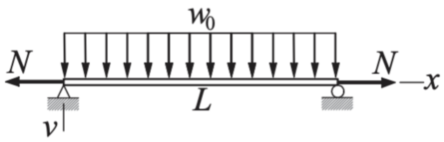
2023 전산물리 과제

1. Solve this boundary value problem and plot the graph.

$$y'' + \sin y + 1 = 0, \quad y(0) = 0, \quad y(\pi) = 0$$

2.



The simply supported bean carries a uniform load of intensity ω_0 and the tensile force N. The differential equation for the vertical displacement v can be shown to be

$$\frac{d^4v}{dx^4} - \frac{N}{EI}\frac{d^2v}{dx^2} = \frac{w_0}{EI}$$

Where EI is the bending rigidity. The boundary conditions are $v = d^2v\,/dx^2 = 0$ at $x = 0$ and $x = L$.

Changing the variables to $\xi = \frac{x}{L}$ and $y = \frac{EI}{\omega_0 L^4}v$ transforms the problem to the dimensionless form

$$\frac{d^4y}{d\xi^4} - \beta\frac{d^2y}{d\xi^2} = 1 \qquad \beta = \frac{NL^2}{EI}$$

$$y|_{\xi=0} = \left.\frac{d^2y}{d\xi^2}\right|_{\xi=0} = y|_{\xi=0} = \left.\frac{d^2y}{d\xi^2}\right|_{x=1} = 0$$

Determine the maximum displacement if (a) $\beta = 1.6529$ and (b) $\beta = -1.6529$ (N is compressive.)

3. The wave function $\Psi(x)$ of Harmonic oscillator can be obtained by the following differential equation,

$$\frac{\hbar^2}{2m}\frac{d^2\Psi}{dx^2} + \frac{1}{2}m\omega^2x^2\Psi = E\Psi$$

$$=> \; -\frac{d^2\Psi}{d\xi^2} = (\xi^2 - E')\Psi$$

Where $\xi = \sqrt{\frac{m\omega}{\hbar}}x$, and $E' = \frac{2E}{\hbar\omega}$ and it follows the boundary conditions of $\Psi(x) \to 0$ when $x \to \pm\infty$. Plot the first five wave functions and print their energies.

Hint. The exact values of energies are $E_n = (n + \frac{1}{2})\hbar\omega$ where $n = 0,1,2\ldots.$