# ME 345 – HTx Fall 2023 Week 7 Homework

## Problem 1:

Update your resume and attend the Career Fair.

## Problem 2:



The center portion of a very long rod that is 5 [mm] diameter is subjected to heat treatment with induction heating. The rod has a thermal conductivity of 25 [W/m\*K]. The center portion is 30 [mm] long and experiences uniform volumetric heating of 7.5 x 106 [W/m3]. The unheated portion protrude from each side and experience convection with h = 10 [W/m2K, and T∞ = 20 °C. Ignore any convection or radiation heat transfer from the 30 [mm] portion of the rod. Calculate the following:

1. Steady-state temperature of the middle of the rod (T0)
2. Steady-state temperature of the rod where it exits the heating portion (Tb)
3. Steady-state rate of heat transfer from the unheated portion of the rod.
4. Minimum length [mm] of each side of the unheated portion of the rod necessary to assume it is a “very long rod” is a valid assumption.

## Problem 3:



The blades on a gas turbine are in a very hot environment. To deal with this the blades are made of Inconel (with k ~ 20 [W/m\*K], but this alone wasn’t enough to keep the blade tip below the maximum allowable temperature of 1050 °C. One idea to help keep the blade cooler is to use cooling air through the ring base (where the blades attach). This cooled air will keep the base temperature at a constant
300 °C.

Some parameters about each turbine blade are:

* Uniform cross-sectional area of 6 x 10-4 [m2]
* Perimeter of 110 [mm]
* Length of 50 [mm]
* Outside surface experiencing convection with h = 250 [W/m2K], and T∞ = 1200 °C

Calculate the following **two different ways**. 1) Assume the blade has an adiabatic tip, and 2) Assume the blade tip is experiencing convection heat transfer (same h and T∞ as the rest of the blade).

1. For each case what is the maximum SS temperature experienced by the turbine blade?
2. For each case what is the heat rate transferred from the blade to the ring base?