KATHMANDU UNIVERSITY
End Semester Examination[C]
July, 2017

Marks Scored:

Level : B.E.
Year : III
Course : COEG 304
Semester : I
Exam Roll No. :
Time : 30 mins.
F. M. : 20
Registration No. :
Date JUL: 1 0 2017

SECTION "A"
[20 Q. × 1=20 marks]

Choose the most appropriate option.

1. Determine the value of 'a' such that the damping ratio of a closed loop control system having transfer function, $\frac{C(S)}{R(S)} = \frac{16}{S^2+(0.8+16a)S+16}$ is 0.5.
a) 0.8 b) 0.2 c)1.5 d) 0.5

2. The transfer function of a closed loop control system is $\frac{C(S)}{R(S)} = \frac{16}{S^2+4S+16}$ then determine the value of rise time.
a)1.5s b)10s c) 0.5s d) 0.605s

3. For a unity feedback control system open loop transfer function is $G(s) = \frac{10}{S(S+1)}$ then its velocity error constant is
a)10 b)50 c)∞ d)0

4. Determine the laplace transform of the function, $F(S) = \frac{8S+4}{S^2+6S+13}$.
a) $8e^{-2t}\cos 2t - 10e^{-2t}\sin 2t$ b) $8e^{-t}\cos 2t - 10e^{-3t}\sin 2t$
c) $8e^{-3t}\cos 2t - 10e^{-2t}\sin 2t$ d) $8e^{-3t}\cos 2t - 10e^{-3t}\sin 2t$

5. Laplace transform of $t^n e^{-at}$
a) $\frac{(n-1)!}{(s+a)^{n-1}}$ b) $\frac{(n-1)!}{(s+a)^{n-1}}$ c) $\frac{n!}{(s+a)^{n+1}}$ d) $\frac{n}{(s-a)^{n-1}}$

6. Laplace transform of $\frac{1}{s(s+1)}$
a) $1-e^{-t}$ b) $1-e^{-2t}$ c) $e^{-t}-1$ d) $1+e^{-t}$

7. Obtain the laplace transform of $\frac{1}{S^2+4S+8}$
a) $0.5e^{-2t}\sin 2t$ b) $e^{-2t}\cos 2t$ c) $e^{-t}\sin 2t$ d) $e^{-2t}\sin 2t$

8. Obtain the solution of the differential equation $2\frac{dx}{dt}+8x=10$ if $x(0+)=2$.
a) $1+e^{-2t}$ b) $1+2e^{-t}$ c) $3+e^{-4t}$ d) $1.25+0.75e^{-4t}$

9. The open loop transfer function of a feedback control system is $T(S)=\frac{K}{S(S+10)}$. Determine the value of gain factor k for critical damping.
a) 20 b) 25 c) 10 d) 15

10. A closed loop control system has the characteristic equation, $S^3 + 4.5S^2 + 3.5S + 1.5 = 0$. Investigate the stability using Routh-Hurwitz criterion that the system is:
a) marginally stable b)critically stable c) stable d) unstable

11. Without affecting the steady state error the maximum overshoot can be decreased by incorporating.....
a) integral error control
b) proportional error control
c) gain adjustment
d) derivative error control

12. If Mp=100%, the damping ratio is
a)1 b) 0 c) 0.5 d) infinity

13. If the digital input is $(101)_2$ then find the analog output voltage using R-2R ladder if V_{ref}=5 V and R_{in}=Rf=15 kΩ.
a) -3.125 V b) -5 V c) 1.5 V d) 3 V

14. A certain binary-weighted DAC has a binary input of (1101)2. If a high=3Vand a low = 0V, then find the analog output voltage if $R_f = \frac{Rin}{2}$.
a) 1.15V b) 3.15V c) 3.25V d) -2.43V

15. The characteristic polynomial of second order system has two 2 distinct negative real roots, it is_____
a) Over damped b) Critically damped c) Oscillatory d) Unstable

16. The transfer function of a system is $\frac{10}{(1+s)}$ when operated as a unity feedback system, the steady state error to a unit step input will be
a) zero b) 10c c) 1/11 d) ∞

17. The transfer function of a system given by $T(S) = -\frac{100}{S^2+20S+100}$ is
a) over damped
b) critically damped
c) under damped
d) unstable

18. A negative feedback closed loop system is supplied to an input of 5 volt. The system has a forward gain of 1 and a feedback gain of 1. What is the output voltage?
a) 1v b) 1.5v c) 2v d) 2.5v

19. First column elements of Routh's tabulation are 3, 5, $\frac{-3}{4}$, $\frac{1}{2}$, 2. It means that there
a) is one root in left half *s* plane
b) are two roots in left half *s* plane
c) are two roots in right half *s* plane
d) is one root in right half *s* plane

20. The transfer function of a closed loop control system is $\frac{C(S)}{R(S)} = \frac{16}{S^2+4S+16}$ then determine the value of maximum overshoot in its step response.
a) 25% b) 16.31% c) 10% d) 12.5%

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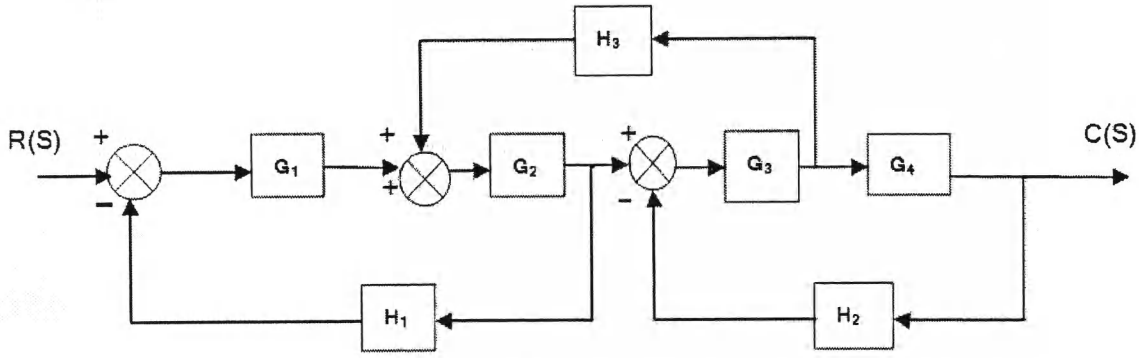
Semester : I
F.M. : 55

SECTION "B"
[5 Q. × 11 = 55 marks]

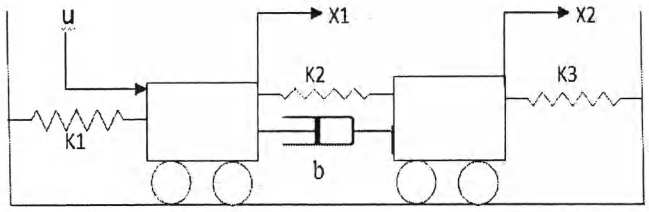
Attempt *ANY FIVE* questions.

1. a. Reduce the block diagram and determine the transfer function, $\frac{C(S)}{R(S)}$ of the figure given below. [7]



b. Determine the minimum value of G at ζ=0.6 for which the transfer function of the step response of the closed loop control system is $\frac{C(S)}{R(S)} = \frac{G}{S^2+3S+G}$. What will be the time period of the maximum overshoot cycle if G is doubled. [4]

2. a. Obtain the transfer function X1(S)/U(S) and X2(S)/U(S) of the mechanical system given below. [7]



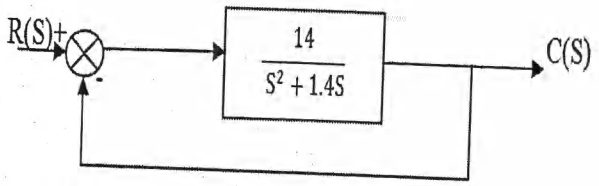
b. Derive the unit step response of a first order system, and determine [4]
a) unit step response,y(t) b)steady state error,e(t) c) e(∞)

3. a. Determine the stability of the closed loop transfer function using Routh Hurwitz stability criterion. [6]

$$T(S) = \frac{K}{S^3+18S^2+77S+K}$$

b. Explain how the rotary potentiometric position sensor measures the fuel level in petrol pump for 12 volt power supply. [5]

4. a. A closed loop control system with unity feedback is shown in figure below. By using derivative control the damping ratio is to be made 0.7. Determine the value of rise time with and without derivative control for unit step input.Give the reason of difference in the rise time. [8]



b. A 6-bit DAC has an analog output range of -2.5 to 5.0V. Calculate the analog output when input is 010101 (decimal 21). [3]

5. a. Derive the equation of output voltage for R-2R ladder DAC with figure. [5]
b. Explain the working principle of thermocouple and thermistor. Point out the similarities and difference between them. [6]

6. a. What are the common energy source of final control elements. Explain how rheostat and switch changes current/voltage to adjust the flow of energy going into the process. [4]
b. Draw the PLC ladder diagram for the automation of 10 apples packaging in a box which includes following components: [7]

i. Actuators: Apple Convey : Moves the conveyer belt of apples
: Box Convey : Moves the conveyer belt of boxes
ii. Sensors : Apple Sensor : Detects apple
: Box Sensor : Detects box