

KATHMANDU UNIVERSITY  
End-Semester Examination  
February/March, 2018

Marks Scored:

Level : B.E.  
Year : III

Course : COEG 304  
Semester: I

Exam Roll No.:

Time: 30 mins.

F.M. : 20

Registration No.:

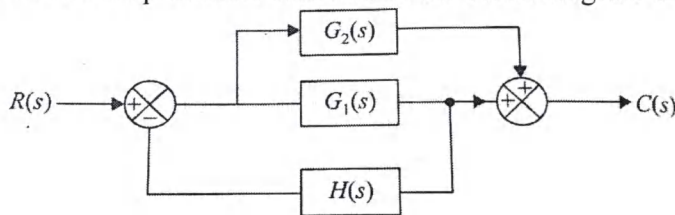
Date **MAR 05 2018**

SECTION "A"

[20 Q × 1=20 marks]

Choose the most appropriate answer.

1. Which of the following sensor has inherent hysteresis?
  - a. Optical encoder
  - b. RTDs
  - c. LVDT
  - d. Bimetallic strip
  
2. The inverse transform of the function  $V(s) = \frac{8s+4}{s^2+6s+13}$  is
  - a.  $8e^{-3t}\cos 2t - 10e^{-3t}\sin 2t$
  - b.  $4e^{-3t}\cos 2t - 8e^{-3t}\sin 2t$
  - c.  $2e^{-3t}\sin 2t - 6e^{-3t}\cos 2t$
  - d.  $3e^{-3t}\sin 2t - 10e^{-3t}\cos 2t$
  
3. A large time constant corresponds to a
  - a. sluggish system
  - b. faster system
  - c. over damped system
  - d. under damped system
  
4. The effect of increase in the forward path gain of a control system on the damping ratio is that the damping ratio is
  - a. increased
  - b. reduced
  - c. not effected
  - d. made zero
  
5. The closed loop transfer function of a system is  $\frac{C(s)}{R(s)} = \frac{e^{-2s}}{s(s+4)}$ . The system with this transfer function is operated in closed loop with unity feedback. The closed loop system is
  - a. Stable
  - b. Unstable
  - c. Marginally stable
  - d. Conditionally stable
  
6. The close loop transfer function of the block diagram of below figure is



(a)  $\frac{G_1(s) + G_2(s)}{1 + G_1(s)H(s)}$

(b)  $\frac{G_1(s) + G_2(s)}{1 + G_2(s)H(s)}$

(c)  $\frac{G_1(s)}{1 + G_2(s)H(s)}$

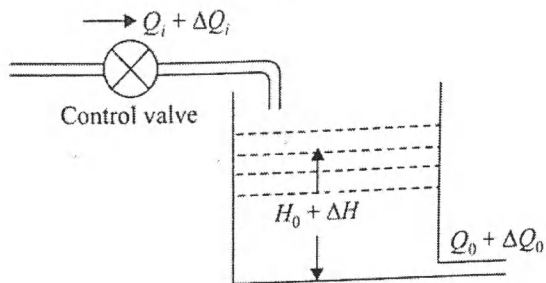
(d)  $\frac{G_1(s) + G_2(s)}{1 + [G_1(s) + G_2(s)]H(s)}$

7. A unity feedback control system has an open loop transfer function of  

$$G(s) = \frac{K}{(s-1)(s+3)}$$

The closed loop system is

- Unstable for all values of  $K$
  - Stable for all values of  $K$
  - Stable for  $K \geq 3$  and unstable for  $K < 3$
  - Unstable for  $K \geq$  and stable for  $K < 3$
8. The characteristic equation of a system is  $2s^3 + 4s^2 + 4s + 8 = 0$ . How many roots are there in the left half  $s$ - plane or on  $j\omega$ -axis.
- One
  - Two
  - Three
  - four
9. For the liquid level system of figure below, which is the correct differential equation model for incremental quantities?



- (a)  $C \frac{d(\Delta H)}{dt} + R(\Delta H) + \Delta Q_i$       (b)  $\frac{d(\Delta H)}{dt} + RC (\Delta H) = \Delta Q_i$
- (c)  $RC \frac{d(\Delta H)}{dt} + \Delta H - \Delta Q_i$       (d)  $R \frac{d(\Delta H)}{dt} + C (\Delta H) - \Delta Q_i$

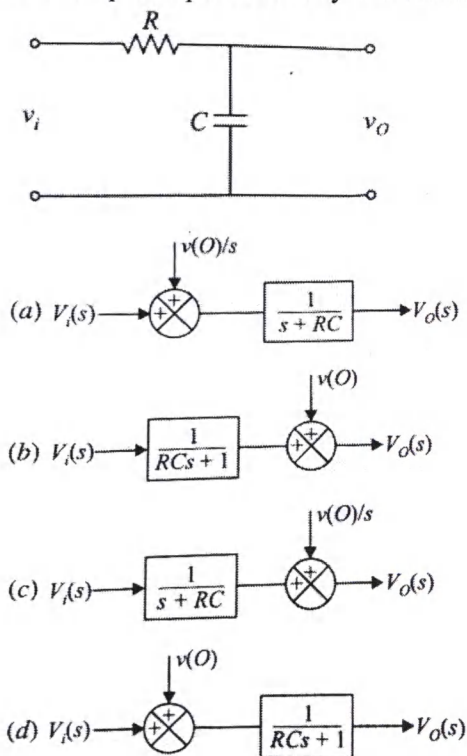
10. Output derivative feedback loop around the plant being controlled
- Increases the effective time constant
  - Reduces the effective time constant
  - Reduces the steady state error
  - Causes the system to become unstable
11. What is meant by type -2 system?
- It's characteristic equation is of second order
  - It has only two open loop poles
  - It has two zeros at  $s=0$
  - It has two poles at  $s=0$
12. Transfer function of PID controller has
- 2 poles and one zero
  - 2 zeroes
  - 1 pole and 2 zeros
  - 2 poles

13. The steady state error constant for a unity negative feedback control system are given by

	$K_p$ (position)	$K_v$ (velocity)	$K_A$ (acceleration)
(a)	$\lim_{s \rightarrow \infty} 1/G(s)$	$\lim_{s \rightarrow \infty} 1/sG(s)$	$\lim_{s \rightarrow \infty} 1/s^2G(s)$
(b)	$\lim_{s \rightarrow 0} s^2G(s)$	$\lim_{s \rightarrow 0} sG(s)$	$\lim_{s \rightarrow 0} G(s)$
(c)	$\lim_{s \rightarrow \infty} 1/s^2G(s)$	$\lim_{s \rightarrow \infty} 1/sG(s)$	$\lim_{s \rightarrow \infty} 1/G(s)$
(d)	$\lim_{s \rightarrow 0} 1 + G(s)$	$\lim_{s \rightarrow 0} sG(s)$	$\lim_{s \rightarrow 0} s^2G(s)$

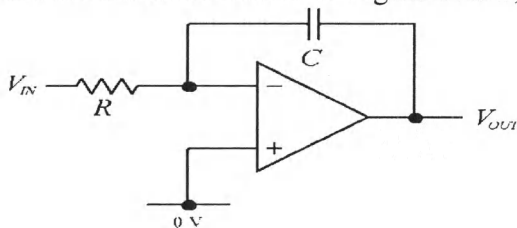
14. Unit impulse response of a linear system is obtained from its unit step response by  
 a. Taking its derivative  
 b. Taking its integral  
 c. Multiplying it with a suitable constant  
 d. Cannot be obtained from the step response

15. In the circuit of fig the capacitance has an initial charge of  $v(0)$ . Its input-output relationship is represented by the block diagram



16. Resistance Temperature Detectors has \_\_\_\_\_.  
 a. Positive temperature coefficient      b. Negative temperature coefficient  
 c. Either type of temperature coefficient      d. High tolerance

17. An a.c signal conditioning system is normally used for
- Resistive transducers like strain gauges
  - Inductive and capacitive transducers
  - Piezoelectric transducers
  - Optical transducers
18. A differential amplifier has a common mode gain of 0.02. It has +200 mV signals applied to each of its inputs. The amplitude of output signal is
- 0V
  - 4 mV
  - 8mV
  - 4.3 mV
19. In an integral controller
- the output is proportional to input
  - the rate of change of output is proportional to input
  - the output is proportional to rate of change of input
  - the output is increased
20. For the circuit as shown in Figure below, the relation between input and output voltage is



- $V_{out} = -\frac{1}{RC} \int V_{in} dt$
- $V_{out} = \frac{1}{RC} \int V_{in} dt$
- $V_{out} = -RC \frac{dV_{in}}{dt}$
- $V_{out} = RC \frac{dV_{in}}{dt}$

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SECTION "B"  
[5 Q × 11 = 55 marks]

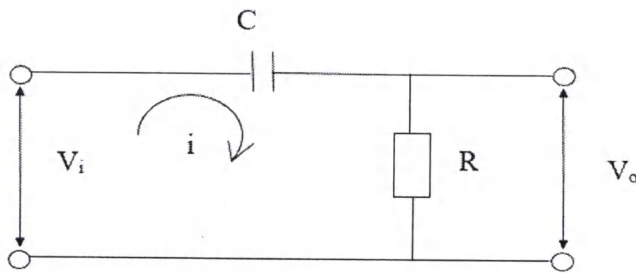
Attempt any FIVE questions. Assume any suitable data if necessary.

1.

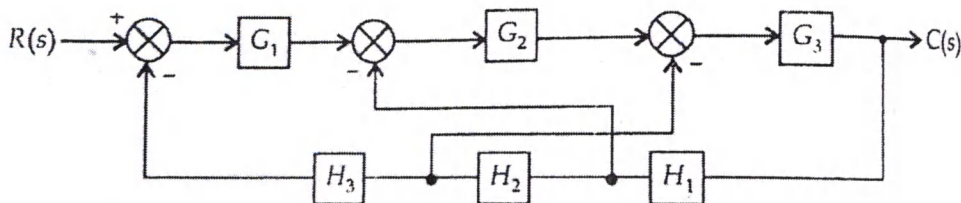
- a. Explain closed loop control system for room heating system with general block diagram. [4]
- b. Why is closed loop preferred over open loop control systems? Explain with examples. [3]
- c. Show that with integral control the steady state error is zero for a ramp input. [4]

2.

- a. For RC network shown in figure below, derive mathematical model and obtain the transfer function of the system. [5]

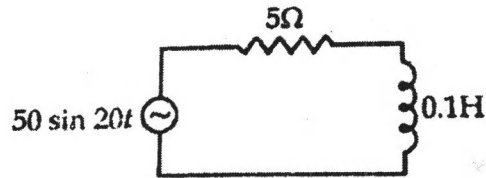


- b. Reduce the block diagram and obtain the overall transfer function of system shown in figure below. [6]



3.

- a. For the given series RL circuit shown in fig find the current at  $t > 0$  if the initial current is zero. [5]



- b. The characteristic equation of a system is given by  $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$ . Comment on stability. [6]

4.

- a. What is PI controller? In what manner does the integral term help in system compensation? What is its effect on system order? [5]

- b. A unity feedback control system has an open loop transfer function of

$$G(s) = \frac{12(s+4)}{s(s+1)(s+2)(s+6)}$$

Determine its steady state error to i) unit step and ii) unit ramp input [3]

- c. Sketch typical unit step response of a second order system with  $\xi < 1$ . Identify peak time, peak overshoot and settling time. Locate on the complex plane the roots of the characteristics equation of a second order system for  $\xi < 1, \xi = 1, \xi > 1$ . [3]

5.

- a. Consider a 6 bit D/A converter with a resistance of  $320 \text{ k}\Omega$  in LSB position. The converter is designed with weighted resistive network. The reference voltage is  $10 \text{ V}$ . The output of the resistive network is connected to an OPAMP with a feedback resistance of  $5 \text{ k}\Omega$ . What is the output voltage for a binary input of 111010 ? [5]

- b. Describe the following terms used in conjunction with digital to analog(D/A)conversion [3]
- Discrete levels
  - Resolution
  - Quantization error
  - Decision Levels

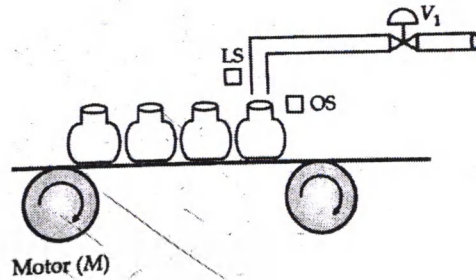
- c. Describe working of mass flow rate sensor using Coriolis sensor. [3]

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6.

a. Draw the state chart and ladder diagram to obtain control action for the following process:

[6]



**Step 1** The Motor M rotates and the conveyor belt moves

**Step 2** As soon as the first bottle crosses the limit switch (LS), the motor stops and bottle is under the pipe

**Step 3** As the bottle is under the pipe, valve V opens

**Step 4** The bottle is filled up and when full, optical switch (OS) is closed and valve V is closed

**Step 5** The motor again rotates and the steps 1 to step 4 are repeated.

b. Write short notes on (any two):

[5]

- i. Dynamic characteristic of a sensor.
- ii. System block diagram and process scan of PLC.
- iii. Transient and steady state performance of underdamped system.

