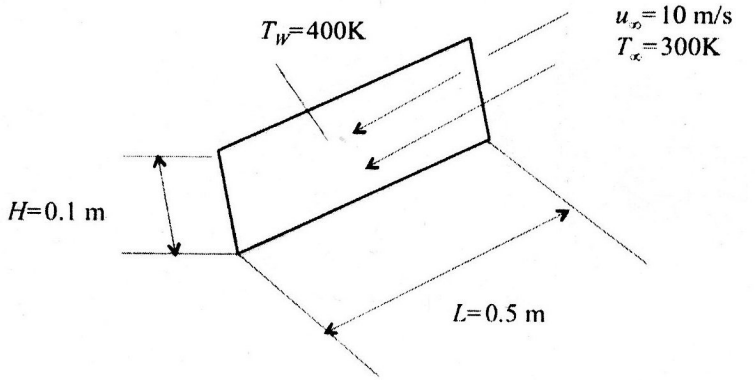
Problem 1

A one-dimensional slab of thickness $2L$ is initially at a uniform temperature T_i. Suddenly, electric current is passed through the slab causing a uniform volumetric heating $\dot{q}$ (W/m^3). Both the outer surfaces of the slab ($x=\pm L$) are exposed at the same time to a fluid of temperature T_∞ via a convective heat transfer coefficient h. Write the explicit finite difference equation for the energy balance on node 1, located at the left surface ($x=-L$). The grid spacing is Δx.

Problem 2

A rectangular shaped thin cooling fin for a heat exchanger is situated parallel to an atmospheric pressure air stream. The fin is 0.1-m-high, and 0.5-m in the flow direction. The fin average temperature is 400K and the free stream air temperature is at 300K. The velocity of the air is 10 m/s. Determine the heat transfer loss from the fin (identical conditions on both fin surfaces).



Problem 3

A thin-walled pipe of D=20 mm internal diameter is subjected to a constant heat flow on the surface of strength q'=400 W/m. Water flows through the pipe at a rate $\dot{m}$=0.1 kg/s. The entry bulk temperature is $T_{b,i}$=20°C.

(a) Find the required length of the pipe if the bulk outlet temperature $T_{b,o}$=40°C.
(b) Find the pipe wall temperature at the exit.

Problem 4

.02

A long horizontal tube of 20mm diameter with an outer surface of 500K is located in a room with an air temperature of 300K. Estimate the heat transfer rate per unit length of the tube due to free convection.