ESC 113 TERM PROJECT:
GROUP 5-

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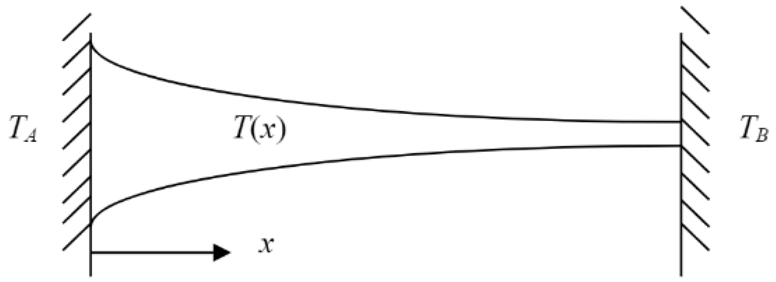
Problem – The diagram shows a body of conical section fabricated from stainless steel immersed in air at zero temperature. It is a circular cross section that varies with x. The large end is located at
x = 0 and is held at temperature Ta = 5. The small end is located at x = L = 2 and is insulated (i.e, the temperature gradient is zero).



When the body is not insulated along its length and the system is at steady state, its temperature satisfies the following ODE:

$$\frac{d^2T}{dx^2} + a(x)\frac{dT}{dx} + b(x)T = f(x)$$

Where, a(x), b(x), and f(x) are functions of the cross-sectional area, heat transfer coefficients, and the heat sinks inside the body. In the present case, they are given by

$$a(x) = -\frac{x+3}{x+1}, \qquad b(x) = \frac{x+3}{(x+1)^2}, \qquad \text{and} \qquad f(x) = 2(x+1) + 3b(x).$$

Approach to the Solution –
Discretizing the above equation using 2nd order central difference approximation and formulating the set of linear simultaneous equations, incorporating the boundary conditions such that the accuracy of the scheme is preserved. Use Δx = 0.5.
Solving the system of equations using Gauss Elimination and drawing the temperature profile indicating the values at the nodes.