South Dakota School of Mines and Technology
Department of Mathematical and Computer Sciences

Math 373: MI 222 | HQ 1 | Oct 8, 2002

1. a) Write the 2D USS Heat Equation in incremental form.

$$\alpha\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right)=\frac{\partial T}{\partial t}$$

   b) Solve it for the new temperature at any time step.
   c) Show the solution for the maximum time step.

2. Mark the location of ξ according to the Mean Value Theorem of Derivatives

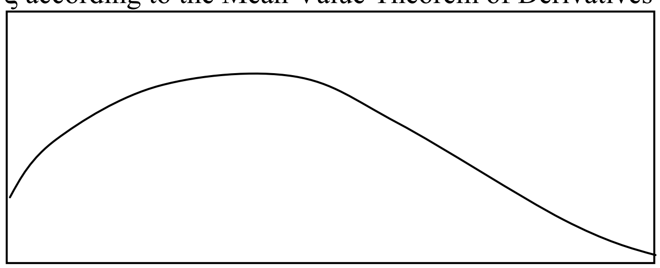

Figure 1. f(x) vs. x

3 For $f(x) = 2x^3 + 3x^2 - 5$
   a) Write the first order Taylor Series approximation in terms of x and h for the above function.
   b) What is the value of ξ that makes the first order approximation exact when x = 1 and h=0.5?
4. Derive the 1D USS HT equation in rectilinear coordinates. Include a generation term, S, per unit volume. Show your work in detail.
5. Solve the equation $\alpha\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right)=\frac{\partial T}{\partial t}$ for the steady state temperature as needed in the spreadsheet solution
6. Given the data below, what is the largest time step allowed in the method of solving a 1D USS HT problem by the methods covered so far in class if
   a) $\alpha = 0.5\ cm^2/sec$ and $\Delta x = 0.2$ cm?
   b) k = 1.0 J/(cm*K*sec),
      Cp = 0.5 J/(g*K), and
      $\rho = 8\ g/cm^3$?
7. Complete the macro below that will find the monthly payment given the number of payments, n, the amount borrowed, P, and the interest per period, i.

   The $Payment = \mathrm{P}\,\frac{(1+i)^n-1}{\mathrm{i}}$

   Function Payment(P, i, n)

   End Function