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Paper Code : PC-EE503/PC-EEE503 Control system

UPID : 005518

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer *any ten* of the following : [1 x 10 = 10]

(I) What are the main advantages of Bode plot?

(II) How do you find the type of a system?

(III) What are the frequency domain specifications?

(IV) What is the use of lag compensator?

(V) Define state and state variables?

(VI) What are the elements of block diagram?

(VII) Name any two analogy models used to represent in control systems.

(VIII) Define Damping ratio.

(IX) What are M circles?

(X) What is the effect of PI controller on the system performance?

(XI) Define state model of nth order system?

(XII) What are sampler and hold circuits?

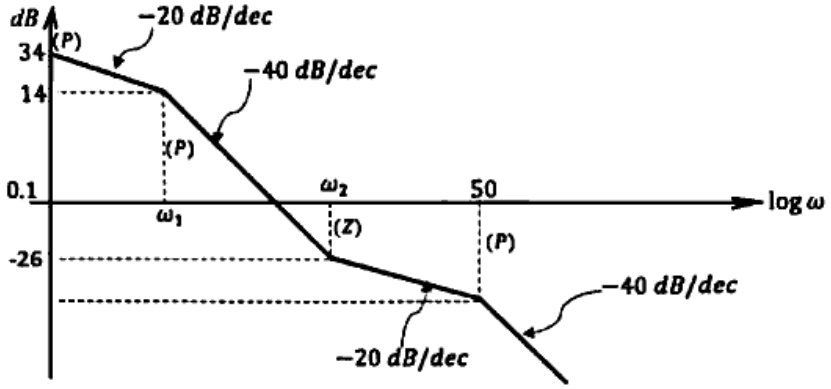
Group-B (Short Answer Type Question)

Answer *any three* of the following : [5 x 3 = 15]

2. Check for controllability of a system having following coefficient matrices. [5]

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \text{ and } C = [10 \quad 5 \quad 1]$$

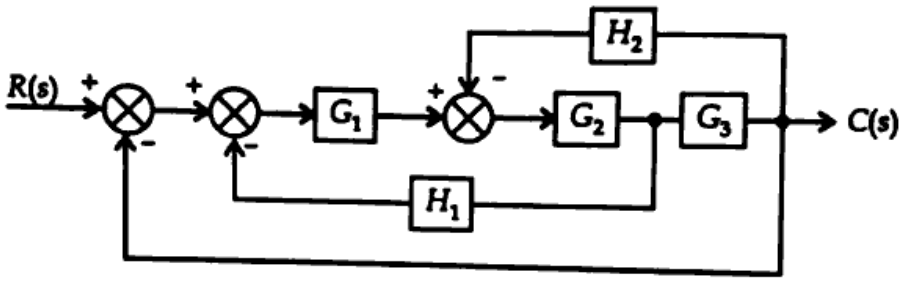
3. The sketch given shows the Bode Magnitude plot for a system. Obtain the Transfer Function. [5]



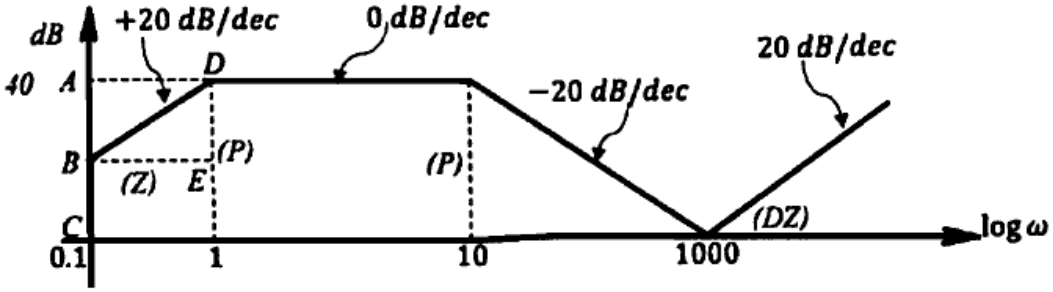
4. Check the stability of the system having following characteristic equation by using Routh Hurwitz Criterion also determined the range of K. [5]

$$\textbf{Given } G(S) = \frac{K(S+13)}{S(S+3)(S+7)}, \; H(S) = 1.$$

5. Determine the transfer function C(s)/R(s) for the system shown in Figure. [5]



6. The sketch given shows the Bode Magnitude plot for a system. Obtain the Transfer Function. [5]



Group-C (Long Answer Type Question)

Answer *any three* of the following : [15 x 3 = 45]

7. (a) The addition of a pole will make a system more stable. Justify your answer. [2]

   (b) Give the effect of addition of poles on the root locus. [1]

   (c) **Draw the root-locus plot for $G(s)H(s) = \frac{k}{s(s+2)(s+3)}$ and determine the stability. Using the root locus method find the gain (k) for the system, when $\xi = 0.341$.** [12]

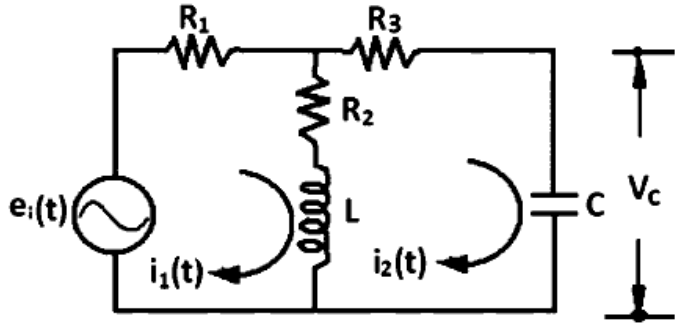
8. (a) Write advantage and disadvantage of Digital Control system. [5]

   (b) Solve the following difference equation using the z-transform method [10]

$$8x(k+2) - 6x(k+1) + x(k) = 9$$

$$given\ x(0) = 0\ and\ x(1) = {}^{3}/_{2}$$

9. (a) Determine the state model for the electrical circuit shown in Figure. [8]



   (b) Determine the state model for the electrical circuit shown in Fig: [7]

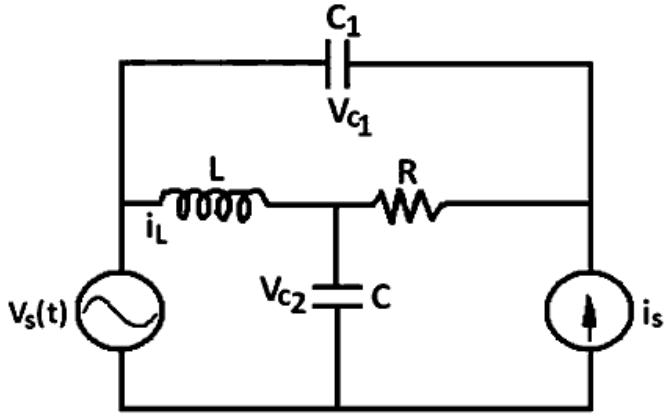


Figure RLC circuit

10. (a) Define- [10]

i. Steady-state error:

ii. Static error Coefficients:

iii. Derive the values of static error coefficients and steady-state error coefficients for type-0, type-1 and type-2 system.

(b) The open loop transfer function of a unity feedback system is given by, [5]

$$G(s) = \frac{K}{s(1+s\tau)} \qquad K, \tau > 0$$

With a given value of K, the peak overshoot was found to be 80%. It is proposed to reduce the peak overshoot to 20% by decreasing the gain. Find the new value of K in terms of the old value.

11. (a) The open loop transfer function of a servo system is given by, [6]

$$G(s) = \frac{10}{s(1+0.2s)}$$

Evaluate the error series for the input,

$$r(t) = 1 + 2t + \frac{3t^2}{2}$$

(b) Find the steady state error for unit step, unit ramp and unit acceleration inputs for the following systems. [9]

1. $G(s) = \frac{10}{s(1+0.1s)(1+0.5s)}$ **2.** $G(s) = \frac{1000(1+s)}{(10+s)(s+50)}$ **3.** $G(s) = \frac{1000}{s^2(1+s)(20+s)}$

*** END OF PAPER ***