EE 2240

Problem #10

For the system described by $\ddot{x}+25x=0$:

a. Determine the characteristic equation.

$r^2 + 25 = 0$

b. Determine the natural frequency, ω_n.

$\omega_n = \sqrt{25} = 5$

c. Determine the damping ratio, ζ.

$2\zeta\omega_n = 0 \Rightarrow \zeta = 0$

d. Determine the numerical values of the two roots of the characteristic equation.

$r^2 + 25 = (r+j5)(r-j5) \Rightarrow r = \pm j5$

e. Classify the system as *overdamped*, *critically damped*, *underdamped*, or *undamped*.

The system is undamped ($\zeta = 0$)

f. Assuming $x(0)=5$ and $\dot{x}(0)=5$, determine the solution of the given equation.

$x(t) = K_1 \cos 5t + K_2 \sin 5t$

$\dot{x}(t) = -5K_1 \sin 5t + 5K_2 \cos 5t$

$x(0) = K_1 = 5$ } $K_1 = 5$

$\dot{x}(0) = 5K_2 = 5$ } $K_2 = 1$

$\therefore x(t) = 5\cos 5t + \sin 5t, \quad t \geq 0$