$$y_n = \sum_m c_{nm} f_m$$

$$(f_l, y_n) = \sum_m c_{nm} (f_l, f_m)$$

$$c_{nl} = (f_l, y_n)$$

$$H_o f_n(x) = \Omega \omega_{o_n}^2 f_n(x)$$

$$H_o = \frac{d^4}{dx^4}$$

$$\Omega = \frac{\rho}{ET^2}$$

$$E\frac{d^2}{dx^2}(WT^3\frac{d^2 y_n}{dx^2}) = -\rho WT\frac{d^2 y_n}{dt^2}$$

$$\frac{1}{W}\frac{d^2}{dx^2}(Wy_n'') = \Omega \omega_n^2 y_n$$

$$\frac{1}{W}\frac{d}{dx}(W'y_n'' + Wy_n^{(3)}) = \Omega \omega_n^2 y_n$$

$$\frac{1}{W}(W''y_n'' + 2W'y_n^{(3)} + Wy_n^{(4)}) = \Omega \omega_n^2 y_n$$

$$\frac{1}{W}(W''y_n'' + 2W'y_n^{(3)}) + y_n^{(4)} = \Omega \omega_n^2 y_n$$

$$\frac{W''y_n''}{W} + 2\frac{W'y_n^{(3)}}{W} + H_0 y_n - \Omega \omega_n^2 y_n = 0$$

$$(f_l, (\frac{W''y_n''}{W})) + 2(f_l, (\frac{W'y_n^{(3)}}{W})) + (f_l, (\Omega \omega_{o_n}^2 - \Omega \omega_n^2) y_n) = 0$$

$$\sum_m c_{nm} \left[(f_l, (\frac{W''y_n''}{W})) + 2(f_l, (\frac{W'y_n^{(3)}}{W})) + (f_l, \Omega(\omega_{o_n}^2 - \omega_n^2)\delta_{ml}) \right] = 0$$

$$\left[F_{lm} + 2D_{lm} + \Omega(\omega_n^2 - \omega_{o_l}^2)\delta_{lm} \right] c_{nm} = 0$$