Example 2-17: Car Response to a Curb.

Purpose:

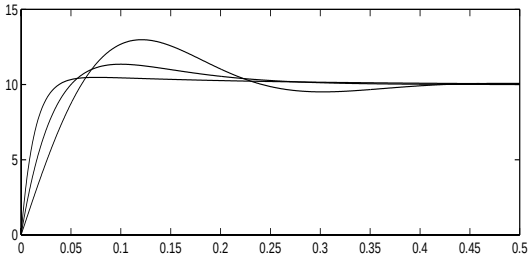
A car with a mass of 1000 kg is driven over a 10-cm-high curb. Each wheel is supported by a coil with spring constant $k = 10^5$ N/m. Determine the car's response to driving over the curb for each of the following values of b, the damping constant of the shock absorber: (a) 2×10^4 N·s/m, (b) 10^4 N·s/m, (c) 5000 N·s/m.

Inputs:

M=car mass in kg.
K=spring constant of coil in N/m.
B=damping of shock absorber in N·s/m.
A=curb amplitude in cm.

Output:

Y=displacement of car in cm.



Comments:

- Divide the car mass M by 4, since each wheel supports 1/4 of car mass.
- The formula for the overdamped case also works for the underdamped case.
- For the critically damped case, perturb B. The output does not change noticeably.

Program:

```
clear;M=1000;K=100000;A=10;
M=M/4;for B=[20000 10001 5000];
%Use formulae from the text.
a1=B/M;a2=K/M;b1=B/M;b2=K/M;
wo=sqrt(a2);aa=a1/2;xi=aa/wo;
p1=wo*(-xi+sqrt(xi*xi-1));
p2=wo*(-xi-sqrt(xi*xi-1));
A1=(b1*p1+b2)/(p1-p2);
A2=-(b1*p2+b2)/(p1-p2);
t=linspace(0,0.5,1000);
Y=A*A1/p1*(exp(p1*t)-1);
Y=Y+A*A2/p2*(exp(p2*t)-1);
subplot(211),plot(t,Y),
axis([0 0.5 0 15]),hold on,end
```