

## MECH 1950 Buildings for Contemporary Living

### QUIZ 4

(24 November 2011)

$$R = \rho \frac{L}{A}$$

$0.3 \text{ mm}$   
 $T_m$   $\rho$   $110^\circ\text{C}$

An electric current of 200 A (ampere) is passed through a stainless steel wire of 3 mm in diameter. The resistivity ( $\rho$ ) of the stainless steel wire may be taken as ( $7 \times 10^{-7} \text{ ohm} \cdot \text{m}$ ) and the length of the wire is 1 m. The wire is submerged in a liquid at  $110^\circ\text{C}$  and experience a convection heat transfer coefficient  $h = 4,000 \text{ W/m}^2 \cdot ^\circ\text{C}$ . Calculate the surface temperature of the stainless steel wire.

Hint 1:  $P = V \times I$  and  $R = V / I$

where  $P$  is the power (watts)  
 $V$  is the voltage (volts)  
 $I$  is the current (ampere)  
 $R$  is the resistance (ohm)

Hint 2:  $Q = h \cdot A \cdot (T_s - T_f)$

where  $Q$  is the rate of heat generated (watts)  
 $h$  is the heat transfer coefficient ( $\text{watts/m}^2 \cdot ^\circ\text{C}$ )  
 $A$  is the surface area of heat transfer ( $\text{m}^2$ )  
 $T_s$  is the surface temperature ( $^\circ\text{C}$ )  
 $T_f$  is the fluid temperature ( $^\circ\text{C}$ )

~ Good Luck ~