

## Assignment 14. Shooting method and PDE

Marks 10

Posted on 29.10.2025 @ 2:30 pm and due on 29.10.2025 @ 6:00 pm

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1. Equation for heat conduction in a thin, un-insulated rod of length  $L = 10$  m is

$$\frac{d^2T}{dx^2} + \alpha(T_a - T) = 0$$

where the heat transfer coefficient  $\alpha = 0.01 \text{ m}^{-2}$  parameterizes heat dissipated to the surrounding air and  $T_a = 20^\circ \text{C}$  is the ambient temperature. If  $T(x = 0) = 40^\circ \text{C}$  and  $T(x = L) = 200^\circ \text{C}$ , solve the boundary value problem using *Shooting Method* with *RK4* integrator and determine at what  $x$  the temperature is  $T = 100^\circ \text{C}$ .

2. Solve the 1-dimensional heat equation  $u_{xx} = u_t$  over a conducting bar, of length 2 units, kept at  $0^\circ \text{C}$  but is heated to  $300^\circ \text{C}$  at its center at time  $t = 0$ . Choose your  $\Delta x$  and  $\Delta t$  with care such that  $\Delta t/(\Delta x)^2 \ll 0.5$ .