$$G(s) = \frac{9}{s^2+2s+9} \quad \frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2} \qquad \omega_n = 3 \qquad 2\zeta\omega_n = 2$$

$\zeta = 1/\omega_n$

$\zeta = 1/3$ Subamortiguado

Con entrada $\_\!\!\!\lceil$ } $1/s$

$$Y(s) = \frac{9}{(s^2+2s+9)(s)} \qquad s = \frac{-2 \pm \sqrt{4-(4\cdot 1\cdot 9)}}{2} = \frac{-2\pm\sqrt{-32}}{2} = \frac{-2\pm 4\sqrt{2}j}{2}$$

$$s = -1 \pm 2\sqrt{2}j \qquad s_1 = -1+2\sqrt{2}j \quad 2\sqrt{2} \approx 2{,}83$$

$$s_2 = -1-2\sqrt{2}j$$

$$Y(s) = \frac{9}{(s+1+2\sqrt{2}j)(s+1-2\sqrt{2}j)(s)} = \frac{A}{s+1+2\sqrt{2}j} + \frac{B}{s+1-2\sqrt{2}j} + \frac{C}{s}$$

$$A(s+1-2\sqrt{2}j)\cdot s + B(s+1+2\sqrt{2}j)s + C(s+1+2\sqrt{2}j)(s+1-2\sqrt{2}j) = 9$$

Si $s = -1+2\sqrt{2}j \quad B(4\sqrt{2}j)(-1+2\sqrt{2}j) = 9 \quad B(-4\sqrt{2}j-16) = 9$

$$B = \frac{-9}{16+4\sqrt{2}j}\frac{(16-4\sqrt{2}j)}{(16-4\sqrt{2}j)} = \frac{-9(16-4\sqrt{2}j)}{256+32} = \frac{-144+36\sqrt{2}j}{288} = -\frac{1}{2}+\frac{\sqrt{2}}{8}j$$

Si $s = -1-2\sqrt{2}j \quad A(-4\sqrt{2}j)(-1-2\sqrt{2}j) = 9 \quad A(4\sqrt{2}j)(1+2\sqrt{2}j) = 9$

$$A(4\sqrt{2}j-16) = 9 \qquad A = \frac{9}{4\sqrt{2}j-16}\frac{(-16-4\sqrt{2}j)}{(-16-4\sqrt{2}j)} = \frac{-9(16+4\sqrt{2}j)}{256+32}$$

$$A = \frac{-144-36\sqrt{2}j}{288} = -\frac{1}{2}-\frac{\sqrt{2}j}{8}$$

Si $s = 0 \qquad 9C = 9 \qquad \underline{C = 1}$

$$Y(s) = \frac{-\frac{1}{2}-\frac{\sqrt{2}}{8}j}{s+1+2\sqrt{2}j} + \frac{-\frac{1}{2}+\frac{\sqrt{2}}{8}j}{s+1-2\sqrt{2}j} + \frac{1}{s}$$

$$Y(s) = \frac{-1/2}{s+1+2\sqrt{2}j} - \frac{\sqrt{2}/8\,j}{s+1+2\sqrt{2}j} - \frac{1/2}{s+1-2\sqrt{2}j} + \frac{\frac{\sqrt{2}}{8}j}{s+1-2\sqrt{2}j} + \frac{1}{s}$$

$$y(t) = (-1/2-\sqrt{2}/8\,j)\,e^{-(1+2\sqrt{2}j)t} + (-1/2+\sqrt{2}/8\,j)\,e^{-(1-2\sqrt{2}j)t} + 1$$

$$e^{-(1+2\sqrt{2}j)t} = e^{-t}\cdot e^{-2\sqrt{2}jt} = e^{-t}(\cos(-2\sqrt{2}t)+j\,\mathrm{Sen}(-2\sqrt{2}t))$$

$$= \underline{e^{-t}(\cos(2\sqrt{2}t)-j\,\mathrm{Sen}(2\sqrt{2}t))}$$

$$e^{-(1-2\sqrt{2}j)t} = e^{-t}\cdot e^{2\sqrt{2}jt} = \underline{e^{-t}(\cos(2\sqrt{2}t)+j\,\mathrm{Sen}(2\sqrt{2}t))}$$

$y(t) = (-\frac{1}{2} - \frac{\sqrt{2}}{8}j)(e^{-t}[\cos(2\sqrt{2}t) - j\,\text{Sen}(2\sqrt{2}t)]) + (-\frac{1}{2} + \frac{\sqrt{2}}{8}j)(e^{-t}[\cos(2\sqrt{2}t) + j\,\text{Sen}(2\sqrt{2}t)])$
$+1$

$y(t) = e^{-t}\cos(2\sqrt{2}t)(-\frac{1}{2} - \frac{\sqrt{2}}{8}j - \frac{1}{2} + \frac{\sqrt{2}}{8}j) + je^{-t}\,\text{Sen}(2\sqrt{2}t)(\frac{1}{2} + \frac{\sqrt{2}}{8}j - \frac{1}{2} + \frac{\sqrt{2}}{8}j) + 1$

$y(t) = e^{-t}\cos(2\sqrt{2}t)(-1) + je^{-t}\,\text{Sen}(2\sqrt{2}t)(\frac{\sqrt{2}}{4}j) + 1$

$\underline{y(t) = -e^{-t}\cos(2\sqrt{2}t) - \frac{\sqrt{2}}{4}e^{-t}\,\text{Sen}(2\sqrt{2}t) + 1}$

$G(s) = \frac{9}{s^2+9}$ $\quad \underline{w_n = 3} \quad 2\xi w_n = 0$
$\underline{\xi = 0}$ } Sin amortiguamiento
oscila de forma eterna

Con entrada ⎍ } $1/s$

$Y(s) = \frac{9}{(s^2+9)s} \qquad s^2+9=0 \quad s^2 = -9 \quad s = \sqrt{-9} = \pm 3j$

$Y(s) = \frac{9}{(s+3j)(s-3j)s} = \frac{A}{s+3j} + \frac{B}{s-3j} + \frac{C}{s}$

$A(s-3j)s + B(s+3j)s + C(s^2+9) = 9$

Si $s = 3j \quad B(6j)(3j) = 9 \quad B(18\cdot -1) = 9 \quad \underline{B = -1/2}$

Si $s = -3j \quad A(-6j)(-3j) = 9 \quad A(-18) = 9 \quad \underline{A = -1/2}$

Si $s = 0 \quad C(9) = 9 \quad \underline{C = 1}$

$Y(s) = \frac{-1/2}{s+3j} - \frac{1/2}{s-3j} + \frac{1}{s}$

$y(t) = -\frac{1}{2}e^{-3jt} - \frac{1}{2}e^{3jt} + 1$

$e^{-3jt} = \cos(-3t) + j\,\text{Sen}(-3t) = \underline{\cos(3t) - j\,\text{Sen}(3t)}$
$e^{3jt} = \underline{\cos(3t) + j\,\text{Sen}(3t)}$

$y(t) = -\frac{1}{2}(2\cos(3t)) + 1 = \underline{-\cos(3t) + 1}$

$e^{\theta j} = \cos\theta + j\,\text{sen}\,\theta$