**MESF6910J, Term 2, 2017-2018**

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**Assignment #1:**

**FEM Analysis of a Michell-Type Structure**

***Due: 9 PM, 1 March, Thursday***

**Readings**:

In addition to the PPT files used in the lectures, students should also read additional reading materials posted online, with file names like “Notes-xxx”.

**Assignment**:

*The program*: A 99 line topology optimization code written in MATLAB is described in a paper listed below. It is intended for engineering education. Students can find the code and download it. The code is used in the courses where students will be assigned to do extensions in FEM analysis and structural optimization.

A description of the code can be found in the paper "A 99 line topology optimization code written in MATLAB" (PDF) (160K) (Structural and Multidisciplinary Optimization 21(2), 2001, pp. 120-127) by Ole Sigmund. This paper is posted online for your use. The original publication is available at <http://dx.doi.org/10.1007/s001580050176>

In the program, the ﬁnite element code is written in lines 65–99. You should take this portion out and modify it into your own function to conduct the FEM analysis for the structure described below. Other portions of the program may be studied later. State variables as well as boundary conditions are deﬁned in the Matlab code and they need to be edited for the given problem.

Note that in the program, there are other variables that are not related to FEM analysis. Thus, they shall be removed or fixed for this exercise. Particularly, “volfrac” is the volume fraction, and “penal” is the penalization power. They all should be set to equal to 1.

*The structure*: A Michell-type structure is considered with three loads at its bottom, spaced in equal distance between the two supports, as shown in the Figure. The rectangular design domain is with . A mesh of  quadrilateral elements (0.1m \* 0.1m) will be used for FEM analysis. The structure has a fixed and a simple support at the bottom corners. The loads are  and . The material has a modulus of elasticity of 100 Mpa and the Poisson’s ratio of = 0.3.

*The solution*: In your solution to this problem using FEM analysis, find the displacements at the following positions on the structure: (Result From MATLAB)

1. The three positions at which the three loads are applied respectively.

3m X: -0.1630 e-005 Y: -0.4184e-005

6m X: -0.2251 e-005 Y: -0.5096e-005

9m X: -0.2872 e-005 Y: -0.4184e-005

1. The left-upper corner.

X: -0.2905e-005 Y: -0.2908e-005

1. The right-upper corner.

X: -0.1598e-005 Y: -0.2908e-005

1. The center point of the rectangular structure.

X: -0.2251e-005 Y: -0.4244e-005

(Figure on next page)

