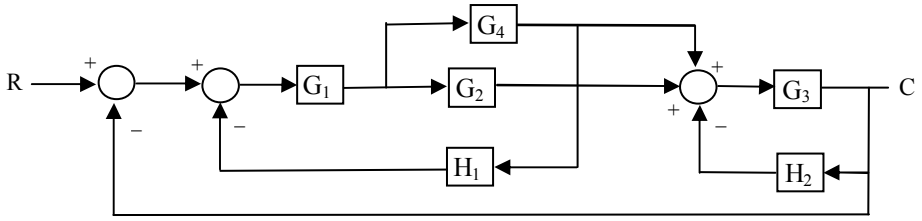

Fig. 4

(j) A unity negative feedback control system has an open loop transfer function $G(s) = \frac{K}{s(s+1)(s+3)}$. 1+1+1+(1+1)

Determine the:

(i) Break away point and centre of gravity,

(ii) Value of K at marginal stability and the frequency of sustained oscillation,

(iii) Value of K at $s = -4$ and

(iv) Comment on the nature of response and stability of the system.

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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