DARBHANGA COLLEGE OF ENGINEERING, DARBHANGA

ME DEPARTMENT,FOURTH SEMESTER

INSTRUMENTATION AND CONTROL

PRACTICE QUESTIONS

1. **If a system has a gain of 5, what will be the output for an input voltage of 2 V?**

2.An open-loop system consists of three elements in series, the elements having gains of 2, 5 and 10. What is the overall gain of the system?

3.A closed-loop control system has a forward loop with a gain of 6 and a feedback loop with a gain of 2. What will be the overall steady-state gain of the system if the feedback is (a) positive, (b) negative?

4.Determine the delay time and the rise time for the following firstorder systems: (a) G{s) = 1/(4s + 1)

5.Determine the natural angular frequency, the damping factor, the rise time, percentage overshoot and 2% settling time for a system where the output y is related to the input x by the differential equation:

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 16y = 16x$$

6.State if the following systems are stable, the relationship between input X and output y being described by the differential equations

$$\text{(a) } \frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = x, \text{ (b) } \frac{d^2y}{dt^2} + \frac{dy}{dt} - 6y = x$$

7.Describe frequency response of a system.Determine the magnitude and the phase of the response of a system with transfer function 3/(s + 2) to sinusoidal inputs of angular frequency (a) 1 rad/s, (b) 2 rad/s

8..What are the frequency response functions for systems with transfer functions (a) l/(s + 5), (b) 1/(s + 2), (c) l/[(s + I0)(s + 2)J?

9.What are Bode plots?.Determine the asymptote Bode plot for the system having the transfer function:

$$G(s) = \frac{50(s+2)}{s(s+10)}$$

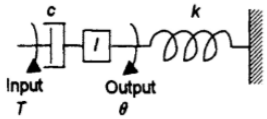
10.Explain Nyquist plot.How it can be used to determine stability of a system.Determine the gain margin and the phase margin for a system having an open-loop transfer function of

$$\frac{K}{s(s+1)(s+2)}$$

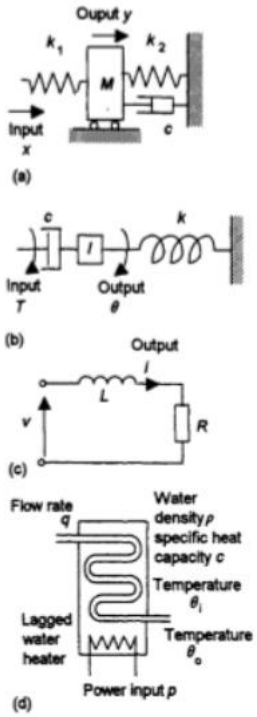
when $K = 4$.

11.A closed-loop negative feedback system for the control of the height of liquid in a tank by pumping liquid from a reservoir tank can be considered to be a system with a differential amplifier having a transfer function of 5, its output operating a pump with a transfer function 5/(s + 1). The coupled system of tanks has a transfer function, relating height in the tank to the output from the pump, of 3/(s + 1)(s + 2). The feedback sensor of the height level in the tank has a transfer function of 0.1. Determine the overall transfer function of the system, relating the input voltage signal to the system to the height of liquid in the tank.

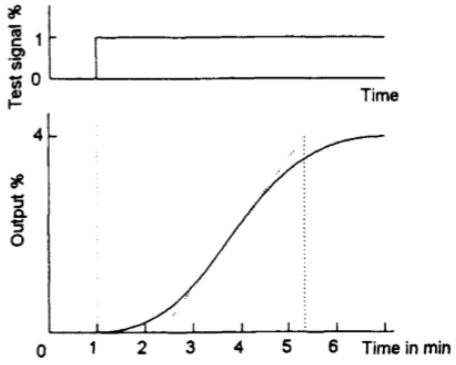
12.For a rotational system, the output theta is related to the input T.For the system to be critically damped, what is the realtion between *c,I* and *k*



14.Derive a differential equation relating the input and output for each of the systems shown in the following figures.



15. Write down the steps involved in the Ziegler-Nichols method for tuning PID controllers.Figure below shows the open-loop response of a system to a unit step in controller output. Using the Ziegler-Nichols data, determine the optimum settings of the PID controller to be used in the system to give good performance.



16. **Figure below shows a control system designed to control the level of water in the container to a constant level. It uses a proportional controller with Kp equal to 10. The valve gives a flow rate of 10 m^3/hr per percent of controller output, its flow rate being proportional to the controller input. If the controller output is initially set to 50% what will be the outflow from the container? If the outflow increases to 600 m^3/h, what will be the new controller output to maintain the water level constant?**

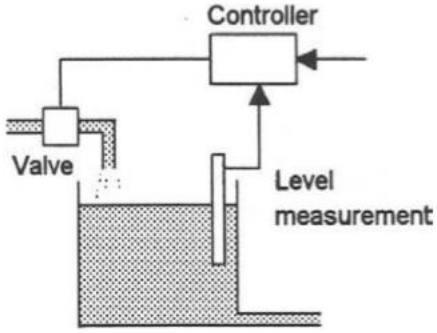


Fig.Proportional controller for water level control

17. **A temperature control system has a set point of 20°C and the measured value is 18°C. What is (a) the absolute deviation, (b) the percentage deviation?**
18. **What is the controller gain of a temperature controller with a 80% PB if its input range is 40°C to 90° and its output is 4 mA to 20 mA?**
19. **Using the Ziegler-Nichols ultimate cycle method for the determination of the optimum settings of a PID controller, oscillations began with a gain of 2.2 with a period of 12 min. What would be the optimum settings for the PID controller?**
20. **Sketch graphs showing how the controller output will vary with time for the error signal shown in Figure 5.34 when the controller is set initially at 50% and operates as (a) just proportional with a Kp = 5, (b)**

proportional plus derivative with Kp = 5 and Kd = 1.0 s, (c) proportional plus integral with Kp = 5 and Ki= 0.5 /s.

21.The cross-sectional area A of 3, wire is to be determined from a measurement of the diameter d, being given by A =$\frac{1}{4}\pi d^2$ The diameter is measured as 2.5 ± 0.1 mm. What will be the error in the area?

22. List and explain the functional elements of a measurement system