L
R_0
H
$R(t) = R_0 + y(t)$
(1)
$y(t)$
t
$d^2y(t)dt^2 + \beta dy(t)dt + \alpha y(t) = \gamma(p(t) - p_0)$
(2)
$\alpha = E\rho_w R_0^2 \quad \gamma = 1\rho_w H \quad \beta = > 0$
(3)
x
t

$(p - p_0) = x\Delta p\,(a + bcos(\omega_0 t))$
(4)
??
??
$L\ 5 \times 10^{-2}\ b\quad 133.32^{-2}$
$R_0 5 \times 10^{-3}\ a\quad 1333.2^{-2}$
$\rho_w 1 \times 10^{3-3} \Delta p 33.33^{-2}$
$H\ 3 \times 10^{-4}\ w_0\ 2\pi/0.8$
$E\ 9 \times 10^{5-2}$
β
$\beta =$
$\sqrt{\alpha}$
$\beta =$
α
??

$\vec{y'}(t) = A\vec{y} + \vec{b}$
(5)
$\vec{y} =$
yy'^T
$\vec{I}$
$\vec{b}(t)$
t
A

$A = (\,0\,)\,1 - \alpha - \beta$
(6)
A

$det(A - \lambda I) = -\lambda 1 - \alpha - \lambda - \beta \rightarrow \alpha\lambda^2 + \beta\lambda + 1 = 0$
(7)

$\lambda_{1,2} = (-\beta \pm \sqrt{\beta^2 - 4\alpha})2$
(8)
$\beta \geq$
$2\sqrt{\alpha}$
λ_1
λ_2
$\beta <$
$2\sqrt{\alpha}$
A
??
$\beta =$
$\sqrt{\alpha} =$
$6.0 \times$
10^3

$A = (\,0\,)\,136.0 \times 10^6 6.0 \times 10^3 \rightarrow\ \lambda_{\,1} = -3000.00 + 5196.15i \lambda_2 = -3000.00 - 5196.15i$
(9)
$\beta =$
$\alpha =$
$36.0 \times$
10^6

$A = (\,0\,)\,136.0 \times 10^6 36.0 \times 10^6 \rightarrow\ \lambda_{\,1} = -1.0 \lambda_2 = -36.0 \times 10^6$
(10)
??
β
$y(x,t) =$
y_j^n
$\partial y/\partial t(x,t) =$
z_j^n
??