KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.
Year : III
Course : COEG 301
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date 03 DEC 2023

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option

1. Which of the following is the major reason closed loop system is preferred over open loop?
   a. Error b. Disturbance c. Amplification d. Filtering

2. Which of the following is an example of a closed loop system?
   a. Fan in room
   b. Pizza baking using oven
   c. Room temperature control system using air conditioners
   d. Bread toast machine

3. A system has two dominant poles and three non-dominant poles. What order can the system be approximated?
   a. Second b. Third c. Fourth d. Fifth

4. Which is the most important criterion while tuning the controller in a control system?
   a. Transient response b. Steady state response
   c. Stability d. Error

5. First order system show _____ response
   a. Slow increasing/decreasing b. Overshoot
   c. Oscillatory d. All of the mentioned

6. Which of the following is an actuator?
   a. Output transducer b. Arduino
   c. Pneumatic amplifier d. Voltage divider

7. A plant has a transfer function of U(s)= 1/(s+5). Its response in time domain is given by:
   a. $U(t) = e^{-2t}$ b. $U(t) = e^{-t}$ c. $U(t) = e^{5t}$ d. $U(t) = e^{-5t}$

8. The steady state error for a type 1 system with ramp input is:
   a. 0 b. 1 c. Infinity d. constant

9. In a thermal system, the thermal capacitance is given by
   a. ΔQ/ ΔH b. Δm/ Δp c. Δθ/ ΔH d. Δθ/H

10. The forward path transfer function of a unity feedback system is $1/(1+s)^2$. What is the phase margin of the system?
   a. -Π rad b. Π rad c. 0 rad d. Π/2 rad

11. Given the transfer function $G(s)=36/(s^2+4.2s+36)$, What is the value of damping ratio (%)?
a. 30 b. -30 c. 35 d. 60

12. Consider a linear time invariant system with input u(t) and output y(t) and related by the equation $\frac{d^2y(t)}{dt^2} + 4y(t) = 6u(t)$. The poles of the system are at
a. 2j, -2j b. 2,-2 c. 4, -4 d. 4j, -4j

13. Slow response of an overdamped system can be made faster using
a. On/off controller
b. Derivative controller
c. Decreasing the controller gain
d. Increasing the controller gain

14. Find the overall transfer function using the signal graph (Figure 1)
a. $G_1G_2G_3/ (1 + G_1H_1 + G_3H_2 + G_3G_1H_1H_2)$
b. $G_1G_3/ (1 + G_1H_1 + G_3H_2 + G_3G_1)$
c. $(G_1G_2G_3 + G_1H_1)/ (1 + G_1H_1 + G_3H_2 + G_3G_1H_1H_2)$
d. $(G_1G_2G_3 + G_1H_1 + G_3H_2) / (1 + G_1H_1 + G_3H_2 + G_3G_1H_1H_2)$

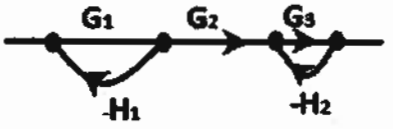

Figure 1

15. The corner frequency in the Bode plot is:
a. The frequency at which bode plot slope is 0 dB /decade.
b. The frequency at which bode plot slope is -10 dB /decade.
c. The frequency at which the two asymptotes intersect.
d. The frequency at which the two asymptotes meet.

16. Determine the type and order of the Nyquist plot (Figure 2)
a. 1,2 b. 2,1
c. 0,2 d. 0,1

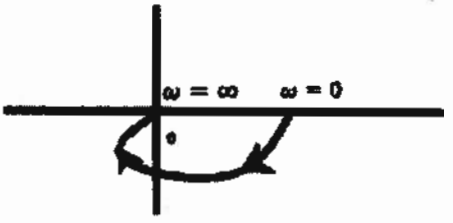

Figure 2. Nyquist plot for a system

17. Identify the disadvantage of the closed loop system
a. Cheap
b. Prone to disturbance
c. Inaccurate
d. Could be unstable

18. What is the system called where output is varying with time called?
a. Linear system
b. Time variant system
c. Non-linear system
d. Time invariant system

19. The term controller means
a. Feedback element and controller elements
b. Error detector and control elements
c. Error detector, feedback elements, and control elements
d. Error detector and feedback elements

20. The steady-state error is specified (usually) in terms of
a. Damping Factor b. Bandwidth c. Error Constants d. Speed of response

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SECTION "B"
[5 Q.× 8 = 40 marks]

Attempt *ANY FIVE* questions. Symbols have their usual meanings.

1. a. Explain with examples the open loop and closed loop control system. [5]
   b. Given the system shown in Figure 1, find the state space representation if the output is the current through the resistor. [3]

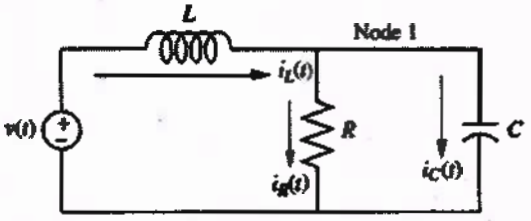

Figure 1. Electrical network

2. Given the system in Figure 2, where the truck of mass M is pulling a cart of mass m through a rope. The connecting rope has a friction (b) and spring effect (k). Obtain the transfer function considering input force F(t) and truck displacement (x(t)) as output. Neglect all other effects. [8]

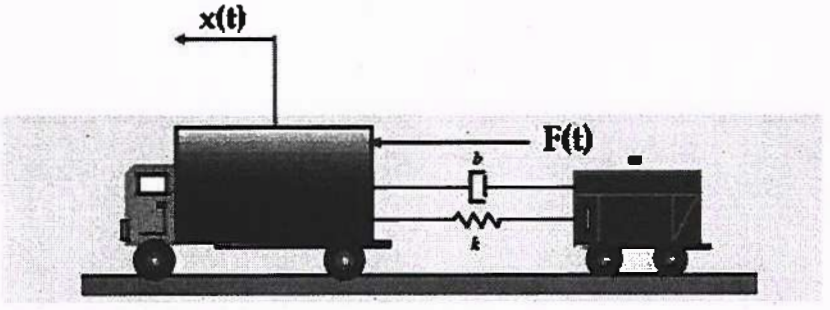

Figure 2. A truck pulling a cart

3. a. Consider the system in Figure 3. [4]

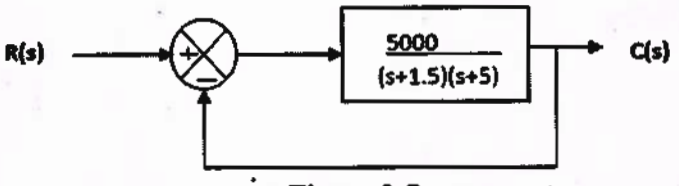

Figure 3 System

   i. Calculate the damping ratio, natural frequency.
   ii. Calculate overshoot and settling time for the system output when excited by a step input.
   iii. Sketch the transient response for the unit step input.
   iv. Calculate the steady state error if ramp input is 0.2rad/s.

b. For a feedback system, G(s)H(s)= 40/(s+4)(s^2+2s+2), find the gain margin and stability from Nyquist plot. [4]

4. a. Perform the block diagram reduction of system shown in Figure 4 to obtain a simplified relationship between R and Y. [5]

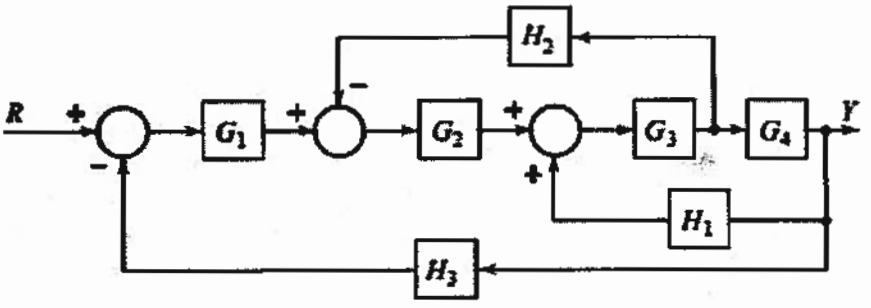

Figure 4. Given system for reduction

b. Explain the transient behavior of a second order system when excited by a unit step input. [3]

5. a. For the system given in Figure 5, find the range for the gain controller K which makes the system stable using the Routh-Hurwitz criterion. [4]

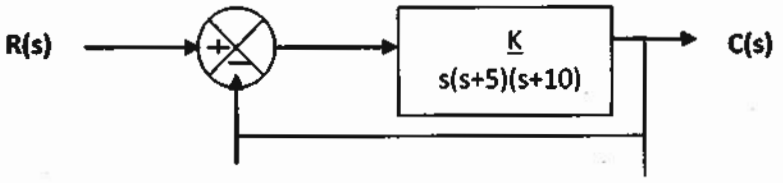

Figure 5. System

b. Sketch the root locus plot for $G(s) = \frac{K}{(s+1)(s+2+j2)(s+2-j2)}$. [4]

6. For a position control system given by Figure 6, find the value of preamplifier gain, *K*, to yield a 9.5% overshoot in the transient response for a step input using Bode plot method. [8]

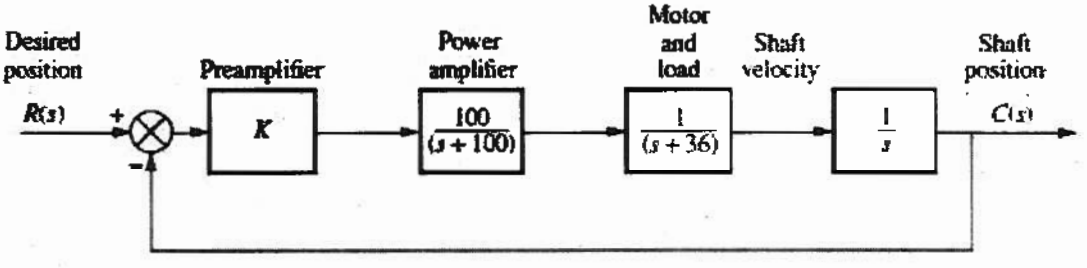

Figure 6. Position control system