

ISC 5935 - Computational Tools for Finite Elements

Homework #9

Assigned 05 November 2014, Due 12 November 2014

http://people.sc.fsu.edu/~jburkardt/classes/fem_2014/homework9.pdf

For these problems, assumed that $\sigma(x)$ is the flux, $k(x)$ is the thermal conductivity, $f(x)$ is the source term, and $u(x)$ is the temperature. Assume we are working in the interval $0 \leq x \leq 10$. Assume that, in general (but not necessarily in question 4):

$$\begin{aligned}\text{Jump}(\sigma(x)) &= 0 \\ \sigma(b) - \sigma(a) &= \int_a^b f(x) dx \\ \sigma(x) &= -k(x) \frac{du}{dx}\end{aligned}$$

1. Suppose that the graph of $\sigma(x)$ as a function of x is a straight line that is 1 at $x = 0$ and 3 at $x = 10$.

- what is an expression for $f(x)$?
- if $k(x) = \frac{1}{10}$, what is a formula for $u(x)$?

2. Suppose that the plot of $f(x)$ as a function of x is 1 for $0 < x < 5$ and 4 for $5 < x < 10$.

- what is a formula for $\sigma(x)$?
- if $k(x) = 3$, what is a formula for $u(x)$?

3. Suppose that the plot of $k(x)$ as a function of x is 5 for $0 < x < 5$ and 2 for $5 < x < 10$. Suppose that $f(x)$ is 1 (*correction!*), and that $u(0)$ is 0.

- what is a formula for $\sigma(x)$?
- what is a formula for $u(x)$?

4. Suppose that $f(x) = 2 + 10\delta(x - 7)$.

- what is a formula for $\sigma(x)$?
 - if $k(x) = 3$, what is a formula for $u(x)$?
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