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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Example 3.2 %
% phase diagram for underdamped oscillator with omega_0 = 1 %
% initial conditions: x(0) = 1, v(0) = 0 %
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clear all;
clc;

t = [0:.05:20];
beta = 0.1;
delta = atan(beta/sqrt(1-beta^2));

for m = 1:size(t,2)
    x(m) = 1/cos(delta)*exp(-beta*t(m))*cos(sqrt(1-beta^2)*t(m)-delta);
    v(m) = -beta/cos(delta)*exp(-beta*t(m))*cos(sqrt(1-beta^2)*t(m)-delta)-sqrt(1-
beta^2)/cos(delta)*exp(-beta*t(m))*sin(sqrt(1-beta^2)*t(m)-delta);
end

%u = sqrt(1-beta^2)*x;
%w = beta*x + v;

plot(x,v,'. ')
axis([-1 1 -1 1])
```