Question Paper

Exam Date & Time: 05-Jun-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

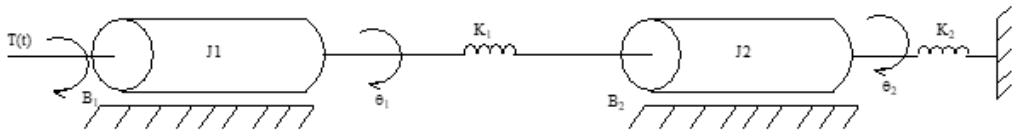
INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. DEGREE MAKE-UP EXAMINATION-MAY/JUNE 2018
DATE: 5 JUNE 2018
TIME: 9.30 AM TO 12.30 PM
Control Systems [EE 241]

Marks: 100 **Duration: 180 mins.**

Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed

1) A) Draw the root locus of a system with $G(s)H(s) = \frac{K(s+3)}{s(s+2)}$ and find the stability. Prove that a part of the root locus is a circle. (12)

B) For the mechanical system write the differential equations. Draw the corresponding electrical network based on torque-current analogy. (8)



2) A) Explain lag and lead compensating networks. (6)

B) Draw the block diagram for the given electrical circuit shown in Fig 2B. find $\frac{V_0(s)}{V_i(s)}$ using block diagram reduction method and verify the answer using Mason's gain formula. (14)

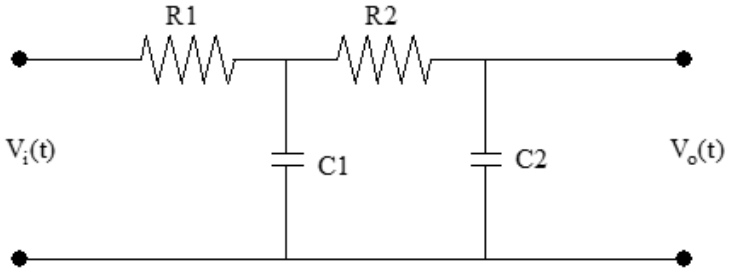


Fig 2B

3) A) A unity negative feedback system is characterised by $G(s) = \frac{10}{(s+1)}$, Find the error as a function of time t and evaluate the same when r(t)=1+2t. What is the steady state error? (8)

B) Write the differential equations for the mechanical system shown in Fig 3B. Draw the corresponding electrical circuit based on force current and force voltage analogies. (12)

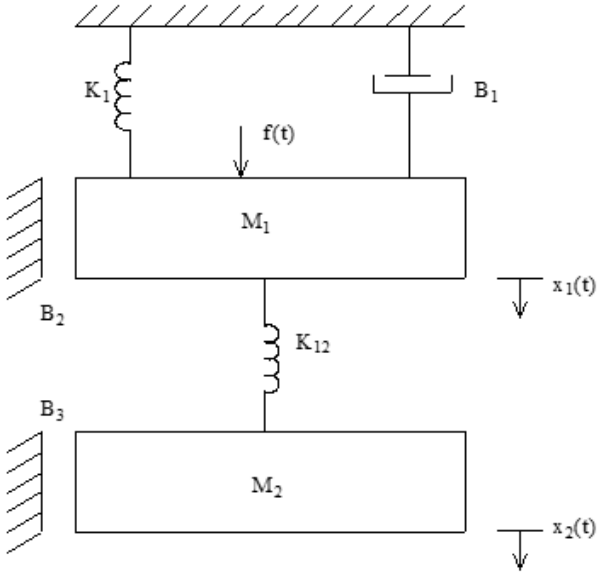


Fig 3B

4) For a second order system subjected to a step input derive expressions for (8)

A) i) peak time t_p

ii) peak overshoot

B) (12)

Given $G(s)H(s)=\frac{K(s+1)}{(s^2-2s+2)}$, Draw the root locus and find the system stability. Prove that s=+j2 lies on root locus.

5) (12)

A) Given $G(s)H(s)=\frac{K}{s(1+0.2s)(1+0.05s)}$ Find K such that the phase margin is 40° and 0°.

B) (8)

Obtain the state model for the system described by $\frac{y(s)}{u(s)}=\frac{S^2+2s+1}{(s^3+6s^2+10s+5)}$

6) (10)

A) Given $G(s)H(s)=\frac{K}{s(1+0.1s)(1+s)}$, Determine the value of K so that gain margin is 6dB.

B) (10)

A feedback control system is characterised by $G(s)H(s)=\frac{K}{s(s+\alpha)}$. Determine K and α so that resonant peak M_r= 1.04 and resonant frequency ω_r=11.55 rads/sec.

7) (8)

A)

Find the transfer function G(s) and frequencies ω_{g1} and ω_{g2} for the bode plot shown in Fig 7A.

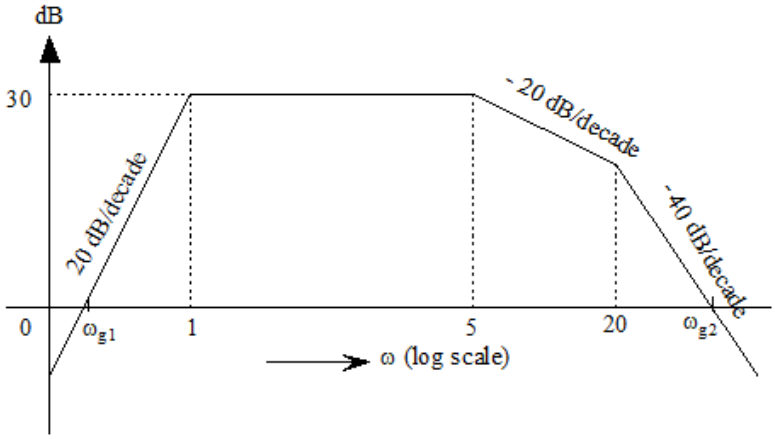


Fig 7A

B) (12)

Sketch the root locus for $G(s)H(s)=\dfrac{K}{s(s+2)\,(s^2+2s+5)}$ and find the stability.

8) (12)

A) For the system represented by the following equations. Find the transfer function $\dfrac{x(s)}{u(s)}$ by signal flow graph technique.

$$x = x_1 + \beta_3 u$$

$$\dot{x}_1 = -a_1 x_1 + x_2 + \beta_2 u$$

$$\dot{x}_2 = -a_2 x_1 + \beta_1 u$$

B) (8)

A second order unity feedback system is characterised by the following transfer function $\dfrac{C(s)}{R(s)}=\dfrac{361}{(s^2+16s+361)}$ Find,

a) ζ b) ω_n c) t_s settling time d) peak time t_p e) peak overshoot

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