KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III
Course : COEG 304
Semester : I

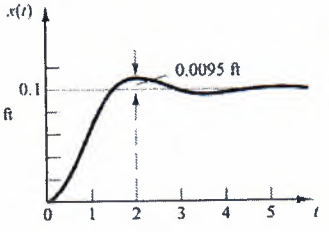
Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : 05 AUG 2024

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose and mark [X] the most appropriate option from each set of choices

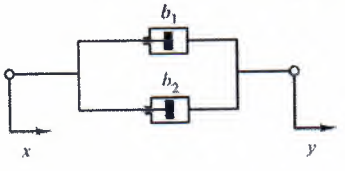
1. Which type of second order system gives the following response to step input?



[ ] Overdamped system [ ] Underdamped system
[ ] Critically damped system [ ] Unstable system

2. Transient response of a feedback control system .....
[ ] rises slowly [ ] rises quickly [ ] decays slowly [ ] decays quickly

3. What is equivalent viscous coefficient for the following system?

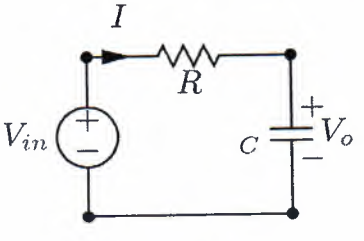


[ ] $b_{eq} = b_1 + b_2$ [ ] $b_{eq} = b_1 b_2$ [ ] $b_{eq} = b_1 / b_2$ [ ] $beq = \frac{b1b2}{b1+b2}$

4. The system pole generates what part of a response?
[ ] imaginary [ ] transient [ ] steady-state [ ] real

5. _____ controller is used to eliminate the steady state error.
[ ] PD- controller [ ] P-controller [ ] I-controller [ ] PI-controller

6. The transfer function [$V_o(s)/V_i(s)$] of an electrical system described below is _____.



[ ] $\frac{1}{sCR+1}$ [ ] $\frac{C}{sCR+1}$ [ ] $\frac{RC}{sC+R}$ [ ] $\frac{R}{s+RC}$

7. A closed loop system is stable if all the poles of the system lie at
[ ] left side of imaginary axis.
[ ] right side of imaginary axis.
[ ] origin.
[ ] imaginary axis.

8. An entire row of zeros will appear in the Routh table when
[ ] roots are only on real axis [ ] roots are only on imaginary axis
[ ] roots are unsymmetrical [ ] roots are symmetrical about origin

9. An object is approximately 300m away. The time difference to calculate the distance, using a light pulse reflected from the surface is _____.
[ ] 1 μs [ ] 2 μs [ ] 3 μs [ ] 4 μs

10. The _____ is the unit impulse response.
[ ] Derivative of unit step response. [ ] Integration of unit ramp response.
[ ] Integration of unit step response. [ ] Derivative of unit ramp response.

11. The high and low pass RC filters are passive circuits used to _____ from the data signal
[ ] add desired frequencies. [ ] block undesired frequencies.
[ ] add undesired frequencies [ ] block desired frequencies.

12. The successive approximation ADC output for a 4-bit converter to a 3.217V input if the reference is 5V is _____.
[ ] 1111 [ ] 1110 [ ] 1101 [ ] 1010

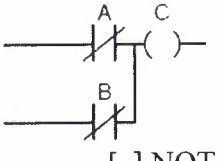
13. The Nyquist sampling theorem presents that a signal can be reconstructed is sampled at a rate of _____.
[ ] twice the maximum frequency. [ ] ten times the maximum frequency.
[ ] half the maximum frequency. [ ] four times the maximum frequency.

14. Find the Seeback emf for a material with $\alpha = 50\ \mu V/°C$ if the junction temperature are 20°C and 100°C.
[ ] 2mV [ ] 2.2mV [ ] 4mV [ ] 0.4 mV

15. A stepper motor has 10° per step and must rotate at 250 rpm. What input pulse rate, in pulses per second, is required?
[ ] 100 pulses/s [ ] 150 pulses/s [ ] 200 pulses/s [ ] 250 pulses/s

16. Sensor effectiveness depends on _____ parameter.
[ ] Sensitivity [ ] Resistivity [ ] Radiation [ ] Elevation

17. The ladder logic represents _____ logic gate.



[ ] NAND [ ] AND [ ] NOT [ ] OR

18. The final control function can be implemented by signal conditioning, _____, and a final control element.

[ ] sensor [ ] actuator [ ] linearization [ ] zero biasing

19. Temperature is measured by a sensor with an output of 0.02 V/°C. The required word size to measure 0° to 100°C with 0.1°C resolution is.

[ ] 6 [ ] 8 [ ] 10 [ ] 12

20. The _____ is a widely used process control standard for transmitting signals in industrial instrumentation systems.

[ ] 3-15 psi [ ] 1-10 VDC

[ ] MODBUS [ ] 4-20mA current loop

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SECTION "B"
[5 Q. × 8 = 40 marks]

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

1. a. For the mechanical system given below. Obtain the transfer function X1(S)/F(S) and X2(S)/F(S). [4]

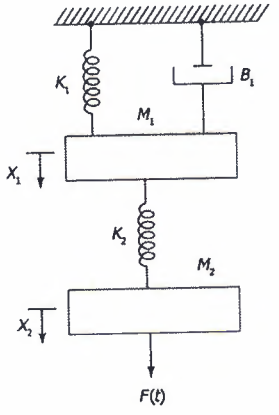

Figure 1: Mechanical system

b. Describe and differentiate open-loop and closed-loop control systems with examples based on construction, reliability, accuracy, stability, response and effect of external noise. [4]

2. a. A sensor outputs a range of 20.0 to 250 mV as a variable over its range. Develop signal conditioning so that this becomes 0 to 5 V. The circuit must have very high input impedance. [4]

b. With a neat diagram of binary-weighted DAC, find the analog output a digital input code of 1011. The reference voltage is taken as 10V. [4]

3. a. An automatic water level controller uses two numbers of float switches (one up and one down). The pump must run when the water is below lower level and must automatically shut down after the tank is full. Mention necessary conditions and draw a ladder diagram for the controller. [4]

b. Attempt **any two.** [4]

i. With a PID controller, the proportional, integral, and derivative terms have to be individually adjusted or tuned. Justify

ii. Explain the working of heat or smoke detector.

iii. What is final control in process control system?

P.T.O.

4. a. Simplify the block diagram to obtain the transfer function, C(S)/R(S). [4]

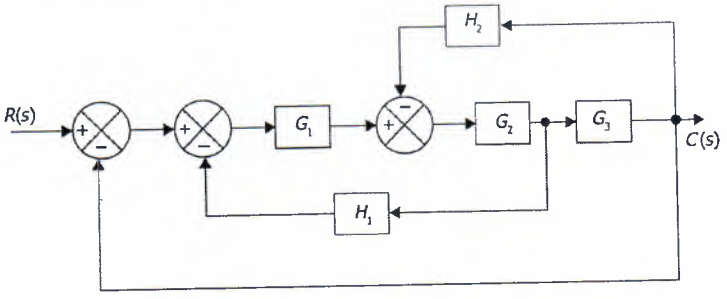

Figure 2: Block diagram of a system

b. The step response of a second order system is shown in figure 3. Determine the closed loop transfer function of the system. Assume unity feedback. [4]

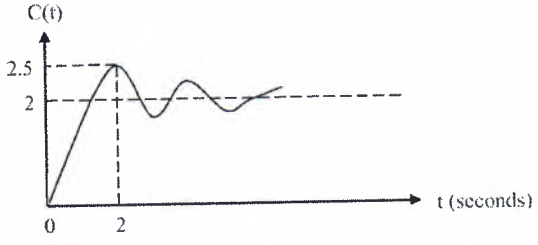

Figure 3: Step response of a system

5. a. Find the number of poles in the left half-plane, the right half-plane, and on the jω-axis for the system given in Figure 4. [4]

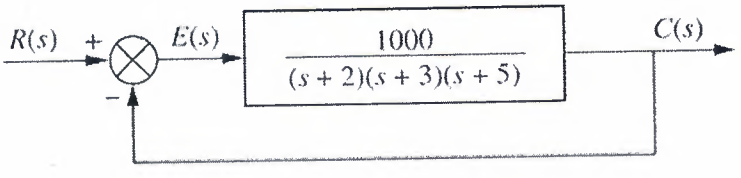

Figure 4: Feedback control system

b. An LVDT has a maximum core motion of ±1.5cm with a linearity of ±0.25% over that range. The transfer function is 24.8 mV/mm. If used to track work-piece motion from -1.0 to +1.2 cm, what is the expected output voltage? If the sensor output voltage is measured at 180mV, what range could the actual core position range be? [4]

6. a. Briefly explain different types of op-amp based signal conditioning circuits. [4]

b. What do you mean by actuators used in process control instrumentation? Write with example about different types of actuators used in process control instruments. [4]