GES 554 Partial Differential Equations

Project 1: [100 pts]

Due: 1st Feb 2016 by 5:00 pm.

Local students: Hardcopy

Online students: Email pdf

Failure is not an option. −Gene Krantz

Prepare an engineering memo (replicating the provided example) solving and discussing the solution to the following heat diffusion equation. The state u represents temperature.

$$u_t - 0.1u_{xx} = 0 \qquad 0 < x < 1$$
$$u(0,t) = 0$$
$$u(1,t) = 0$$

The initial condition is a rectified triangle wave.

$$u(x,0) = \begin{cases} x & 0<x<\dfrac{1}{4} \\ \dfrac{1}{2} - x & when \quad \dfrac{1}{4}<x<\dfrac{1}{2} \\ 0 & \dfrac{1}{2} < x < 1 \end{cases}$$

Please include answers to the following questions in your memo.

- How many sine terms are needed for convergence? What are your criteria?
- What is the temperature and time when the maximum temperature at x=0.6 occurs?
- What location and time has the fastest change in temperature versus time?
- Plot the set of locations and times where the heat flux is zero?
- [10 pt bonus] How much total energy was transported in/out of the system between time zero and steady state? Show two fundamentally different ways (i.e. Flux and volume integrals) to compute the total transported energy.