|  |  |  |  |
| --- | --- | --- | --- |
| **Course Name:** | **Automation & Control Systems** | **Semester:** | **V** |
| **Date of Performance:** | **24 / 07 / 2024** | **Batch No:** | **B - 1** |
| **Faculty Name:** | **Shila Dande** | **Roll No.:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade / Marks:** | **\_\_\_ / 25** |

**Experiment No.: 1**

**Title: Determine the impulse and step response for type ‘0’, type ‘1’ and type ‘2’ systems**

|  |
| --- |
| **Aim and Objective of the Experiment:** |
| Determine the impulse and step response for type ‘0’, type ‘1’ and type ‘2’ systems. |

|  |
| --- |
| **COs to be achieved:** |
| **CO1:** Understand the basic concepts of control system. |

|  |
| --- |
| **Theory:** |
| A real time system can be expressed by its transfer function. Based on presence of poles at origin of s plane, transfer functions can be classified as Type ‘0’, Type ‘1’, Type ‘2’ …. Systems. Let open loop transfer function a system is expressed as:  G(s)H(s)=k∗(1+sTa)(2+sTb).........sN(1+sT1)(1+sT2)...............(i)  From equation (i) it is clear that ‘N’ determines the number of poles at origin.  For a Type '0' system, N = 0  For a Type '1' system, N = 1  For a Type '2' system, N = 2  .  .  .  .  For a Type ‘N’ system, N = N    The steady state error can be found out by the following equation:  Ess = sR(s)1+G(s)H(s)  https://ce-dei.vlabs.ac.in/exp/type-zero-one-two-system/images/exp4graph.png |

|  |
| --- |
| **Procedure:** |
| **Procedure: Select “To determine Step and Impulse response of Type 0 2nd order system”.**  **User Input:**  Firstly, adjust the values of the coefficient c of a numerator polynomial by sliding the slider. Now adjust the value of coefficients p, q and r of a denominator polynomial by sliding the slider. Press “Submit” button to submit the values of coefficients of numerator and denominator polynomial.  **Calculations:**  Click “Run” button to obtain input transfer function with the given coefficients. Click on “Run” button again to obtain the step response transfer function. Again, click on “Run” button to obtain the impulse response transfer function. Once again, click on “Run” button to obtain the step response and impulse response in time domain, static error coefficient and the steady-state error.  **Results:**  Once more, click on the “Run” button to obtain the step response and impulse response plots in the result section and the conclusions of the experiment in the Conclusions Section.  **Procedure: Select “To determine Step and Impulse response of Type 1 2nd order system”.**  **User Input:**  Firstly, adjust the values of the coefficient c of a numerator polynomial by sliding the slider. Now adjust the value of coefficients p, q and r of a denominator polynomial by sliding the slider. Press “Submit” button to submit the values of coefficients of numerator and denominator polynomial.  **Calculations:**  4.2.2.1 Click “Run” button to obtain input transfer function with the given coefficients. 4.2.2.2 Click on “Run” button again to obtain the step response transfer function. 4.2.2.3 Again, click on “Run” button to obtain the impulse response transfer function. 4.2.2.4 Once again, click on “Run” button to obtain the step response and impulse response in time domain, static error coefficient and the steady-state error.  **Results:**  Once more, click on the “Run” button to obtain the step response and impulse response plots in the result section and the conclusion of the experiment in the Conclusions Section.  **Procedure: Select “To determine Step and Impulse response of Type 2 2nd order system”.**  **User Input:**  Firstly, adjust the values of the coefficient c of a numerator polynomial by sliding the slider. Now adjust the value of coefficients p, q and r of a denominator polynomial by sliding the slider. Press “Submit” button to submit the values of coefficients of numerator and denominator polynomial.  **Calculations:**  Click “Run” button to obtain input transfer function with the given coefficients. Click on “Run” button again to obtain the step response transfer function. Again, click on “Run” button to obtain the impulse response transfer function. Once again, click on “Run” button to obtain the step response and impulse response in time domain, static error coefficient and the steady-state error.  **Results:**  Once more, click on the “Run” button to obtain the step response and impulse response plots in the result section and the conclusion of the experiment in the Conclusions Section. |

|  |
| --- |
| **MATLAB Simulation Result:** |
|  |

|  |
| --- |
| **Virtual Lab Simulation Result:** |
| 1. [**Pole-zero plot**](https://ce-dei.vlabs.ac.in/exp/pole-zero-plot/)**:**   Graph of pole-zero –    Post-test –     1. [**First order unity feedback**](https://ce-dei.vlabs.ac.in/exp/first-order-unity-feedback/)**:**   To determine step response of 1st order system –    To determine Impulse response of 1st order system –    Post-test –     1. [**Second order unity feedback system**](https://ce-dei.vlabs.ac.in/exp/second-order-unity-feedback-system/)**:**   To determine Step response of 2nd order system –    To determine Impulse response of 2nd order system –    Post-test – |

|  |
| --- |
| **Post Lab Subjective / Objective Type Questions:** |
| 1. **Why do we perform Laplace Transform?**    a: It is useful for study of transient responses (or time responses) of Linear Time-Invariant Systems (LTIS).   b: It is also utilised to solve complex differential equations.   c: Both a and b   d: None of the above   1. **Why Transfer Function is always realised in S domain?**    a: To calculate output y(t) of system in time domain the convolution of the input with the response signal is to be calculated. This makes it a complex process.   b: Mathematics involved in Transformation of the equation made the realization easier to understand.   c: Both a and b   d: None of the above   1. **What is the Laplace transform of Ramp Response?**    a: 1/S3   b: 1/S2   c: 1/S   d: None of the above  **Statement: An impulse response is defined as signal caused due to sudden change in amplitude.**   1. **Example: Impulse response is taken into consideration while testing breaking mechanism of designed automobile.**    a: Example is able to explain the statement.   b: Example is contradicting the information.   c: Information provided in example is not enough to draw a conclusion.   d: None of the above   1. **Which of the following statement is correct?**    a: Based on the presence of poles at origin we can classify Type of system.   b: Type 0 system has more poles at origin compare to type 1 and 2 system.   c: Both a and b   d: None of the above   1. **An open loop Type 1 Impulse response is similar to?**    a: Type 0 step response   b: Type 0 impulse response   c: Type 0 ramp response   d: None of the Above   1. **Steady state error of Type 0 Ramp response is?**    a: 0   b: Infinity   c: A/(1+k)   d: None of the Above   1. **Steady state error of Type 0 Step response is?**    a: 0   b: Infinity   c: A/(1+k)   d: None of the Above   1. **To estimate steady state error for step response we use expression i.e., ess = A/(1+KP ). What does Kp signifies.?**    a: Position Constant   b: Velocity Constant   c: Acceleration Constant   d: None of the Above   1. **If the transfer function G(s) = 1/((S2+2S+1)), what is going to be the open loop output response for input response which is ramp in nature?**    a: G(s)/S2   b: G(s)/S   c: G(s)   d: None of the Above |

|  |
| --- |
| **Conclusion:** |
| The impulse response reveals the immediate effect of an input on a system, while the step response shows how the system reacts over time. Higher system types (Type '1' and Type '2') exhibit more complex behavior, including integration effects, resulting in ramp and parabolic responses respectively. |

**Signature of faculty in-charge with Date:**