Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. During the quiz you may use your textbook, my notes, and your own notes. No communication with others and no calculators or other electronic devices are permitted.

Name _____

1. (5) Consider the function

$$f(x) = \sin(\pi x)$$

expressed as

$$f(x) = \sum_{m=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} F[m, k]\psi(2^m x - k)$$

where

$$\psi(x) = \begin{cases} 1 & \text{if } 0 \leq x < 1/2 \\ -1 & \text{if } 1/2 \leq x < 1 \\ 0 & \text{otherwise} \end{cases}$$

What is $F[2, 1]$?

2 (5) Using the data returned from PDEtool by `getpetuc`, how can you find the maximum length of the side of a triangle in the triangulation?

3. (5) Suppose you are computing a finite element approximation to a self-adjoint elliptic partial differential equation and you decide to use an iterative method to solve the linear system. Which of these two algorithms would you use: conjugate gradients or GMRES? Why?

4. (5) Consider the problem

$$-u''(x) = f(x) \text{ for } x \in (0, 1)$$

with $u(0) = u(1) = 0$ and f computed so that the true solution is

$$u(x) = \begin{cases} x(1-x)e^x & \text{if } x \le 2/3 \\ x(1-x) & \text{if } x > 2/3 \end{cases}$$

Will a Galerkin finite element approximation with piecewise linear elements and mesh size $h = .0001$ give a good approximation to u? Justify your answer.