

Math 319 - Differential Equations II
Assignment # 3
due Fri Oct 17th, 4PM, SCI 386

Special Note: Note that you have a few extra hours on Friday this time!

Instructions: You are being evaluated on the presentation, as well as the correctness, of your answers. Try to answer questions in a clear, direct, and efficient way. Sloppy or incorrect use of technical terms will lower your mark.

The assignment may be done with up to 4 other classmates (i.e. total group size: no more than 5). If you collaborate with classmates, the group should hand in one document with all contributing names at the top.

1. When we derived the heat equation in class using a conservation of flux approach, we assumed that no particles were created or destroyed within the domain. This time, rederive the conservation law assuming that particles are created at a rate $\beta C(x)$ per unit volume per unit time.

Note: If the particles are bacteria, say, this “creation rate” corresponds to birth of new bacteria from the current bacterial population. If the particles instead are units of heat, the creation of more heat from current heat units could be due to some sort of autocatalytic reaction, for example.

2. Section 10.5 #1
(Don't stop at the formal solution. Solve for the Fourier coefficients and obtain the final solution.)
3. Section 10.5 #7 (Don't stop at the formal solution. Solve for the Fourier coefficients and obtain the final solution.)
4. Section 10.5 #18
(Don't stop at the formal solution. Solve for the Fourier coefficients and obtain the final solution.)
5. Show that

$$\left\{ \sin \left(\frac{(2n-1)\pi}{2a} x \right) \right\}_{n=1}^{\infty}$$

is an orthogonal set on $[0, a]$ with respect to the weight function $w(x) = 1$.