Finite element method - 1 Wave Equation

Consider the wave equation,

$$\ddot{u} - \Delta u = 0$$
, in $\Omega \times J$,

with boundary conditions

$$\mathbf{n} \cdot \nabla u = 0, \text{ on } \Gamma_N \times J,$$

$$u = 0.1 sin(8\pi t), \text{ on } \Gamma_D \times J,$$

and initial condition



For J = [0, 2], solve the equation using the FEM—derive the weak formulation and solve the resulting ODE system by first reducing it to a first-order system and then constructing a Crank-Nicolson scheme. For the time step, use $\tau = 0.005$.