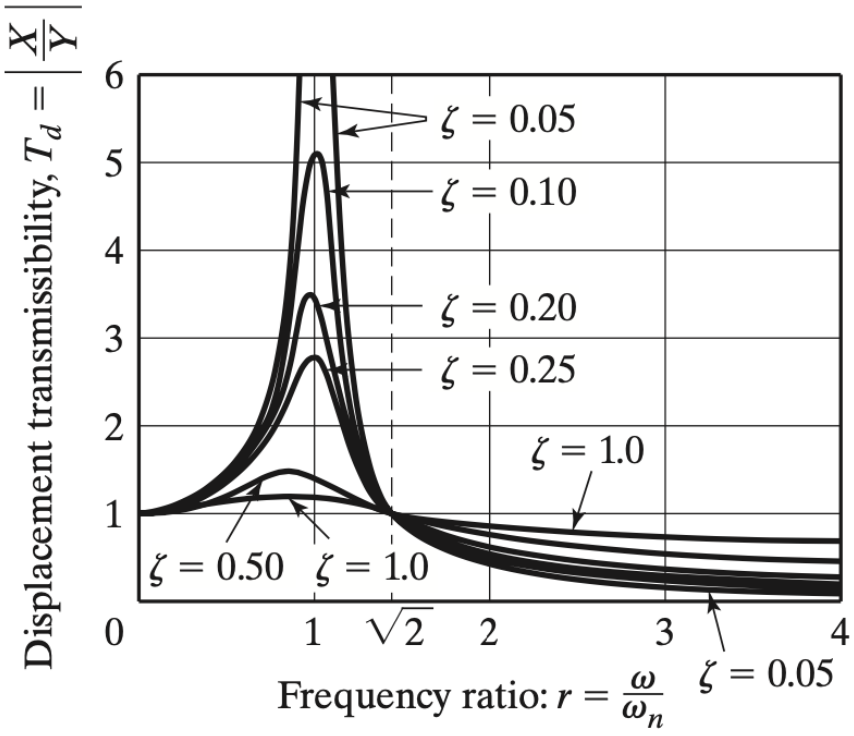
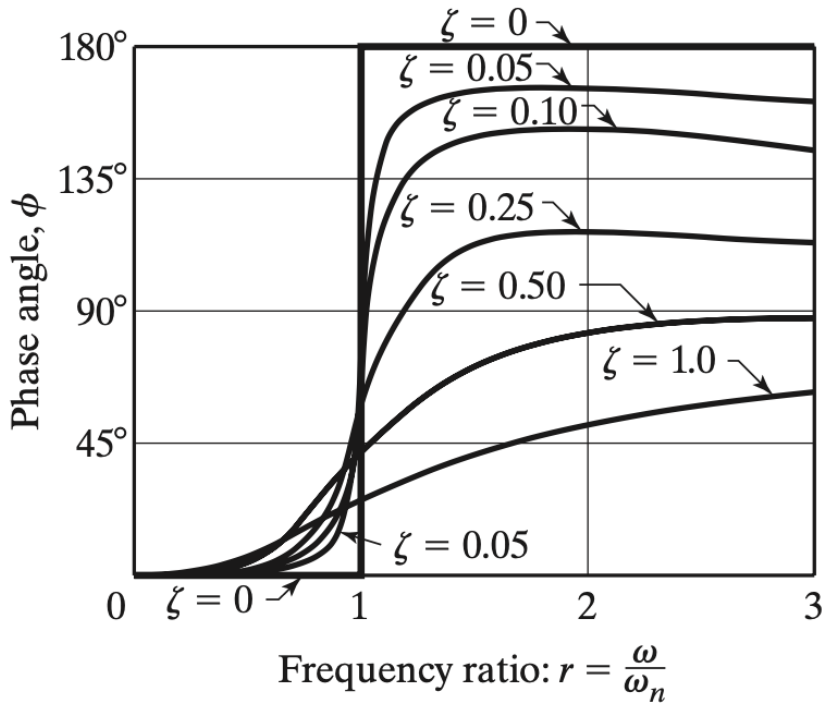
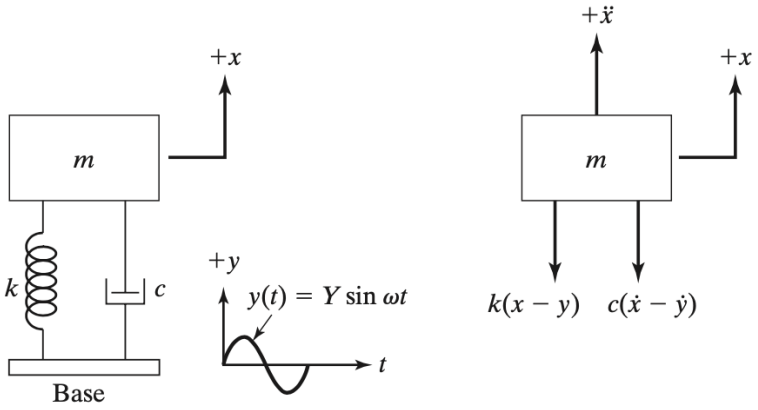
Dinâmica de Sistemas Navais e Oceânicos

PNV3314 Dinâmica de Sistemas

Aula 12





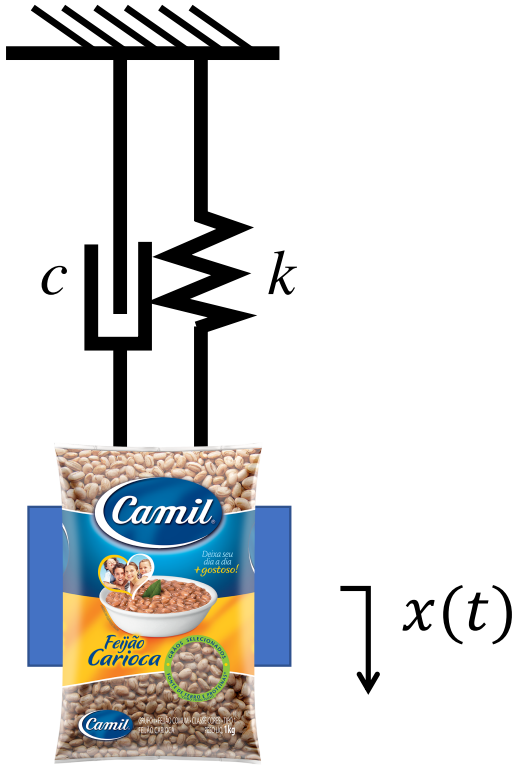


$$m\ddot{x} + c(\dot{x} - \dot{y}) + k(x - y) = 0$$

Rigidez não linear

VARIAÇÕES

Mola não linear: $F = k_1 x + k_2 x^3$



$m = 1\text{kg}$

$c = ?$

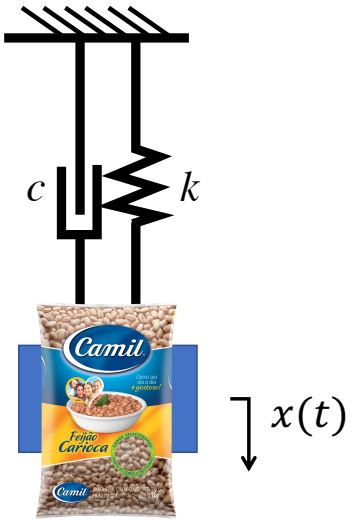
$k = ?$

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = 1\text{Hz}$$

$$k = 4\pi^2 m f_n^2 = 39{,}47\text{N/m}$$

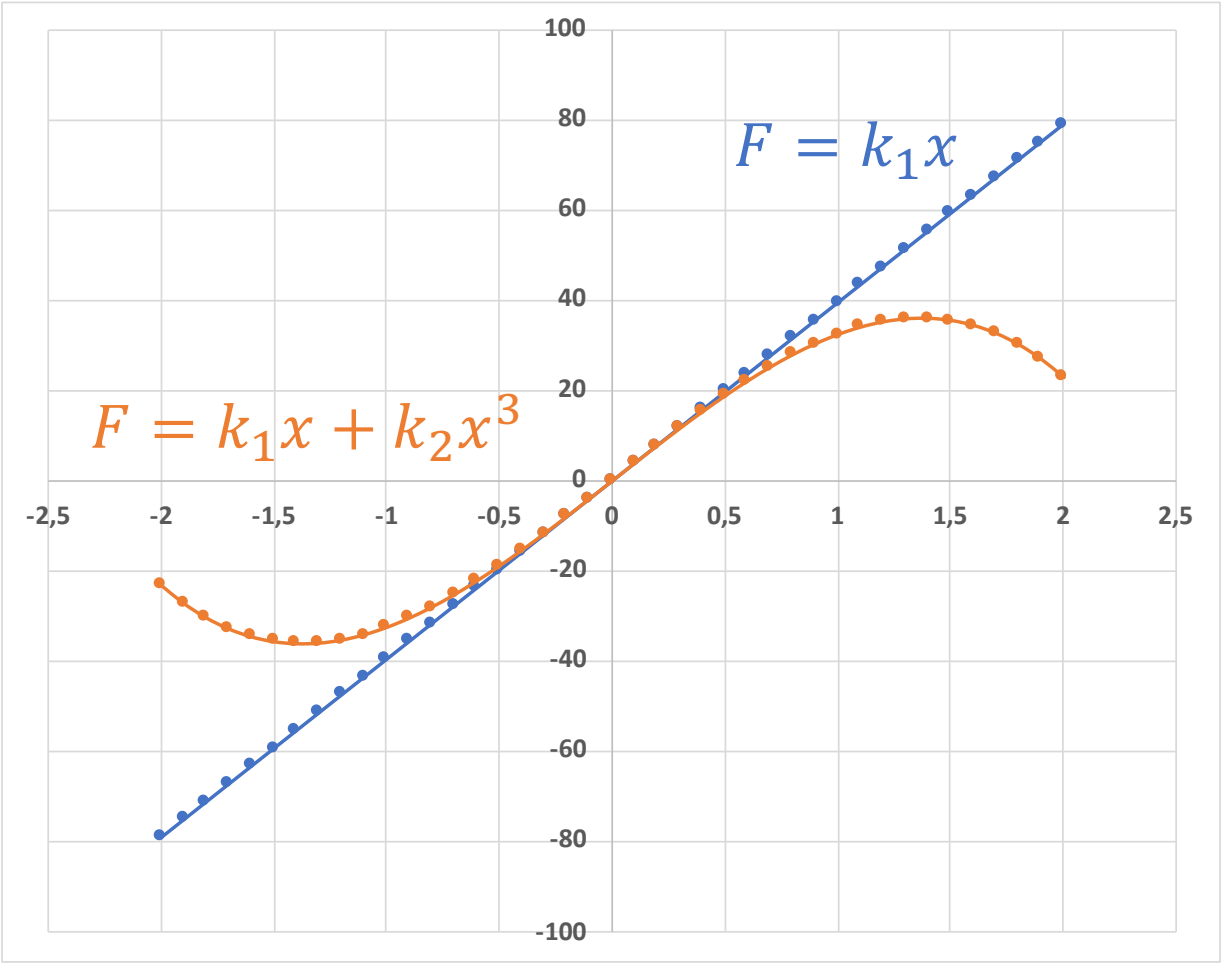
$$1\text{kgf} = k x_0 = 0{,}25\text{m}$$

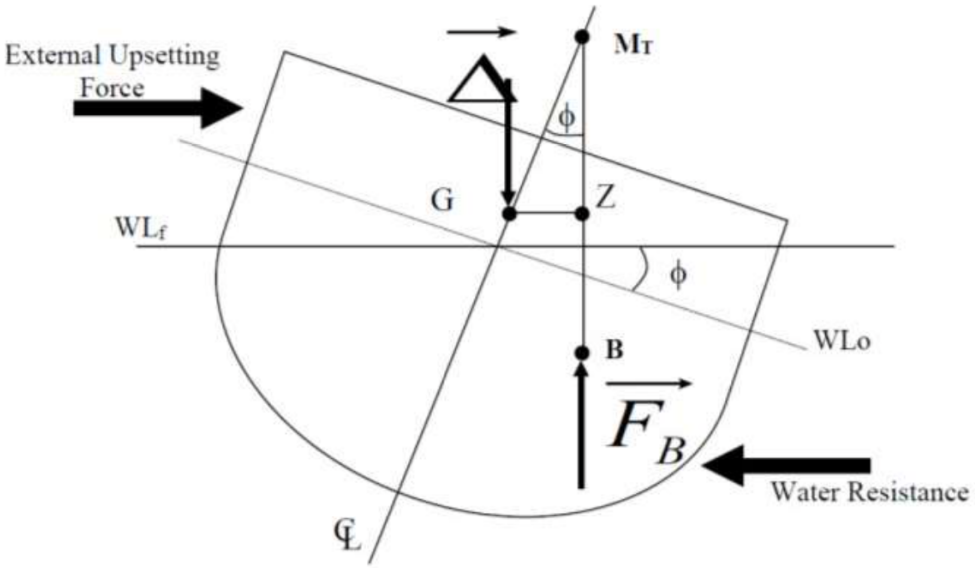
Mola não linear: $F = k_1 x + k_2 x^3$



$k_1 = 39{,}47$

$k_2 = -7$





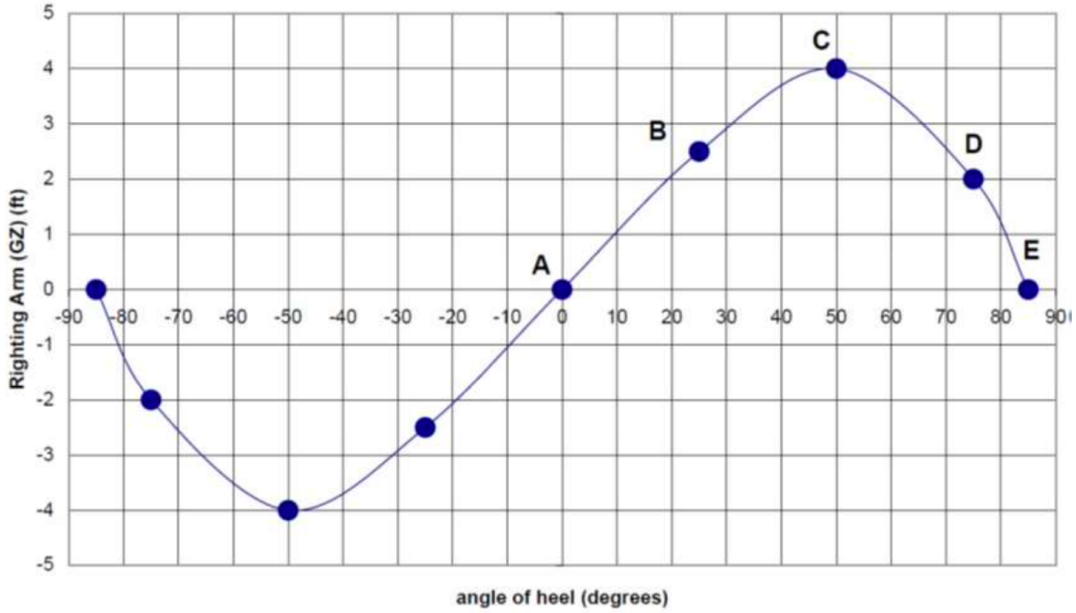
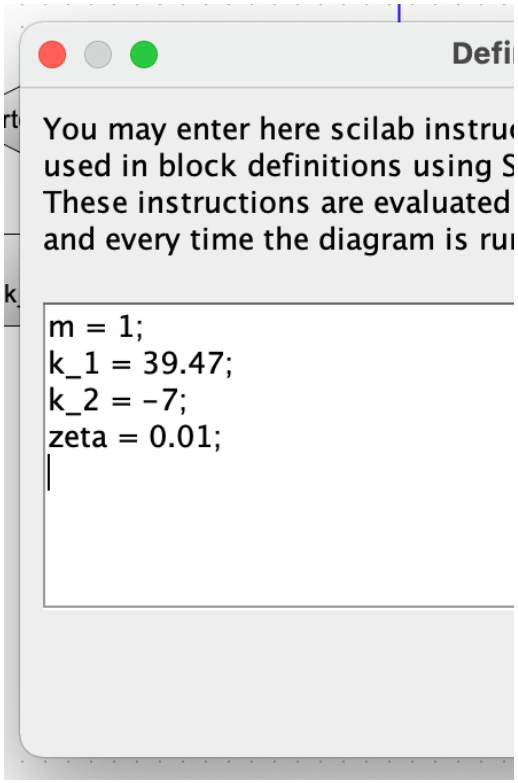
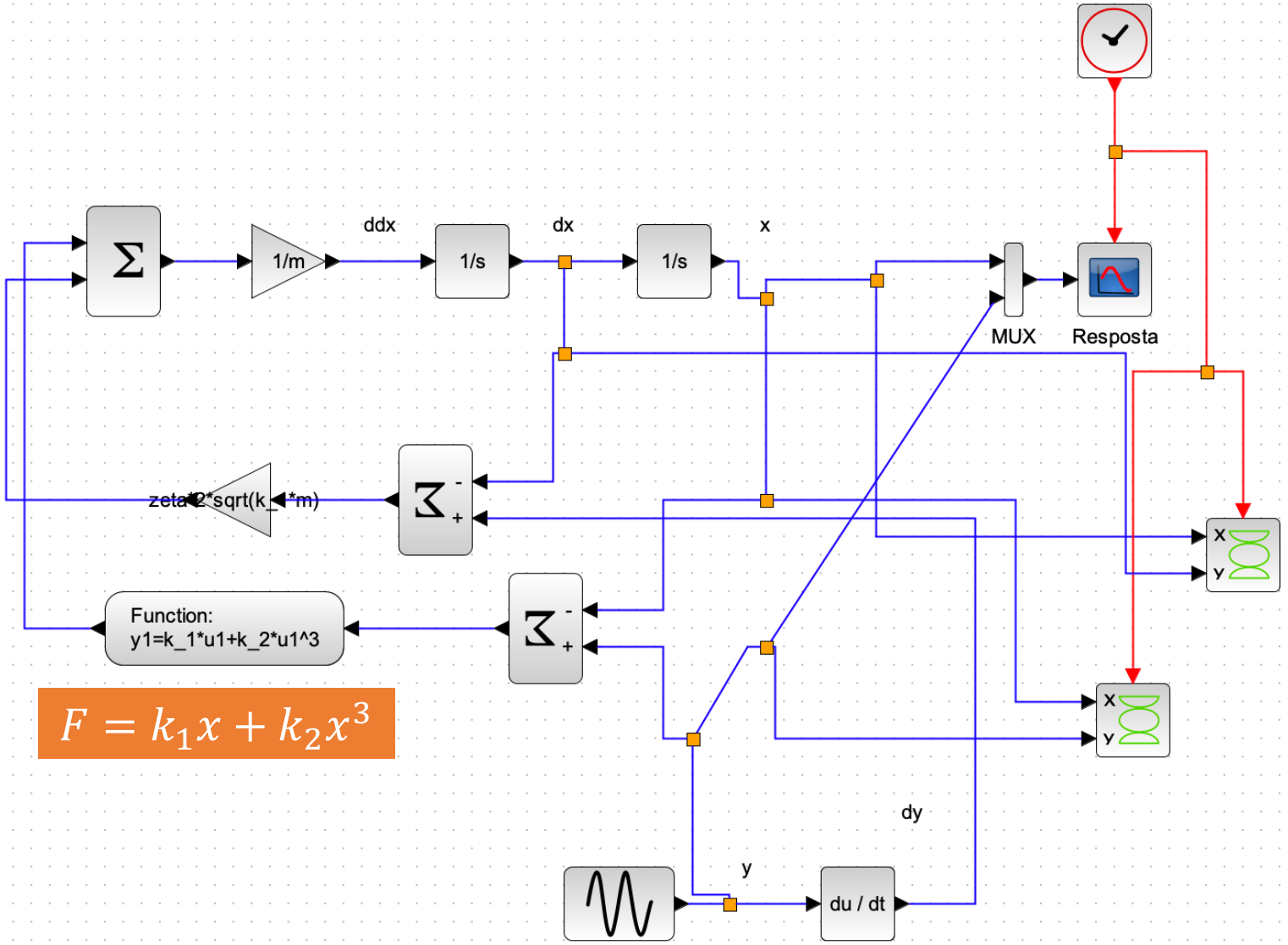


Figure 2.2: Curve of Intact Statical Stability


You may enter here scilab instruc
used in block definitions using S
These instructions are evaluated
and every time the diagram is ru
m = 1;
k_1 = 39.47;
k_2 = -7;
zeta = 0.01;

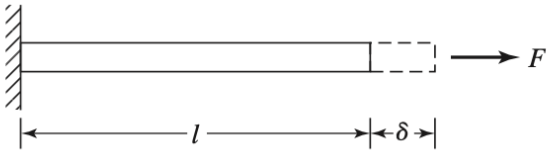

Σ
1/m
ddx
1/s
dx
1/s
x
MUX
Resposta
zeta*sqrt(k_*m)
Function:
y1=k_1*u1+k_2*u1^3
x
y
x
y
dy
y
du / dt

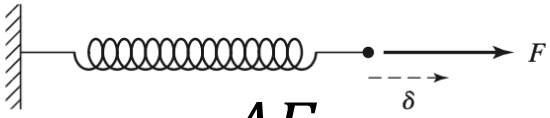
$$F = k_1 x + k_2 x^3$$

Rigidez variante no tempo

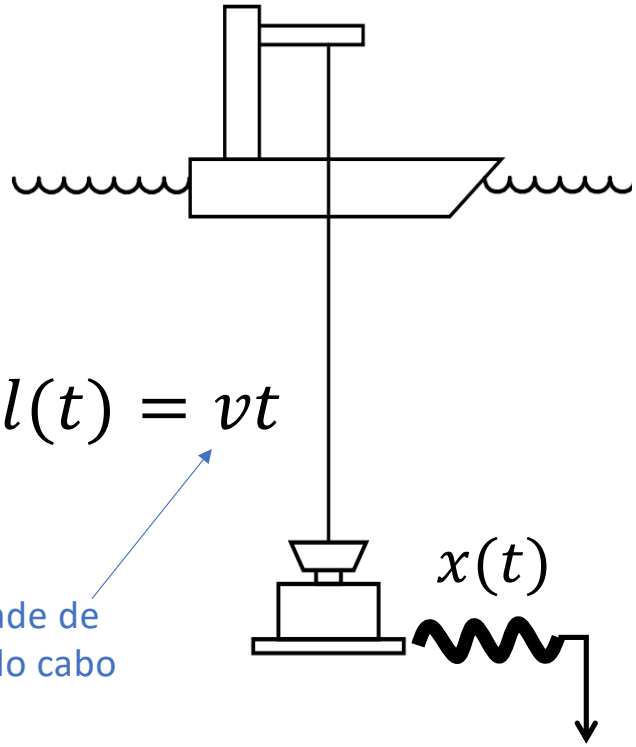
VARIAÇÕES

Rigidez de uma barra estendida





$$k = \frac{AE}{l}$$



$$l(t) = vt$$

Velocidade de descida do cabo

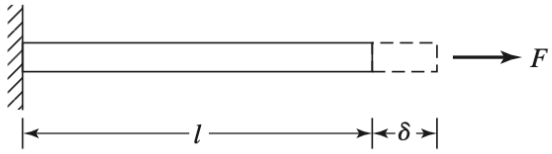
$v = 0$ “Estático”

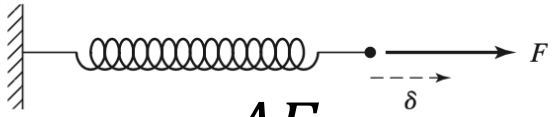
$v \ll \frac{\omega}{2\pi} X$ “Quase-estático”

$v \approx \frac{\omega}{2\pi} X$ “Dinâmico”

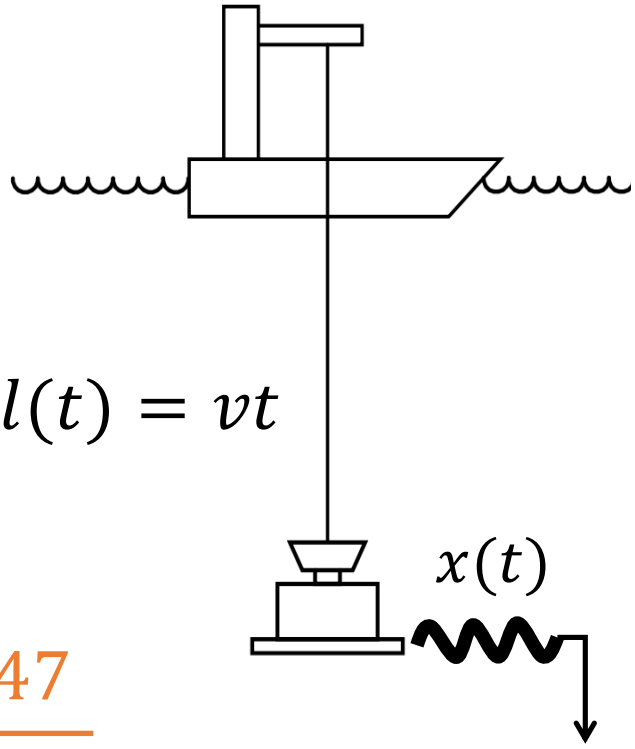
$v \gg \frac{\omega}{2\pi} X$ “Estacionário”

Rigidez de uma barra estendida





$$k = \frac{AE}{l}$$



$$l(t) = vt$$

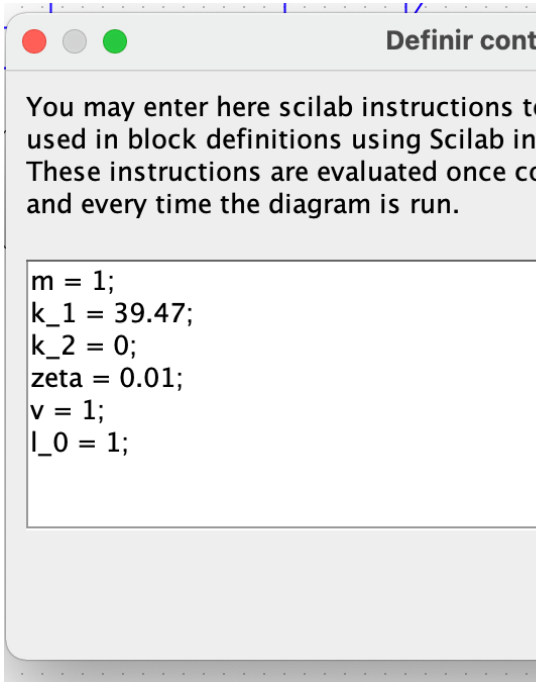
$$k = \frac{AE}{l_0 + vt} = \frac{39{,}47}{l_0 + vt}$$

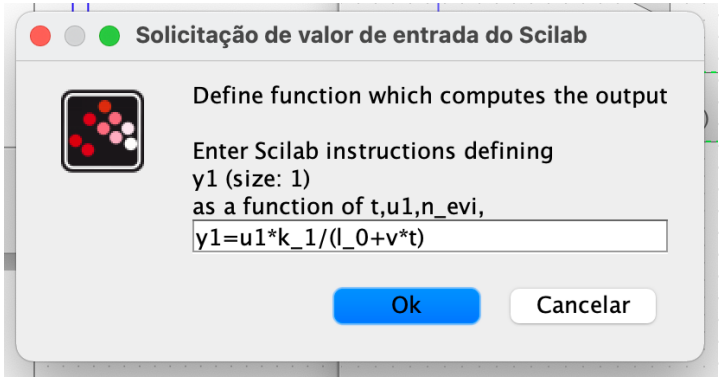
$v = 0$ “Estático”

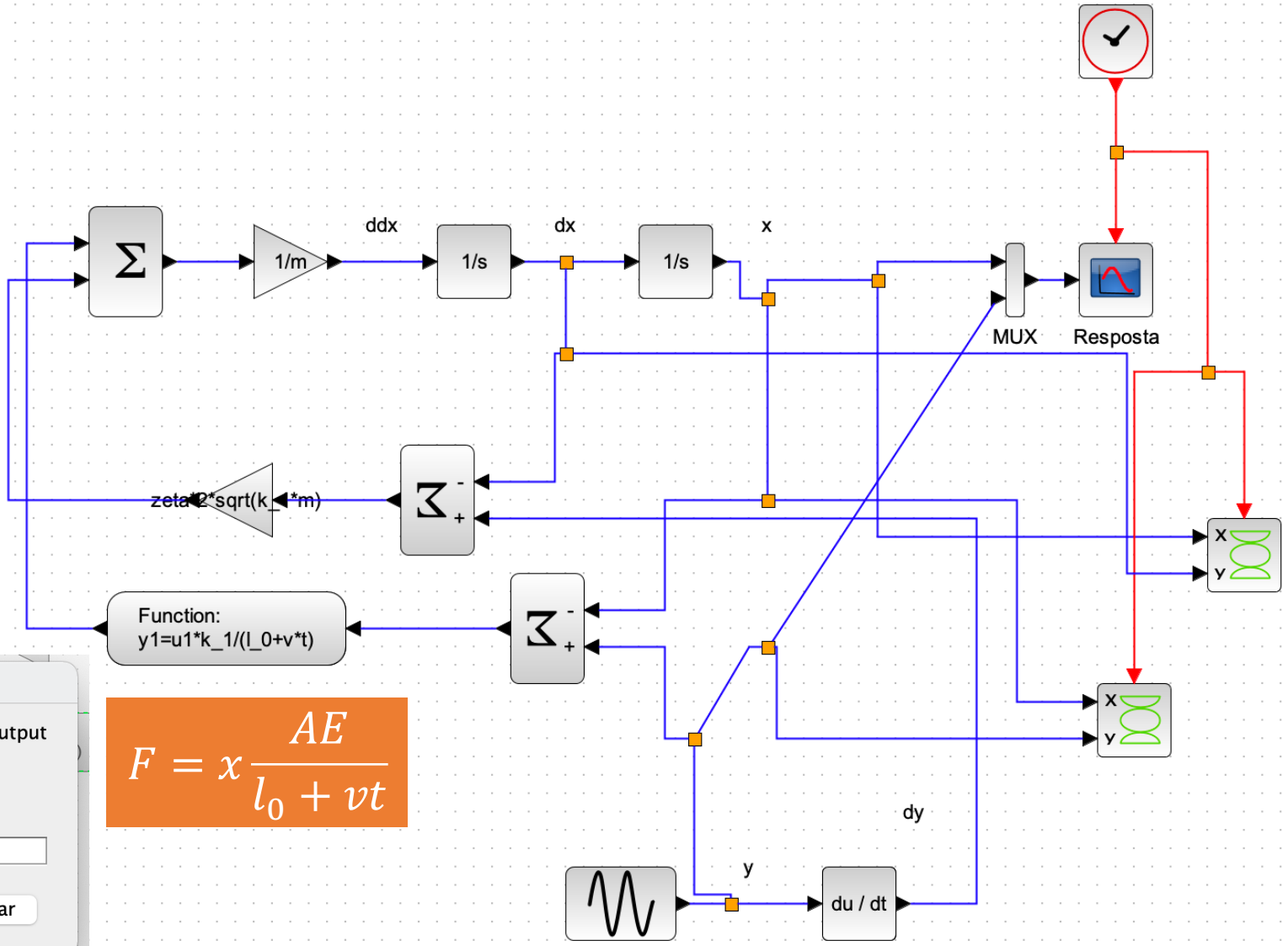
$v \ll \frac{\omega}{2\pi} X$ “Quase-estático”

$v \approx \frac{\omega}{2\pi} X$ “Dinâmico”

$v \gg \frac{\omega}{2\pi} X$ “Estacionário”





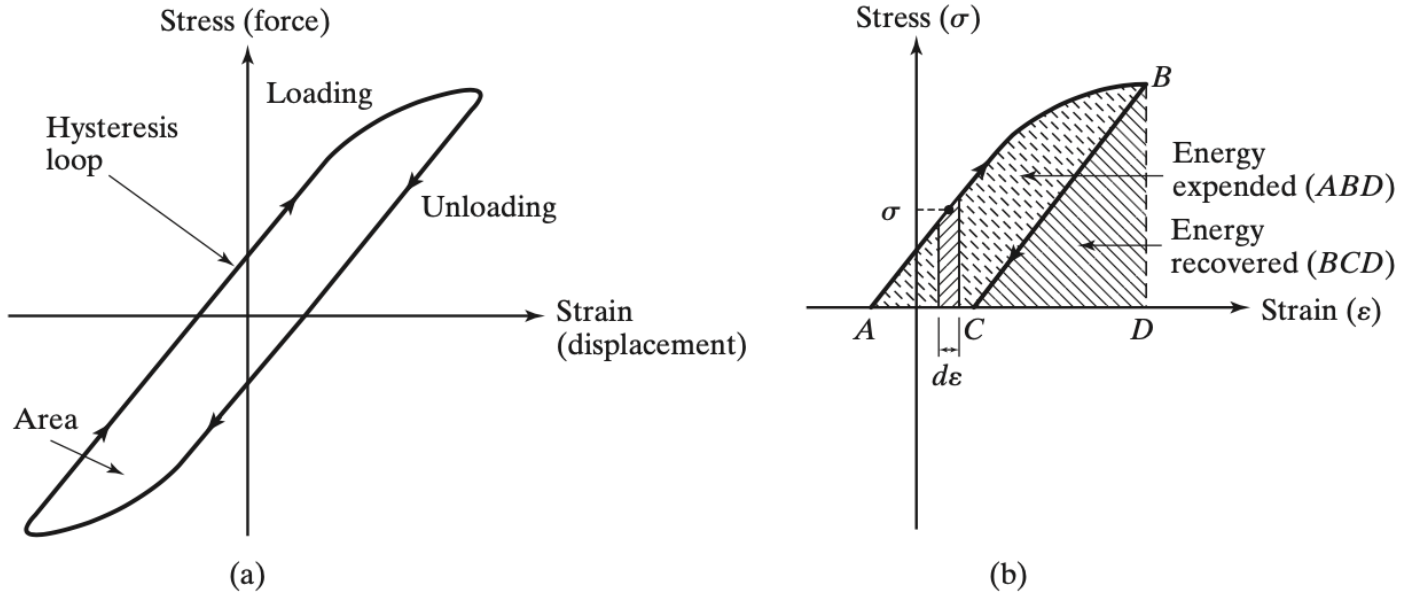


$$F = x\frac{AE}{l_0 + vt}$$

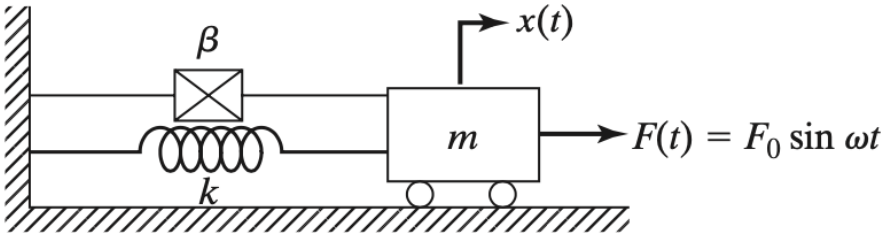
Amortecimento histerético

VARIAÇÕES

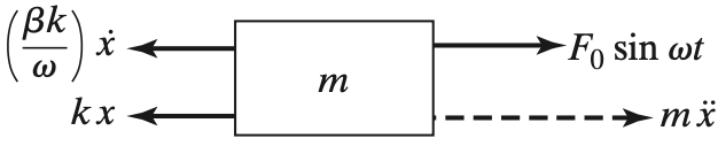
Amortecimento histerético



Amortecimento histerético



(a)



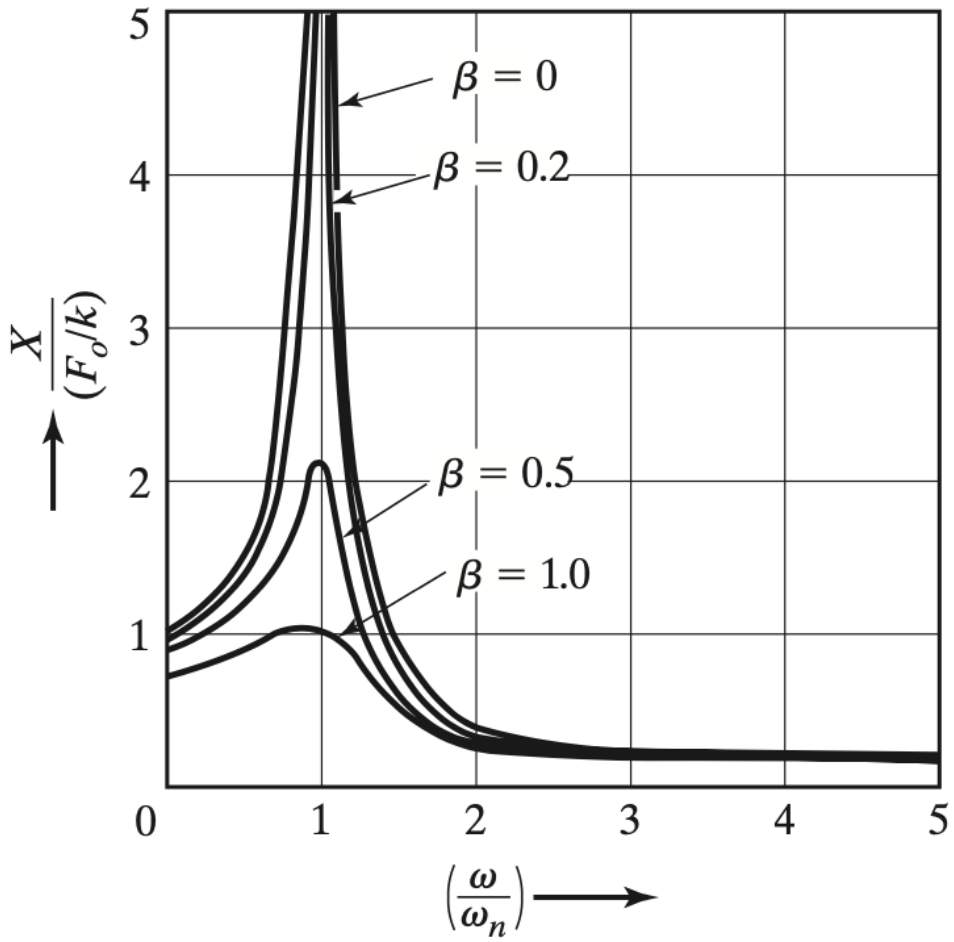
(b)

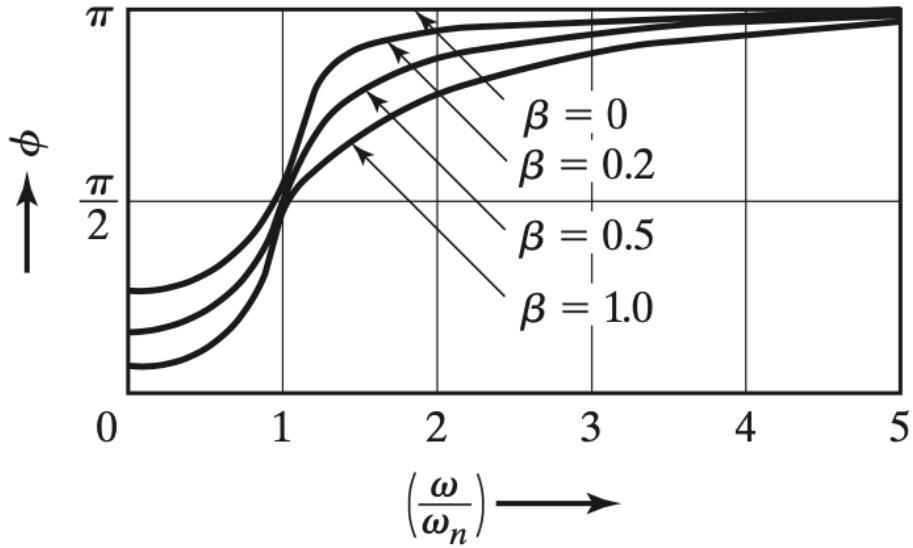
$$m\ddot{x} + \frac{\beta k}{\omega}\dot{x} + kx = F_0 \sin \omega t$$

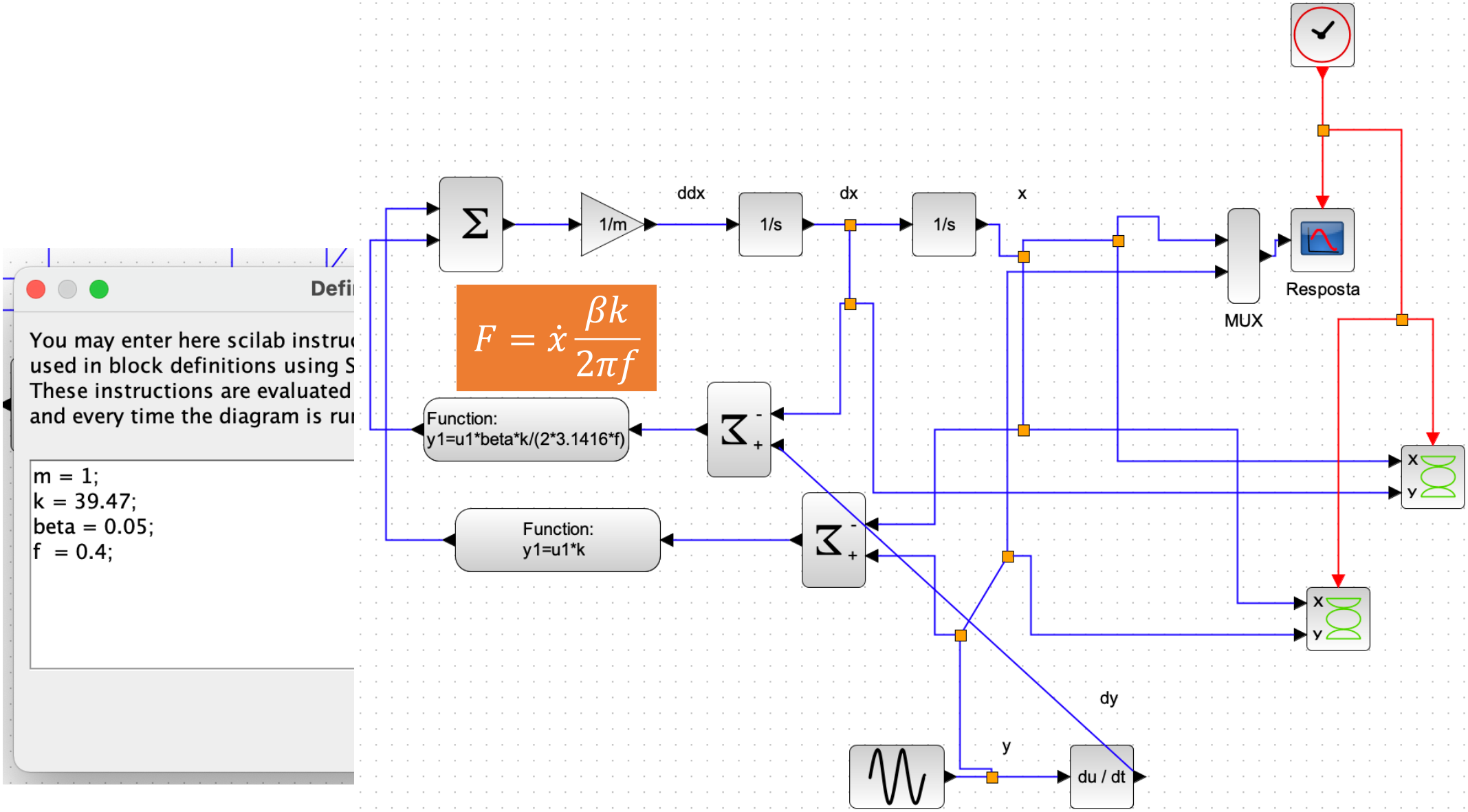
$$(\beta k/\omega)\dot{x} = (h/\omega)\dot{x}$$

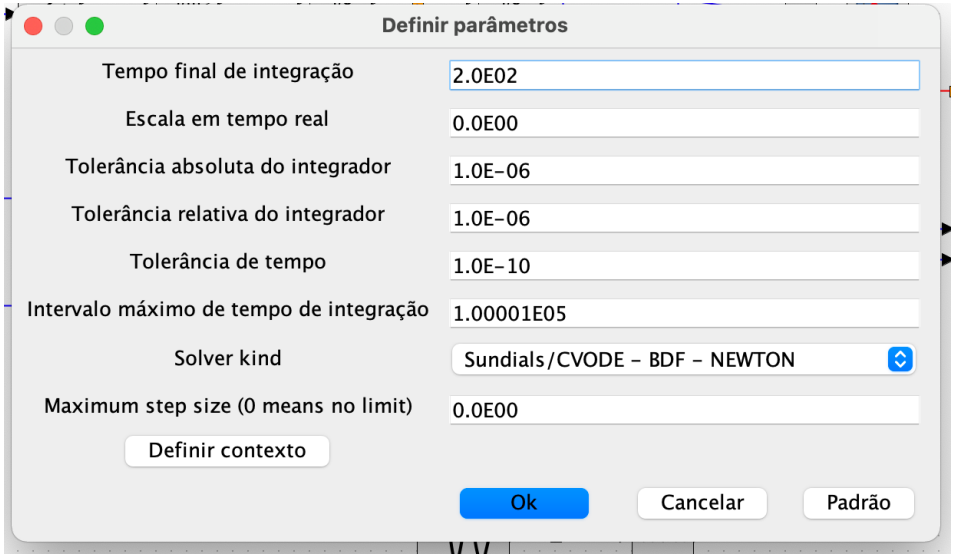
$$x_p(t) = X \sin(\omega t - \phi)$$

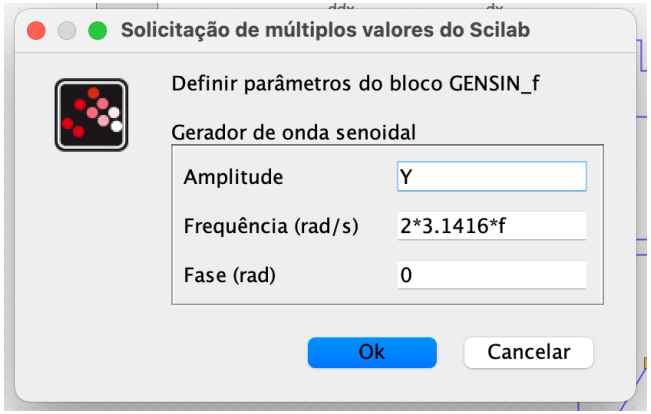
$$X = \frac{F_0}{k\left[\left(1-\frac{\omega^2}{\omega_n^2}\right)^2 + \beta^2\right]^{1/2}} \qquad \phi = \tan^{-1}\left[\frac{\beta}{\left(1-\frac{\omega^2}{\omega_n^2}\right)}\right]$$

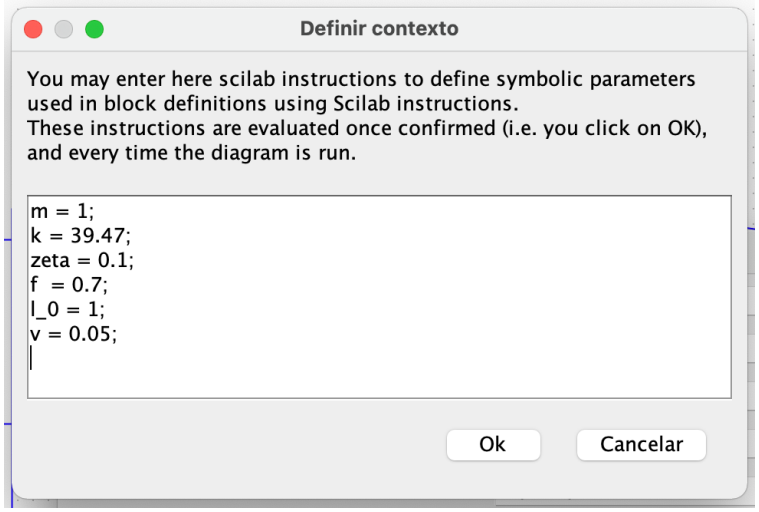

$\frac{X}{(F_o/k)}$
5
4
3
2
1
0
1
2
3
4
5
$\beta = 0$
$\beta = 0.2$
$\beta = 0.5$
$\beta = 1.0$
$\left(\frac{\omega}{\omega_n}\right)$

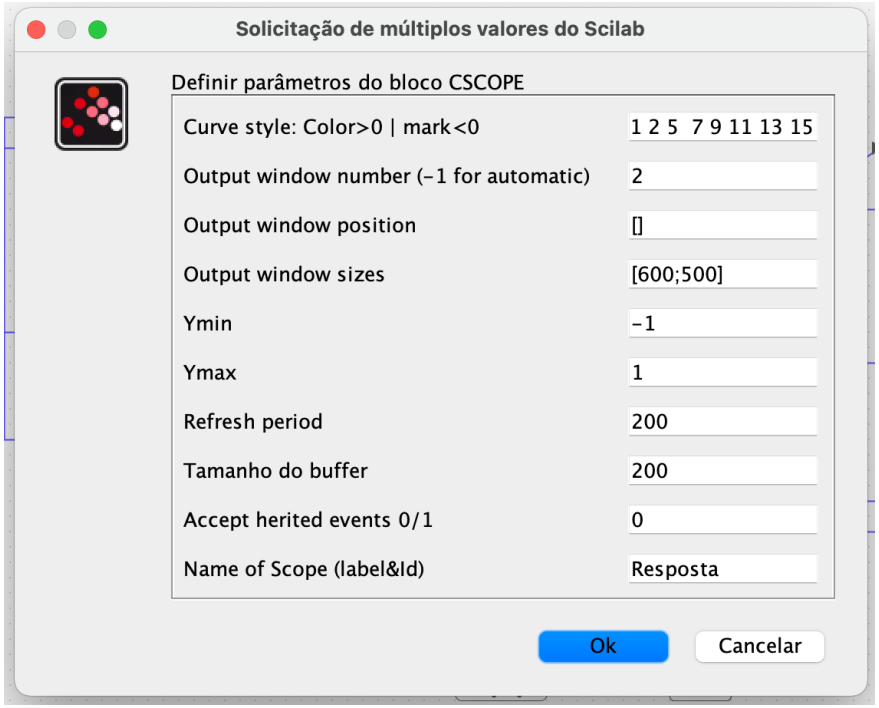

ϕ
π
$\frac{\pi}{2}$
0
1
2
3
4
5
$\beta = 0$
$\beta = 0.2$
$\beta = 0.5$
$\beta = 1.0$
$\left(\frac{\omega}{\omega_n}\right)$


Defi
You may enter here scilab instruc
used in block definitions using S
These instructions are evaluated
and every time the diagram is ru
m = 1;
k = 39.47;
beta = 0.05;
f = 0.4;
$F = \dot{x}\frac{\beta k}{2\pi f}$
1/m
ddx
1/s
dx
1/s
x
MUX
Resposta
Function:
y1=u1*beta*k/(2*3.1416*f)
Function:
y1=u1*k
dy
y
du / dt


Definir parâmetros
Tempo final de integração
2.0E02
Escala em tempo real
0.0E00
Tolerância absoluta do integrador
1.0E-06
Tolerância relativa do integrador
1.0E-06
Tolerância de tempo
1.0E-10
Intervalo máximo de tempo de integração
1.00001E05
Solver kind
Sundials/CVODE - BDF - NEWTON
Maximum step size (0 means no limit)
0.0E00
Definir contexto
Ok
Cancelar
Padrão


Solicitação de múltiplos valores do Scilab
Definir parâmetros do bloco GENSIN_f
Gerador de onda senoidal
Amplitude
Y
Frequência (rad/s)
2*3.1416*f
Fase (rad)
0
Ok
Cancelar


Definir contexto
You may enter here scilab instructions to define symbolic parameters
used in block definitions using Scilab instructions.
These instructions are evaluated once confirmed (i.e. you click on OK),
and every time the diagram is run.
m = 1;
k = 39.47;
zeta = 0.1;
f = 0.7;
I_0 = 1;
v = 0.05;
Ok
Cancelar


Solicitação de múltiplos valores do Scilab
Definir parâmetros do bloco CSCOPE
Curve style: Color>0 | mark<0
1 2 5 7 9 11 13 15
Output window number (-1 for automatic)
2
Output window position
[]
Output window sizes
[600;500]
Ymin
-1
Ymax
1
Refresh period
200
Tamanho do buffer
200
Accept herited events 0/1
0
Name of Scope (label&Id)
Resposta
Ok
Cancelar