
Heat Transfer - 1

A heat transfer experiment is performed to determine the convective heat transfer coefficient of flow over a flat plate. The flat plate has internal heat generation, $q''' = 5.37 \text{ MW/m}^3$, and thermocouples on each side of the plate are used to measure the surface temperature on the top and bottom of the plate as shown in the figure below. The system operates at steady state, and the external flow over the plate is at 20°C . Assuming 1-D conduction (temperature only varies in x direction and not in the flow direction) through the plate, the thermal conductivity of the plate is 115 W/mK , and heat transfer coefficient on the top plate is constant; determine the following:

- (40 points)** Derive an expression for the temperature of the plate as a function of x .
- (25 points)** Determine location of maximum temperature, the maximum temperature in the plate, and draw a sketch of the temperature profile through the plate.
- (10 points)** Determine the heat flux on the bottom surface of the plate.
- (25 points)** Determine the heat flux to the external flow and the convection heat transfer coefficient.

$$T_\infty = 20^\circ\text{C}$$

