Problem 11.05

File: `Ch11_P05.m`

---------- SOLUTION ----------

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Solution Part (a). Y(s)/Ysp(s)

Step 1. Open loop transfer functions

```
Gc = tf([1],[1]);
Gv = tf([2],[1]);
Gd = tf([2],[1 1 0]);
Gp = Gd;
Gm = tf([1],[1]);
Km = Gm;
```

Step 2. Develop closed-loop transfer functions

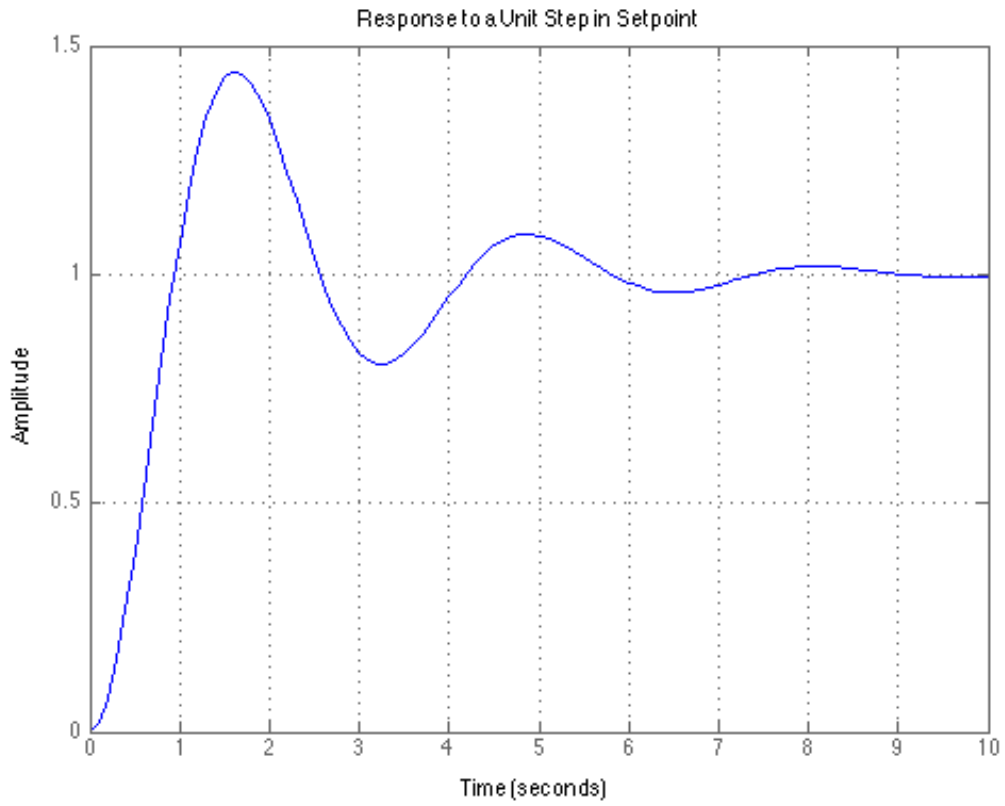
```
Hyd = Gd/(1 + Gp*Gv*Gc*Gm);
Hyr = Gp*Gv*Gc*Km/(1 + Gp*Gv*Gc*Gm);

display(Hyr);
```

```
Hyr =

         4 s^2 + 4 s
  -------------------------
  s^4 + 2 s^3 + 5 s^2 + 4 s

Continuous-time transfer function.
```

Solution Part (b). y(infinity)

```
t = 0:0.1:10;
step(Hyr,t);
title('Response to a Unit Step in Setpoint');
grid
displaytable(dcgain(Hyr),'Steady State Unit Step Response = ');
```

```
Steady State Unit Step Response =    1
```



Solution Part (c). Offset

```
displaytable(dcgain(Hyr)-1,'Steady State Offset = ');
```

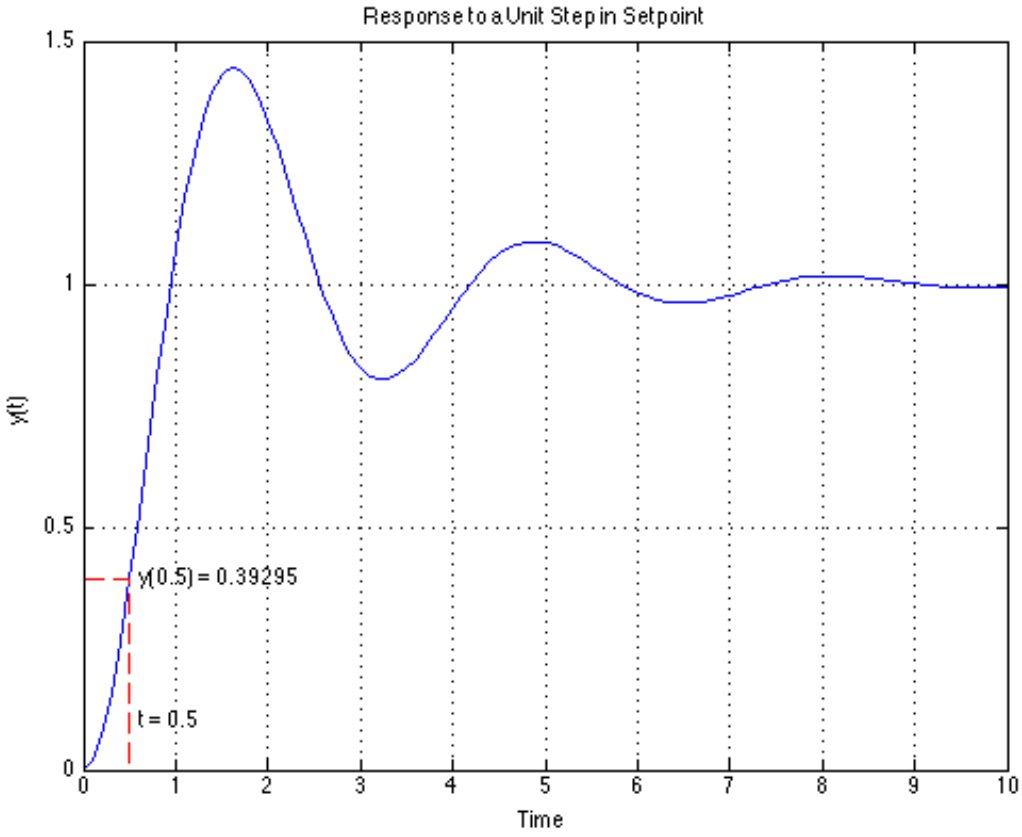
```
Steady State Offset =    0
```

Solution Part (d). Response at t = 0.5

```
t = 0:0.1:10;
y = step(Hyr,t);
plot(t,y);
xlabel('Time');
ylabel('y(t)');
title('Response to a Unit Step in Setpoint');
grid
displaytable(dcgain(Hyr),'Steady State Unit Step Response = ');

z = y(find(t==0.5));
hold on
```

```
plot([0.5 0.5 0],[0 z z],'r--');
text(0.6,0.1,'t = 0.5');
text(0.6,z,['y(0.5) = ',num2str(z)]);
hold off;
```

```
Steady State Unit Step Response =   1
```



Solution Part (e). Is the closed-loop response oscillatory?

The step response is underdamped but not oscillatory.

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