**Governing Equation**

For, *one-dimensional* and *unsteady heat conduction*,

**Parameters**

**Initial Conditions**

**Boundary Conditions**

**Discretisation**

For the Crank-Nicolson scheme, the weight; .

Dividing in to 5 equal control volumes, results in all nodal distances, , as 0.004 m.

The governing equation may be approximated in the following form, for a control volume, (*An Intro. To CFD The FVM*, by Versteeg & Malalasekera, p.245)

For nodes 2,3 & 4, equation 1 becomes:

and for

Thus,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

and therefore, for or

For the control volume bounding node 1,

Thus, equation 1 simplifies to

So that,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

For a control volume bounding node 5, equation 1 changes to (to incorporate the BC at )

So that,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Temperatures at nodes 1-5 can be evaluated by solving the following linear system of equations, where the coefficient matrix is formed from noting the respective coefficients in equations 2-4;

Thus for the given time step up to

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [s] | [oC] | | | | |
| 1 | 2 | 3 | 4 | 5 |
| 0 | 200 | 200 | 200 | 200 | 200 |
| 2 | 199.999569147615 | 199.992675509460 | 199.868590022671 | 197.641944898624 | 157.686418152559 |
| 4 | **199.996146349257** | **199.948275213692** | **199.307191194467** | **191.786285561234** | **128.303712151786** |

clc

clear all

close all

A=[2125 -125 0 0 0

-125 2250 -125 0 0

0 -125 2250 -125 0

0 0 -125 2250 -125

0 0 0 -125 2375];%Coefficient Matrix for Ax=B

To=[199.999569147615 199.992675509460 199.868590022671 197.641944898624 157.686418152559]';%Update with the row vector of x from Workspace

B=[1875\*To(1)+125\*To(2)

125\*To(1)+1750\*To(2)+125\*To(3)

125\*To(2)+1750\*To(3)+125\*To(4)

125\*To(3)+1750\*To(4)+125\*To(5)

124\*To(4)+1625\*To(5)]%Column Vector

x=A\B;%Solve Linear System