```
disp("Part B (1)")
```

```
Part B (1)
```

```
A = [0, 0, 1, 0;
     0, 0, 0, 1;
     -0.9, 0.9, -0.09, 0.09;
     0.1, -0.1, 0.01, -0.01];
disp(A)
```

```
         0         0    1.0000         0
         0         0         0    1.0000
   -0.9000    0.9000   -0.0900    0.0900
    0.1000   -0.1000    0.0100   -0.0100
```

```

% Calculate the eigenvalues and eigenvectors of matrix A
[eigenVectors, eigenValues] = eig(A);

disp(diag(eigenValues))
```

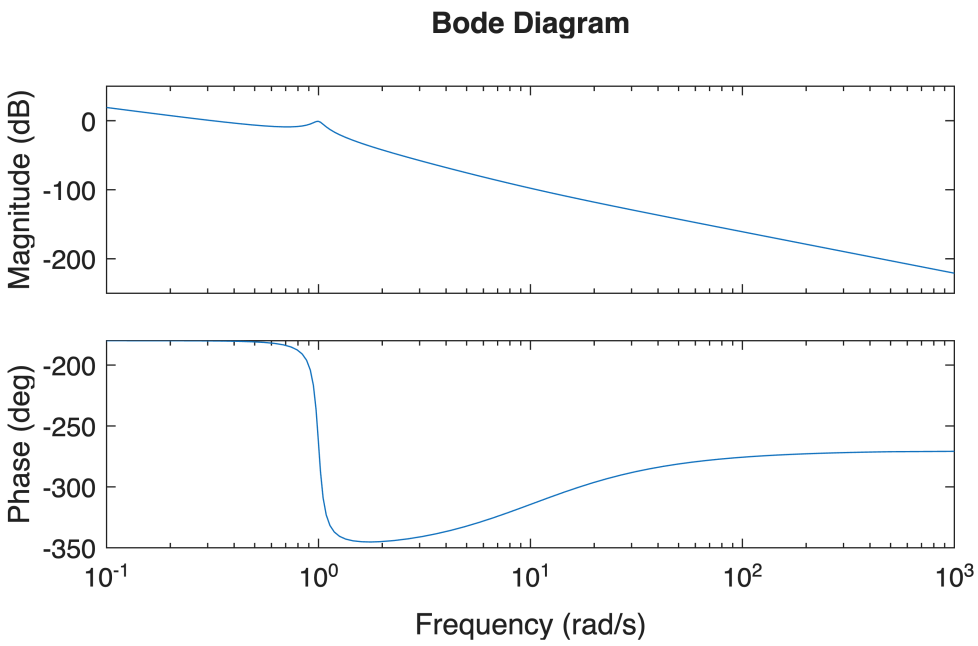
```
  -0.0500 + 0.9987i
  -0.0500 - 0.9987i
  -0.0000 + 0.0000i
   0.0000 + 0.0000i
```

```

```

```
disp("Part B (2)")
```

```
Part B (2)
```

```
A = [0, 0, 1, 0;
     0, 0, 0, 1;
     -0.9, 0.9, -0.09, 0.09;
     0.1, -0.1, 0.01, -0.01];

B = [0; 0; 0.9; 0];

C = [0, 1, 0, 0];

D = 0;

sys = ss(A, B, C, D);

bode(sys)
```




```
pole(sys)
```

```
ans = 4×1 complex
  -0.0500 + 0.9987i
  -0.0500 - 0.9987i
  -0.0000 + 0.0000i
   0.0000 + 0.0000i
```

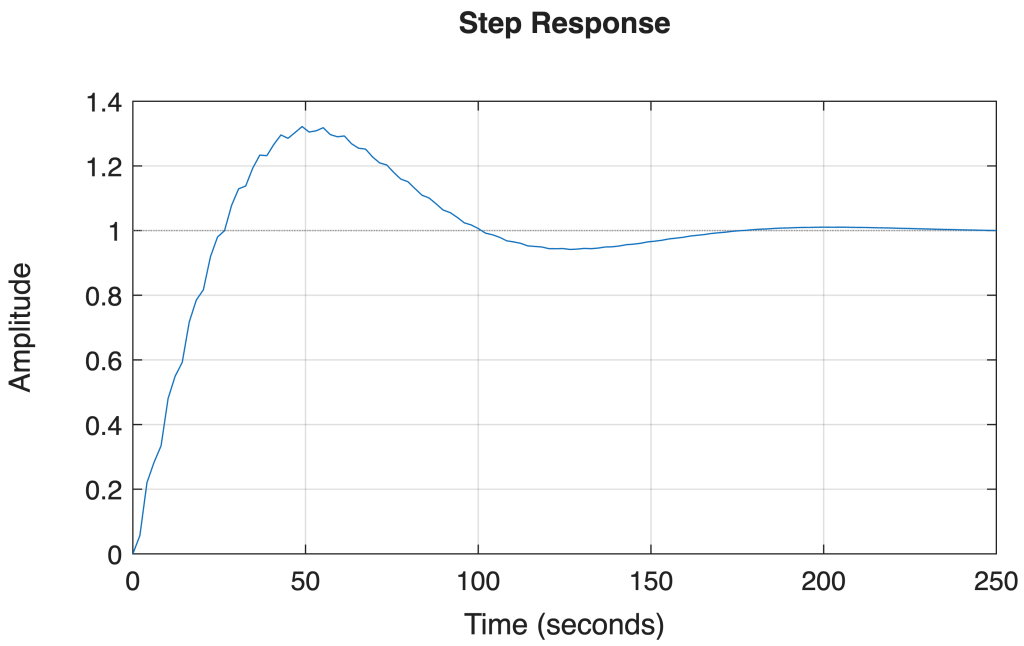
```
zero(sys)
```

```
ans =
-10.0000
```

```
disp("Part C")
```

```
Part C
```

```
Kp = 0.025;
Kd = 0.5;

C_pd = tf([Kd Kp],[1]);

sys_cl = feedback(C_pd*sys,1);

step(sys_cl)
grid on
```




```
info = stepinfo(sys_cl, 'SettlingTimeThreshold', 0.02);
ss_error = abs(1 - dcgain(sys_cl));

fprintf('Rise time: %.3f s\n', info.RiseTime);
```

```
Rise time: 19.502 s
```

```
fprintf('Settling time: %.3f s\n', info.SettlingTime);
```

```
Settling time: 159.718 s
```

```
fprintf('Percent overshoot: %.2f %%\n', info.Overshoot);
```

```
Percent overshoot: 32.18 %
```

```
fprintf('Steady-state error: %.3f rad\n', ss_error);
```

```
Steady-state error: 0.000 rad
```

```

```

```
disp("Part D (1) ")
```

```
Part D (1)
```

```
desired_poles = [-2, -1, -1+1i, -1-1i];

K = place(A, B, desired_poles);

disp(K);
```

```
    8.9333   35.5111    5.4444  101.2222
```

```
Acl = A - B*K;
eigAcl = eig(Acl);
disp(eigAcl)
```

```
  -2.0000 + 0.0000i
  -1.0000 + 1.0000i
  -1.0000 - 1.0000i
  -1.0000 + 0.0000i
```

```
disp("Part D (2)")
```

```
Part D (2)
```

```
Kr = -1 / (C * ((A - B*K) \ B))
```

```
Kr =
44.4444
```

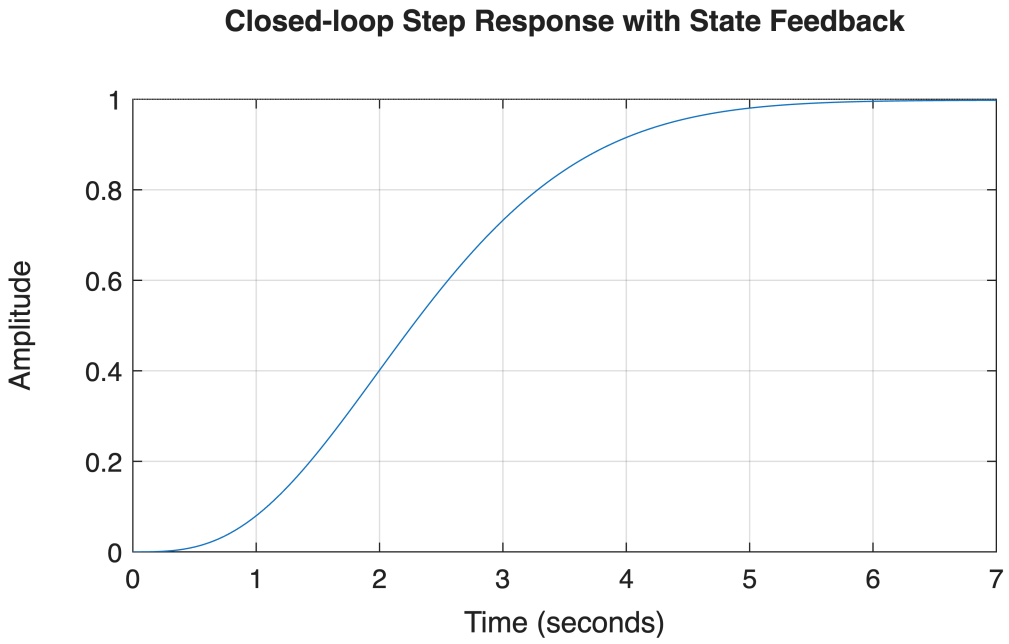
```
disp("Part D (3)")
```

```
Part D (3)
```

```
Bcl = B * Kr
```

```
Bcl = 4×1
         0
         0
   40.0000
         0
```

```
Acl = A - B*K;
Bcl = B*Kr;

sys_fb = ss(Acl, Bcl, C, 0);

step(sys_fb)
grid on
title('Closed-loop Step Response with State Feedback')
```




```
info = stepinfo(sys_fb, 'SettlingTimeThreshold', 0.02);
ss_error = abs(1 - dcgain(sys_fb));

fprintf('Rise time: %.3f s\n', info.RiseTime);
```

```
Rise time: 2.782 s
```

```
fprintf('Settling time: %.3f s\n', info.SettlingTime);
```

```
Settling time: 4.984 s
```

```
fprintf('Percent overshoot: %.2f %%\n', info.Overshoot);
```

```
Percent overshoot: 0.00 %
```

```
fprintf('Steady-state error: %.3f rad\n', ss_error);
```

```
Steady-state error: 0.000 rad
```

```

```