SIMUTECH CHT PROJECT

Assignment 4

-Manvendra Singh, 190487

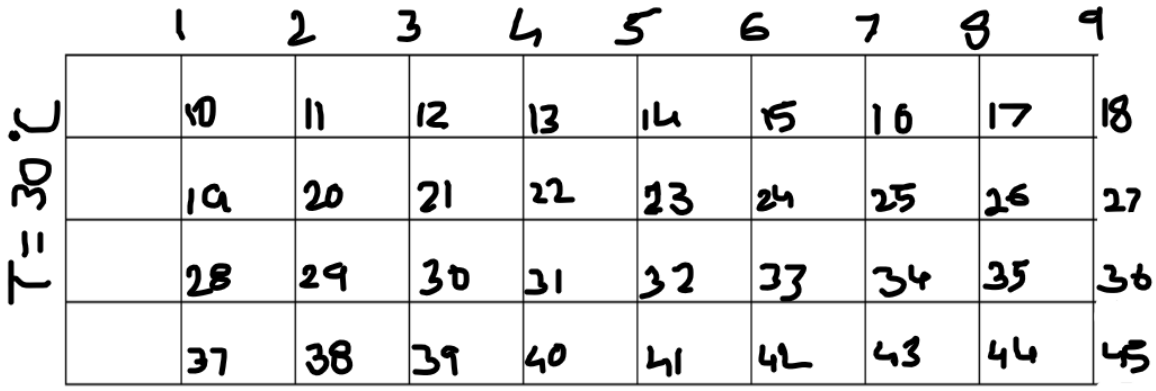
Theory

Equation for steady state heat conduction:

$$\partial Q_{cond,left}/\partial t + \partial Q_{cond,right}/\partial t + \partial Q_{cond,top}/\partial t + \partial Q_{cond,bottom}/\partial t + \partial E_{gen,element}/\partial t = \Delta E/\Delta t = 0$$

Applying this equation to different nodes of the following temperature grid (10×5) nodes:

(Temperature for 5 left nodes is already given to be 303K)



For Top node:

$$h\Delta x(T_{\infty} - T_{i,j}) + k\Delta x(T_{i+1,j} - T_{i,j})/\Delta y + k\Delta y(T_{i,j-1} - T_{i,j})/2\Delta x + k\Delta y(T_{i,j+1} - T_{i,j})/2\Delta x = 0$$

Similarly for bottom node:

$$h\Delta x(T_{\infty} - T_{i,j}) + k\Delta x(T_{i-1,j} - T_{i,j})/\Delta y + k\Delta y(T_{i,j-1} - T_{i,j})/2\Delta x + k\Delta y(T_{i,j+1} - T_{i,j})/2\Delta x = 0$$

For interior node:

$$(T_{i-1,j} - 2T_{i,j} + T_{i+1,j})/(\Delta x)^2 + (T_{i,j-1} - 2T_{i,j} + T_{i,j+1})/(\Delta y)^2 = 0$$

For the right node, except for the corner, the insulated boundary can be taken as a mirror and the node becomes an interior node with the left and right node temperatures to be the same. So the equation becomes:

$$(2T_{i-1,j} - 2T_{i,j})/(\Delta x)^2 + (T_{i,j-1} - 2T_{i,j} + T_{i,j+1})/(\Delta y)^2 = 0$$

For the right top and bottom corners:

$$(h\Delta x(T_{\infty} - T_{i,j}) + k\Delta x(T_{i+1,j} - T_{i,j})/\Delta y + k\Delta y(T_{i,j-1} - T_{i,j})/\Delta x)/2 = 0$$

Result

2D Temperature plot: