***ME 554 Finite Element Analysis – Final Project***

## Spring Semester 2018

**Learning Objectives:**

Be able to program the 2D finite element method.

**Instructions:**

Attached is incomplete code that uses the finite element method to solve the heat equation on a rectangular plate. Please complete this code.

**Deliverables:**

You must turn in (1) your code, (2) a user’s guide, and (3) a report that shows the solution to two problems.

**(1) Your Code** (35 points)

The code should operate as intended, i.e. be able to solve 2D heat transfer problems with the finite element method, and be well commented. The code must be general enough that it not only solves the problem in the main program (fem\_2dmodel.m), but can also solve problems with different heat sources and/or boundary conditions.

**(2) User’s Guide** (25 points)

The user’s guide should thoroughly explain how to use your code to solve 2D heat problems. This includes how to change the code for different sources, domains, and boundary conditions.

**(3) Report** (40 points)

The report is to demonstrate the capabilities of your code. This report should look similar to reports from other computer projects, but instead of using ANSYS to get results, you should use your own code.

For this report please solve two problems:

1. The problem in the code provided to you
2. One other heat problem of your choosing that has a different heat source and/or boundary conditions than the current problem.

For each problem, use at least two meshes to show convergence.

In this report include the following sections:

* *Introduction* 
  + In your own words summarize the problems being asked.
* *Model Development*

This section should show a diagram with the original meshes, and clearly define all loads and boundary conditions. In particular, be sure to clearly define the problem of your choosing. Also state any assumptions that you made for your model.

* *Results*

Please show plots of the temperature distribution for each load case. In order to be sure that results converge, you may have to do multiple mesh cases for each load/BC case.

* *Discussion*

In this section please comment on the results you obtained. These comments must include a discussion about:

* + Do the results make sense? Why or why not?
  + Do results converge? How can you tell?
  + How does the finite element solution compare to the exact solution for the problem given in the code?
  + *Conclusion*
* Summarize the results of these problems.
* Draw conclusions about programing the finite element method in 2D.

**Grading Rubric:**

|  |  |
| --- | --- |
| **Item** | **Points** |
| *Computer Code* |  |
| Operational (as confirmed by various test problems) | 30 |
| Comments | 5 |
| *User's Guide* |  |
| How to use code | 10 |
| How to change code | 10 |
| Grammar & Organization of the user's guide | 5 |
| *Report* |  |
| Introduction | 5 |
| Model Development | 5 |
| Results | 10 |
| Discussion | 10 |
| Conclusion | 5 |
| Grammar & Organization of the report | 5 |
| **TOTAL** | **100** |

**Extra Credit:**

Change the code so that both 4-noded quad elements and 3-noded triangle elements can be used. Having operational triangular element, which are adequately explained in the user’s guide will can add up to 10 points to your score on this assignment.