Lab Title: PID Controller Tuning Using S-Shape Methods

Objective:
This lab aims to explore the tuning of a PID controller using S-shape methods to optimize the response of a given control system.

Equipment/Software Required:
1. MATLAB/Simulink
2. Control System Toolbox

System Transfer Function:
The system under consideration has a transfer function represented as:

$G(s) = 10 / (s+2)(s+5)$

Lab Procedure:

Part 1: System Setup
1. **Model Creation:** Construct the system model in Simulink using the provided transfer function.
2. **PID Controller Integration:** Integrate a PID controller into the system model.

Part 2: Initial System Response
1. **PID Parameter Initialization:** Set initial values for the PID controller parameters.
2. **System Operation:** Run simulations to observe the system's response with the initial PID parameters.

Part 3: S-Shape Parameter Optimization
1. **S-Shape Method Application:** Apply the S-shape method to incrementally adjust PID parameters. Gradually modify Kp, Ki, and Kd in controlled increments, observing system responses after each change.
2. **Data Collection:** Record system behavior and performance metrics (e.g., overshoot, settling time) at each parameter adjustment step.

Part 4: Comparative Analysis
1. **Response Evaluation:** Compare and analyze system responses with different PID parameter settings.
2. **Performance Metrics Comparison:** Evaluate performance metrics obtained at various parameter settings.

Part 5: Optimal Parameter Selection
1. **Parameter Selection:** Determine the PID parameters that optimize system performance and stability, considering observed data.
2. **Validation:** Validate the chosen parameters by running the system with the optimized PID settings.

Conclusion:

Summarize the impact of S-shape methods in PID parameter optimization. Discuss the significance of selecting optimal PID parameters for improved system performance and stability based on observed data and comparative analysis from the conducted experiments.