

12RSEN Control Systems and Sensors – Sample Examination Test

Winter Semester 2025/6

1. Explain the principle of closed-loop control system. What are its main components? 3 points
2. Define the static and dynamic characteristics of a control system. What are their mathematical representations? 2 points
3. Define (Laplace) transfer function for linear, time-invariant system. What is characteristic polynomial and characteristic equation of a transfer function? Demonstrate these concepts using a specific example of a second-order system. 4 points
4. How is the stability of a control system generally defined? What condition must the poles of a continuous-time system satisfy for the system to be stable? Where is the stability boundary located in the complex s-plane? 3 points
5. What is the frequency response of a system? How is it measured, and what are its applications? What does a logarithmic frequency response plot (Bode plot) illustrate? 4 points
6. Figures 1 through 4 show the step responses of various control systems. For each response, identify the basic model structure and estimate the order of the system (it is sufficient to distinguish between first-order and second-or-higher-order systems). 5 points
7. Can you name the basic and combined types of controllers? Which of these controllers can ensure zero steady-state error? 3 points
8. What defines the transient response shape of a control system? What are the key time-domain performance indices? Identify and mark these indices on the step response of the control system shown in Figure 5. 6 points
9. Draw a block diagram of a simple digital (discrete-time) control loop that includes a discrete controller and a continuous-time plant. Label the reference input, output variable, and the error signal on your diagram. 3 points
10. List the fundamental methods for describing the dynamic behavior of a discrete-time LTI (Linear Time-Invariant) system. Demonstrate one of these methods using a specific example of a second-order discrete-time system. 3 points
11. List four fundamental static and dynamic characteristics of sensors. Briefly describe the significance of each. 4 points
12. What is an active sensor? Provide an example of an active temperature sensor and explain its operating principle. 3 points
13. What types of thermal sensors (temperature-based sensors) are used for measuring laser power and energy? 2 points
14. What types of optical sensors are used for single-photon detection? 2 points
15. Describe the two basic operating modes (circuits) for a photodiode. Which mode is used to achieve higher sensitivity? 3 points

Grading:

45-50 points.....	A
40-44 points.....	B
35-39 points.....	C
30-34 points.....	D
25-29 points.....	E

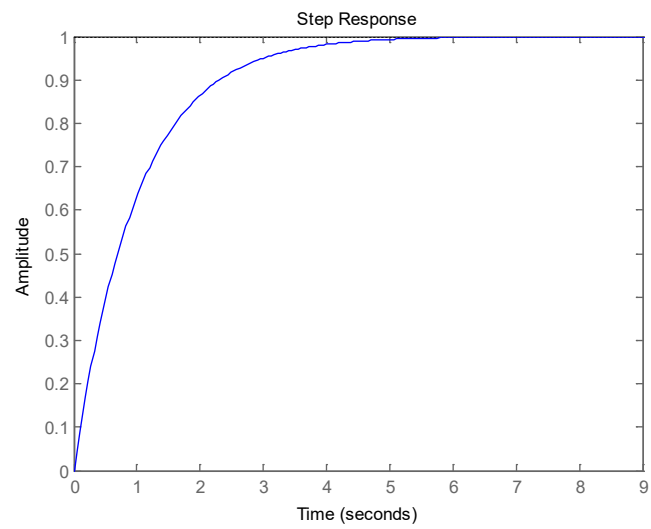


Figure 1

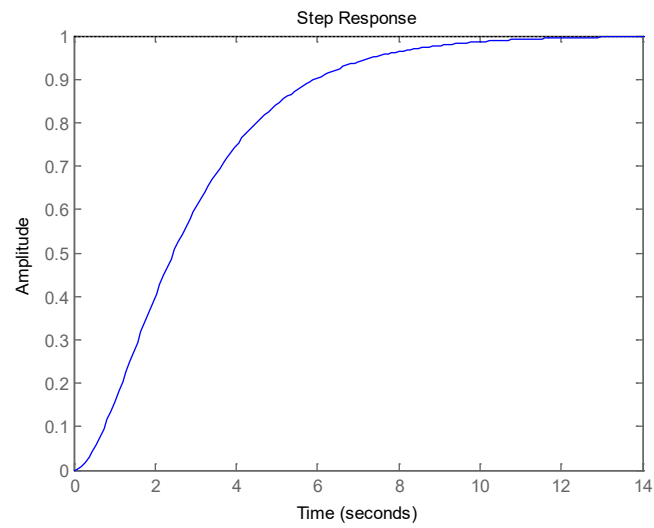


Figure 2

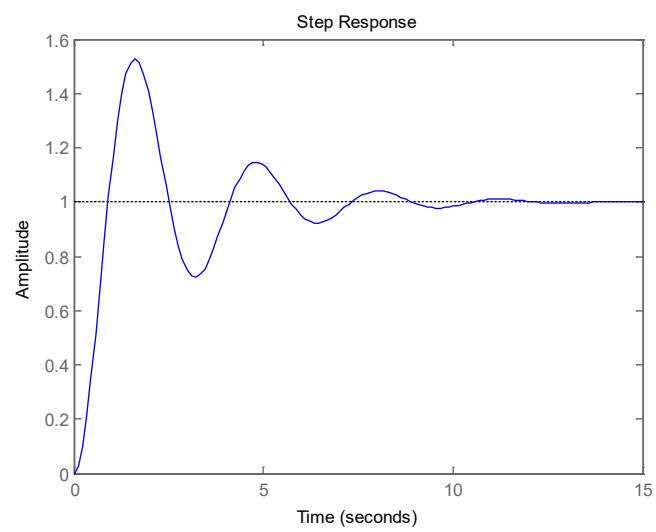


Figure 3

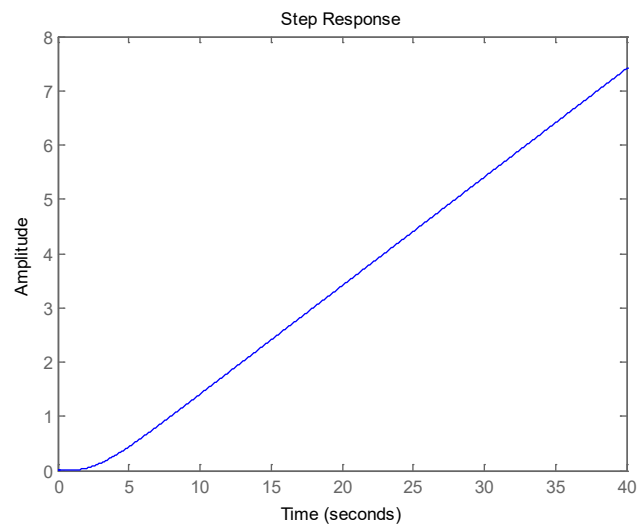


Figure 4

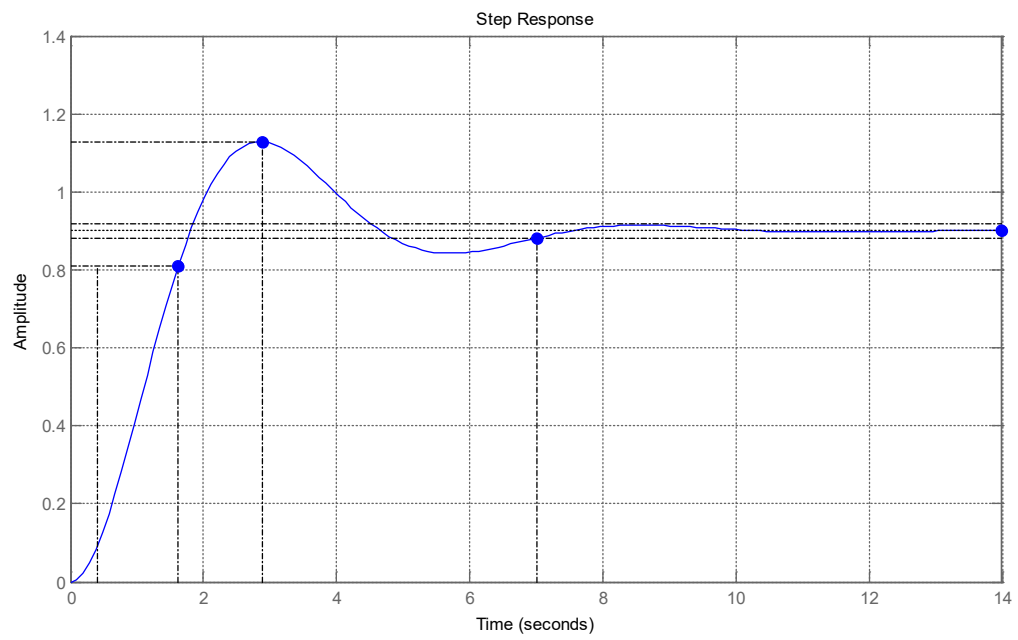


Figure 5