

```

clear
syms beta F x0 v0 real
syms x(t)

omega = [0 0.5 1 1.5 2];
omegazero = [1 1 1 1 1];
omegaprime = 10*omega;

figure;hold on
leg=[];
time=[0:.1:100];
F0val=1;betaval=.1;v0val=0;x0val=0;

for i=1:5
    ode = diff(x,t,2) + beta*diff(x,t,1) + omegazero(i)^2*x(t) == F*(cos(omega(i)*t) + cos(omegaprime(i)*t));

    cond1 = x(0)==x0;
    Dx = diff(x);
    cond2 = Dx(0)==v0;
    conds = [cond1 cond2];
    xSol(t) = dsolve(ode,conds);
    xSol = simplify(xSol);

    osc = matlabFunction(xSol)
    xosc=real(osc(time, F0val,betaval,v0val,x0val));
    plot(time,xosc)

    leg=cat(1,leg,strcat("\omega_0 = "+ num2str(omega(i))));
end

```

ode(t) =

$$\frac{\partial^2}{\partial t^2} x(t) + \beta \frac{\partial}{\partial t} x(t) + x(t) = 2 F$$

osc = function_handle with value:

@(t,F,beta,v0,x0)F.*2.0-(exp(t.*(beta+sqrt(beta.^2-4.0)).*(-1.0./2.0)).*1.0./sqrt(beta.^2-4.0).*(v0.*2.0-F.*beta

$$\frac{\partial^2}{\partial t^2} x(t) + \beta \frac{\partial}{\partial t} x(t) + x(t) = F \left(\cos\left(\frac{t}{2}\right) + \cos(5 t) \right)$$

osc = function_handle with value:

@(t,F,beta,v0,x0)(exp(t.*(beta+sqrt(beta.^2-4.0)).*(-1.0./2.0)).*1.0./sqrt(beta.^2-4.0).*(v0.*-1.0368e+4+F.*beta

$$\frac{\partial^2}{\partial t^2} x(t) + \beta \frac{\partial}{\partial t} x(t) + x(t) = F (\cos(10 t) + \cos(t))$$

osc = function_handle with value:

@(t,F,beta,v0,x0)(exp(t.*(beta+sqrt(beta.^2-4.0)).*(-1.0./2.0)).*1.0./sqrt(beta.^2-4.0).*(F.*1.9602e+4-beta.*v0.

$$\frac{\partial^2}{\partial t^2} x(t) + \beta \frac{\partial}{\partial t} x(t) + x(t) = F \left(\cos\left(\frac{3 t}{2}\right) + \cos(15 t) \right)$$

osc = function_handle with value:

@(t,F,beta,v0,x0)(exp(t.*(beta+sqrt(beta.^2-4.0)).*(-1.0./2.0)).*1.0./sqrt(beta.^2-4.0).*(v0.*-2.5088e+6+F.*beta

ode(t) =

$$\frac{\partial^2}{\partial t^2} x(t) + \beta \frac{\partial}{\partial t} x(t) + x(t) = F (\cos(2t) + \cos(20t))$$

osc = function_handle with value:

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@(t,F,beta,v0,x0)(exp(t.*(beta+sqrt(beta.^2-4.0)).*(-1.0./2.0)).*1.0./sqrt(beta.^2-4.0).*(v0.*-2.865618e+6+F.*be
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```
xlabel('t (s)');ylabel('x(t) (m)');
title('Oscillator Displacement v Time, difference of Heavisides, various natural frequencies');
legend('leg')

hold off
```

Oscillator displacement vs time, step function force, various natural frequency

