Due Friday, Mar. 11

Develop a finite element code that can solve the anisotropic heat conduction equation in two dimensions.

$$\nabla \cdot (\Bbbk \cdot \nabla T) + f = 0, \quad \text{for } 0 < x < a \text{ and } 0 < y < b,$$

where $\Bbbk = \Bbbk(x, y)$ is the (2×2) anisotropic thermal conductivity tensor and $f = f(x, y)$ is the heat generation. The boundary conditions should be sufficiently flexible to specify either Dirichlet boundary conditions

$$T|_\Gamma = \tilde{T},$$

or Neumann boundary conditions

$$\nabla T \cdot \hat{n}|_\Gamma = \tilde{q},$$

along each boundary of the rectangular domain.

Your code should have the following features and capabilities:

(a) Generate a mesh of 100×100 isoparametric elements.

(b) Use Gauss-Legendre quadrature for the integrals.

(c) Provide the ability to select from a library of three types of elements (3-node linear triangles, 4-node linear rectangles, 9-node quadratic rectangles) at run time.

(d) Specify the domain size a and b at run time.

(e) Specify the analytical form of the thermal conductivity tensor and heat generation term at run time.

(f) Specify the boundary conditions at run time.

(g) Plot the temperature contours at a resolution specified at run time.

Everyone should write their own code. Do not share your code with classmates. You are free to use any of the functions provided in FSELIB library, but you should have a thorough understanding of the details of their functionality.

The specifications for your runs will be provided on March 10. You should provide a pseudo-code or flow chart for your code as part of a brief report (2-3 pages) describing the code's operation. Your report, code, and plots are due on March 11.