Homework #3

This homework is strictly optional and has no influence at all on your final marks. Its only purpose is to let you test your preparation, it's hence important that you try to do everything on your own.

If you want feedback, please return your papers to me, by email, before the end of May.

For a correct evaluation your paper should be reasonably complete, including details of the procedure you followed to reach the required results and presenting the intermediate results.

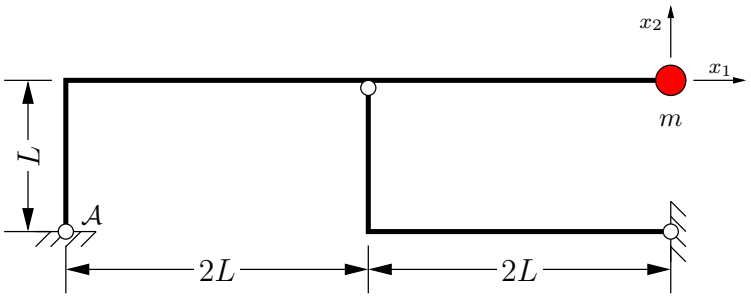
1 Beam Response

A uniform beam, its length L, its stiffness $EJ = \text{const}$ and its unit mass $\bar{m} = \text{const}$ is clamped at $x = 0$ and is simply supported at $x = L$.

The beam is in a condition of static equilibrium (see figure) under a couple $W = w\frac{EJ}{L}$ applied at $x = L$ when, at time $t = 0$, the external load is suddenly released.

Determine the modal responses for the first 3 modes and plot the bending moment $M_b(0, t)$ in the interval $0 \le \omega_0 t \le 5$, where $\omega_0^2 = {}^{EJ}/_{\bar{m}L^4}$

2 Differential Support Motion



The dynamic system in figure is composed of two uniform beams of negligible mass, their flexural stiffness being $EJ = \text{const}$, supporting a lumped mass of negligible rotatory inertia (the flexibility matrix is $\boldsymbol{F} = {}^{L^3}/_{6EJ}\begin{bmatrix} 3 & 2 \\ 2 & 96 \end{bmatrix}$).

The left support is subjected to an imposed horizontal displacement

$$u_{\mathcal{A}} = \begin{cases} \frac{20\tau^3 - 15\tau^4 + 3\tau^5}{16} & \text{for } 0 \le \tau \le 2, \\ 0 & \text{otherwise} \end{cases}$$

where $\tau = \omega_0 t$ and $\omega_0^2 = {}^{EJ}/_{mL^3}$. Plot the *total* vertical displacement of the mass in the time interval $0 \le \tau \le 10$.