

MA4523 Assignment 4

1. Let $\{x_j\}_{j=0}^{N+1}$ define a uniform mesh on $(0, 1)$ with the stepsize $h = x_{j+1} - x_j$ and let $\phi_i(x)$ be the basis function of linear FEM defined by

$$\phi_i(x) = \begin{cases} \frac{x-x_{i-1}}{h}, & x \in (x_{i-1}, x_i) \\ \frac{x-x_{i+1}}{-h}, & x \in (x_i, x_{i+1}) \\ 0 & \text{other} \end{cases}$$

Calculate the following integral by composite Gauss-quadrature rule with one point and two points, respectively, in each subinterval (x_j, x_{j+1}) ,

$$\int_0^1 \sin^2 x \phi_i(x) dx, \quad i = 1, 2, \dots, N$$

2. For the truss below, a horizontal load of $P = 4000lb$ is applied in the x-direction at node 2.

- (a) Write down the element stiffness matrix for each element.
- (b) Assemble the global matrix.
- (c) Evaluate the stress in element 2 and the displacement at the node 2.

3. For the three-bar truss shown below, determine the displacements of node 1 and the stress in element 3.

