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[ STUDENT > restart;
[ STUDENT > # analytical solution ASSUMING that the force pulse is
    impulse-like
[ STUDENT > # i.e. occurs with duration << sqrt(k/m)
[ STUDENT > # So problem is simply solving SDOF with initial
    condition...
[ STUDENT > #    V0 = Fpulse*Tpulse/m
[ STUDENT >
[ STUDENT > # Additionally, assume underdamped system
[ STUDENT > restart;
[ STUDENT > with(inttrans);
[ [addtable, fourier, fouriercos, fouriersin, hankel, hilbert, invfourier, invhilbert, invlaplace,
    laplace, mellin]
[ STUDENT >
[ STUDENT > sigma:=c/2/m;


$$\sigma := \frac{1}{2} \frac{c}{m}$$

[ STUDENT > w0:=sqrt(k/m);


$$w0 := \sqrt{\frac{k}{m}}$$

[ STUDENT > wd:=sqrt(w0^2-sigma^2);


$$wd := \frac{1}{2} \sqrt{4 \frac{k}{m} - \frac{c^2}{m^2}}$$

[ STUDENT >
[ STUDENT > x(t):=Xmax*sin(wd*t)*exp(-t*c/2/m); # phase angle of sin

    # assumed zero since pulse is assumed so short that
    #displacement is 0 (approximation)


$$x(t) := 2 \frac{F_{\text{pulse}} T_{\text{pulse}} \sin\left(\frac{1}{2} \sqrt{4 \frac{k}{m} - \frac{c^2}{m^2}} t\right) e^{\left(-1/2 \frac{tc}{m}\right)}}{\sqrt{-\frac{-4 k m + c^2}{m^2} m}}$$

[ STUDENT > v(t):=diff(x(t),t);


$$v(t) := \frac{F_{\text{pulse}} T_{\text{pulse}} \cos\left(\frac{1}{2} \sqrt{4 \frac{k}{m} - \frac{c^2}{m^2}} t\right) \sqrt{4 \frac{k}{m} - \frac{c^2}{m^2}} e^{\left(-1/2 \frac{tc}{m}\right)}}{\sqrt{-\frac{-4 k m + c^2}{m^2} m}}$$


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$$-\frac{F_{\text{pulse}} T_{\text{pulse}} \sin\left(\frac{1}{2}\sqrt{4\frac{k}{m}-\frac{c^2}{m^2}}t\right) c e^{\left(-1/2\frac{tc}{m}\right)}}{\sqrt{-\frac{-4km+c^2}{m^2}}m^2}$$

$$Eq1 := X_{\text{max}} \sin(-\theta) e^0 = 0$$

STUDENT > **Xmax:=simplify(solve(subs(t=0,v(t))=Fpulse*Tpulse/m,Xmax))**
;

$$X_{\text{max}} := 2 \frac{F_{\text{pulse}} T_{\text{pulse}}}{\sqrt{-\frac{-4km+c^2}{m^2}}m}$$

STUDENT > **x(t);**

$$2 \frac{F_{\text{pulse}} T_{\text{pulse}} \sin\left(\frac{1}{2}\sqrt{4\frac{k}{m}-\frac{c^2}{m^2}}t\right) e^{\left(-1/2\frac{tc}{m}\right)}}{\sqrt{-\frac{-4km+c^2}{m^2}}m}$$

STUDENT > **v(t);**

$$\frac{F_{\text{pulse}} T_{\text{pulse}} \cos\left(\frac{1}{2}\sqrt{4\frac{k}{m}-\frac{c^2}{m^2}}t\right) \sqrt{4\frac{k}{m}-\frac{c^2}{m^2}} e^{\left(-1/2\frac{tc}{m}\right)}}{\sqrt{-\frac{-4km+c^2}{m^2}}m} - \frac{F_{\text{pulse}} T_{\text{pulse}} \sin\left(\frac{1}{2}\sqrt{4\frac{k}{m}-\frac{c^2}{m^2}}t\right) c e^{\left(-1/2\frac{tc}{m}\right)}}{\sqrt{-\frac{-4km+c^2}{m^2}}m^2}$$

STUDENT > **Fbase(t):=simplify(k*x(t)+c*v(t));**

$$F_{\text{base}}(t) := F_{\text{pulse}} T_{\text{pulse}} e^{\left(-1/2\frac{tc}{m}\right)} \left(2k \sin\left(\frac{1}{2}\sqrt{-\frac{-4km+c^2}{m^2}}t\right)m + c \cos\left(\frac{1}{2}\sqrt{-\frac{-4km+c^2}{m^2}}t\right) \sqrt{-\frac{-4km+c^2}{m^2}}m - \sin\left(\frac{1}{2}\sqrt{-\frac{-4km+c^2}{m^2}}t\right)c^2 \right) \Bigg/ \left(\sqrt{-\frac{-4km+c^2}{m^2}}m^2 \right)$$

STUDENT >