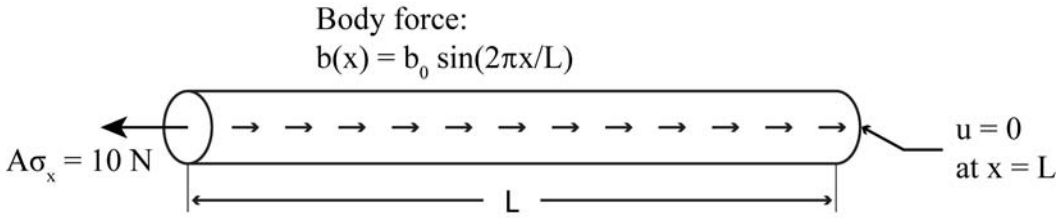
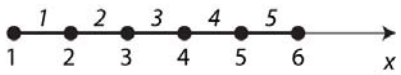
MAE 404/598 Finite Elements in Engineering
Programming assignment #5

Calculate the external forces on the body as shown below.



The mesh should be defined with N nodes that are evenly spaced and ordered left-to-right. The elements are two-node, linear displacement, bar elements. You should use the solution to the first HW assignment to define the nodal coordinates and connectivity matrix.



The element external forces resulting from the body force and applied traction are:

$$\mathbf{f}^e = \int_{x_1^e}^{x_2^e} \mathbf{N}(x) b(x)\, dx + \left(\mathbf{N}(x)\sigma(x)An\right)\Big|_{t_\Gamma} \quad \mathbf{f}^e = \int_{x_1^e}^{x_2^e} \mathbf{N}(x) b(x)\, dx + \left(\mathbf{N}(x)\sigma(x)An\right)\Big|_{t_\Gamma}$$

where $b(x)$ is the body force (defined above, with b_0 = 5 N/m), A is the cross section area (which is constant over the body), and $n = \pm 1$ is the outward normal direction of the body. Note that you do not need know the value of A to compute the external forces for this problem.

Note that you cannot numerically integrate the body forces exactly, so use a two point Gaussian quadrature integration for sufficient accuracy.

Instructions for programming and assignment submission:

- For this assignment, submit only a single MATLAB code named "**asurite_hw5.m**".
- The file **must** define a function of the same name as the file name (but without the ".m") , e.g.

```
function [f] = asurite_hw5(N, L)
    % Compute external forces here.
end
```

- **Input arguments:** N: the number of nodes defined along the mesh, L: length of the mesh in meters.
- **Output arguments:** f: an Nx1 matrix containing the external nodal forces from body force and prescribed tractions.

Your submission will be graded electronically. Failure to comply with the above instructions may result in zero credit.

Submit your assignment to http://sparky.fulton.asu.edu/fe/index.php

Can be resubmitted daily until Thursday Feb 18 at 12 midnight.