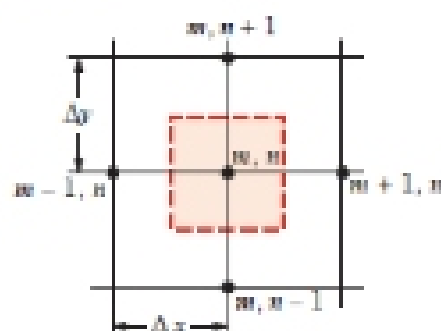
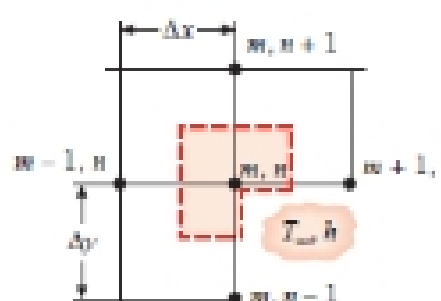
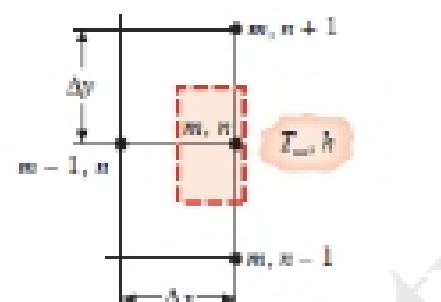
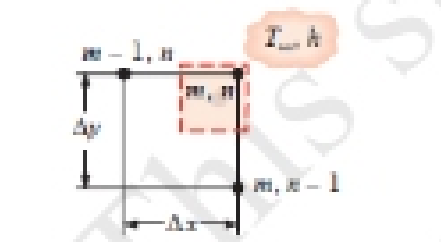
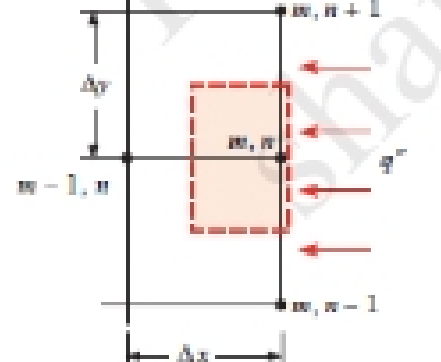


MEEN 461-501 Heat Transfer

Homework 4-3

Due Tuesday, September 27, 2016 at the beginning of class

TABLE 4.2 Summary of nodal finite-difference equations

Configuratio	Finite-Difference Equation for $\Delta x = \Delta y$
	$T_{m,n+1} + T_{m,n-1} + T_{m+1,n} + T_{m-1,n} - 4T_{m,n} = 0 \quad (4.29)$ <p>Case 1. Interior node</p>
	$2(T_{m-1,n} + T_{m,n+1}) + (T_{m+1,n} + T_{m,n-1}) + 2\frac{h\Delta x}{k}T_{\infty} - 2\left(3 + \frac{h\Delta x}{k}\right)T_{m,n} = 0 \quad (4.41)$ <p>Case 2. Node at an internal corner with convection</p>
	$(2T_{m-1,n} + T_{m,n+1} + T_{m,n-1}) + \frac{2h\Delta x}{k}T_{\infty} - 2\left(\frac{h\Delta x}{k} + 2\right)T_{m,n} = 0 \quad (4.42)^a$ <p>Case 3. Node at a plane surface with convection</p>
	$(T_{m,n-1} + T_{m-1,n}) + 2\frac{h\Delta x}{k}T_{\infty} - 2\left(\frac{h\Delta x}{k} + 1\right)T_{m,n} = 0 \quad (4.43)$ <p>Case 4. Node at an external corner with convection</p>
	$(2T_{m-1,n} + T_{m,n+1} + T_{m,n-1}) + \frac{2q''\Delta x}{k} - 4T_{m,n} = 0 \quad (4.44)^b$ <p>Case 5. Node at a plane surface with uniform heat flux</p>

^{a,b}To obtain the finite-difference equation for an adiabatic surface (or surface of symmetry), simply set h or q'' equal to zero.

- 4.38** Consider nodal configuration 2 of Table 4.2. Derive the finite-difference equations under steady-state conditions for the following situations.
- The horizontal boundary of the internal corner is perfectly insulated and the vertical boundary is subjected to the convection process (T_∞, h).
 - Both boundaries of the internal corner are perfectly insulated. How does this result compare with Equation 4.41?
- 4.39** Consider nodal configuration 3 of Table 4.2. Derive the finite-difference equations under steady-state conditions for the following situations.
- The boundary is insulated. Explain how Equation 4.42 can be modified to agree with your result.
 - The boundary is subjected to a constant heat flux.
- 4.40** Consider nodal configuration 4 of Table 4.2. Derive the finite-difference equations under steady-state conditions for the following situations.
- The upper boundary of the external corner is perfectly insulated and the side boundary is subjected to the convection process (T_∞, h).
 - Both boundaries of the external corner are perfectly insulated. How does this result compare with Equation 4.43?