**Heat Diffusion (Conduction) Equation / Heat Equation**

We wish to know the temperature distribution within a material.

If you know two temperatures of two different points within a material or temperature distribution within a material, you can use Fourier’s law to find the heat flux.

Temperature distribution is the variation of temperature as a function of position ….. T= f(x)

For example, T (x)= ax2+bx+c

If you don’t have the temperature distribution, then you can derive it by using the heat equation (energy balance)

Heat equation is simply the conservation of energy for a system in which only conduction occurs should be derived accordingly,

1- Determine the geometry ---- which coordinate system do you choose ?

2- Define a differential control volume (differential volume element) at the system

3- Establish energy balance for that differential volume element.

Consider the differential volume element



Divide both sides by



Considering k is a constant, the equation can be organized as follows :

=

Dividing both sides by k

…….. Recall =

(Eqn. 2.21 in the textbook)

**Red terms are conduction terms in cartesian coordinates.**

**Blue term is the generation term.**

**Green term is the storage (accumulation) term.**

This last term is the most simplified version of heat equation in cartesian coordinates. As mentioned, this equation is used to determine temperature distribution within a system in which heat transfer occurs only by conduction.

1- Assumption: If you assume T=f(x) only, then

2- Assumption: If there is no heat generation =0

3- Assumption: The system is at S.S.,

=0 *distribution with unknow,* m and n which are arbitrary constants.

Once m and n are determined, T distribution will be obtained.

Such as, you have T = 3x2 -4x +5 then the heat flux at x=0 can be calculated as follows:



How are the arbitrary constants m and n are found ?

We need boundary conditions or an initial condition to get the temperature distribution completely.

(refer to Table 2.2 on page 83 of the textbook)

