Problem 3

# **CODE:**

% PROBLEM 3

% Clear workspace

close all

clear

clc

% Add parser and solver to path

addpath(genpath('C:\Users\tsamak\Downloads\MathWorks\Toolboxes\archives\required\YALMIP'))

addpath(genpath('C:\Users\tsamak\Downloads\MathWorks\Toolboxes\archives\required\SeDuMi'))

% Define the system matrices

A1 = [-4, 1; 0, 2];

B1 = [1; 0];

A2 = [-3, 2; 4, 1];

B2 = [0; 1];

% Define decision variables

n = size(A1, 1); % Number of states

P1 = sdpvar(n, n);

P2 = sdpvar(n, n);

Z1 = sdpvar(1, n);

Z2 = sdpvar(1, n);

% Define the LMI constraints for SYS1

Constraints1 = [P1 >= 0.001\*eye(n), A1\*P1 + P1\*A1' + B1\*Z1 + Z1'\*B1' <= 0];

% Define the LMI constraints for SYS2

Constraints2 = [P2 >= 0.001\*eye(n), A2\*P2 + P2\*A2' + B2\*Z2 + Z2'\*B2' <= 0];

% Solve the LMI for SYS1

options = sdpsettings('verbose', 0);

sol1 = optimize(Constraints1, [], options);

% Solve the LMI for SYS2

sol2 = optimize(Constraints2, [], options);

% Check the feasibility of the LMIs and compute Z1 and Z2 if feasible

if sol1.problem == 0

disp('SYS1 is stabilizable.');

% Compute stabilizing control gain

K1 = value(Z1)/value(P1);

disp('Stabilizing control gain for SYS1:');

disp(K1);

% Verify stabilizing control gain

disp('Verifying stabilizing control gain for SYS1...');

Acl1 = A1+B1\*K1;

eigAcl1 = real(eig(Acl1));

disp('Eigen values (real parts) for closed loop SYS1:');

disp(eigAcl1);

if eigAcl1 <= 0

disp('Verification successful!')

else

disp('Verification failed!')

end

else

disp('SYS1 is not stabilizable.');

end

if sol2.problem == 0

disp('SYS2 is stabilizable.');

% Compute stabilizing control gain

K2 = value(Z2)/value(P2);

disp('Stabilizing control gain for SYS2:');

disp(K2);

% Verify stabilizing control gain

disp('Verifying stabilizing control gain for SYS2...');

Acl2 = A2+B2\*K2;

eigAcl2 = real(eig(Acl2));

disp('Eigen values (real parts) for closed loop SYS2:');

disp(eigAcl2);

if eigAcl2 <= 0

disp('Verification successful!')

else

disp('Verification failed!')

end

else

disp('SYS2 is not stabilizable.');

end

# **OUTPUT:**

SYS1 is not stabilizable.

SYS2 is stabilizable.

Stabilizing control gain for SYS2:

-7.8742 -0.6528

Verifying stabilizing control gain for SYS2...

Eigen values (real parts) for closed loop SYS2:

-1.3264

-1.3264

Verification successful!

# **SCREENSHOT:**

