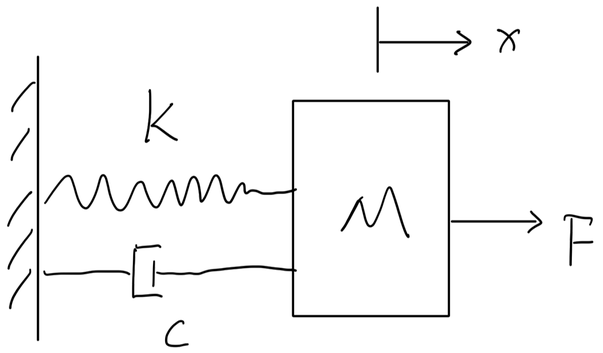

SPRING - MASS - DAMPER SYSTEM

EQUATION OF MOTION

$$M\ddot{x} + c\dot{x} + kx + k_3x^3 = F\sin(wt+\varphi)$$

k_3x^3: 3rd order nonlinearity

The solution to the equation above is assumed to be:

$$x = A\sin(wt)$$

φ reflects the phase required to have this solution To make things easier

Sub:

$$x^3 = A^3\sin^3(wt)$$

$$= \frac{3}{4}A^3\sin wt - \frac{1}{4}A^3\sin(3wt)$$

$$\dot{x} = Aw\cos(wt)$$

$$\ddot{x} = -Aw^2\sin(wt)$$

For the equations to have solutions, the co-efficients of $\sin(wt)$ & $\cos(wt)$ have to be equal on LHS & RHS.

$\sin wt$: $-MAw^2 + kA + \frac{3}{4}k_3A^3 = F\cos\varphi$

$\cos wt$: $cAw = F\sin\varphi$

} EQUATIONS IN THE CODE { $w = x$, $A = y$