Question Paper

Exam Date & Time: 26-Apr-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATION - APRIL 2018
IV SEMESTER B. S. (ENGG)
Date: 26.04.2018
Time: 9.30 A.M. TO 12.30 P.M.
Control Systems [EE 241]

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

Answer 5 out of 8 questions.

Missing data, if any, may be suitably assumed

1) (6)

A) For the Bode plot shown in Fig 1A find the open loop transfer function and frequencies ω_{g1} and ω_{g2}.

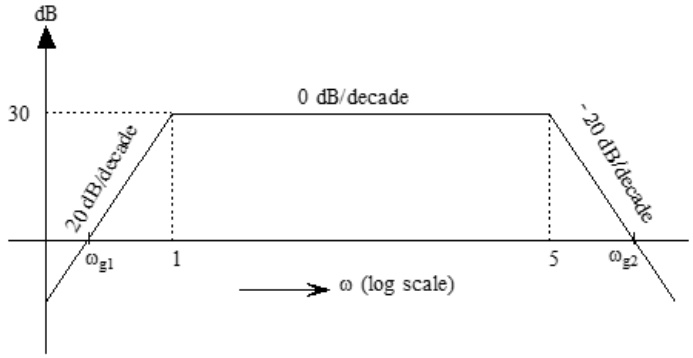


Fig 1A

B) For the given electrical circuit shown in Fig 1B find $\frac{V_o(s)}{V_i(s)}$ using Mason's gain formula. (10)

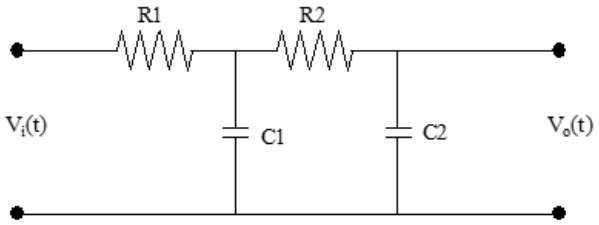


Fig 1B

C) Write a brief note on compensating networks. (4)

2) (6)

A) Find the state space representation of Armature controlled DC Motor.

B) (14)

Write the differential equations for the mechanical system shown in Fig 2B. Draw the corresponding electrical circuit based on force current and force voltage analogies.

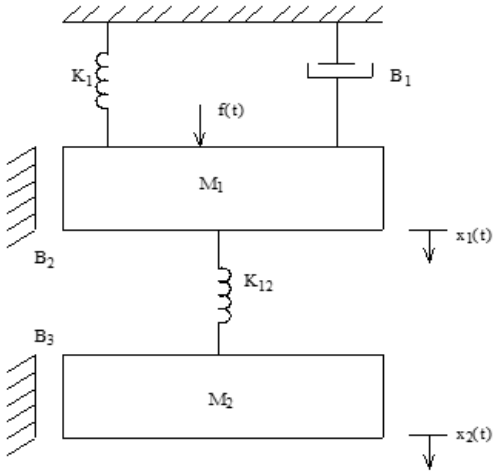


Fig 2B

3) (10)

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

B) (10)

Find the gain margin for a unity feedback system with $G(s)=\frac{6}{(s^2+2s+2)\,(s+2)}$ using Nyquist criterion.

4) (12)

A) For a second order system subjected to a step input derive expressions for

a) peak time t_p b) peak overshoot

B) (8)

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

a) ζ b) ω_n c) t_s settling time

d) peak time t_p e) peak overshoot

5) (10)

Derive expressions for resonant peak, resonant frequency and bandwidth.

A)

Derive expressions for resonant peak, resonant frequency and bandwidth.

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.

6) (5)

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

B) (10)

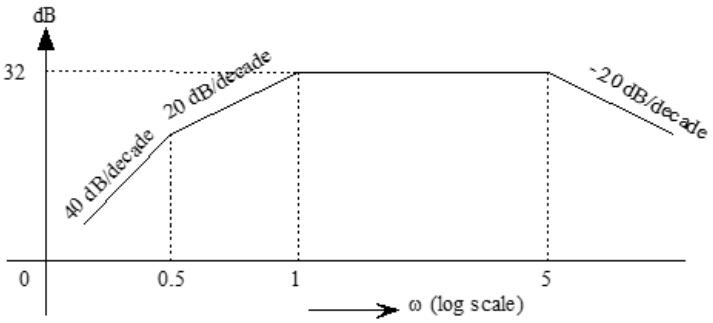
For the system represented by the following equations. Find the transfer function $\frac{x(s)}{u(s)}$ by signal flow graph technique.

$$x = x_1 + \beta_3 u$$

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

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

C) Find the transfer function for the Bode plot shown. (5)



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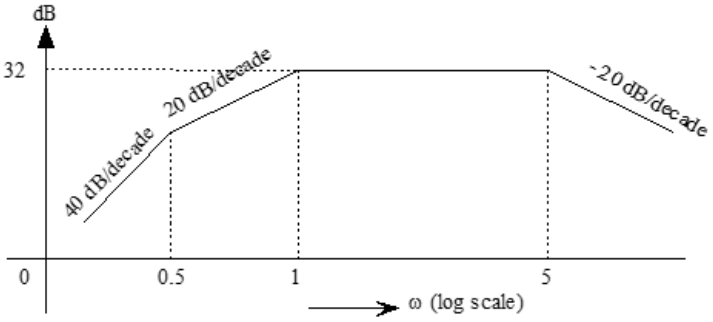
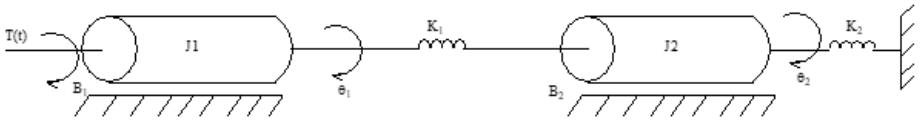


7) A) A unity negative feedback system is characterised by $G(s) = \frac{10}{(s+1)}$, Find the error as a function of time t and evaluate the same when r(t)=1+2t. (10)

What is the steady state error?

B) For the mechanical system write the differential equations. Draw the corresponding electrical network based on torque-current analogy and torque voltage analogy. (10)



8) A) Given $G(s)H(s) = \frac{K}{s(1+0.2s)(1+0.05s)}$ Find K such that the phase margin is 40° (10)

B) Given $G(s)H(s) = \frac{K}{s(1+0.1s)\,(1+s)}$, Determine the value of K so that gain margin is 6dB. (10)

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