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

**Assignment #3:**

**Topology Optimization of a Michell-Type Structure (Part 1)**

***Due: 7 PM, 12 April, Thursday***

**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. State variables as well as boundary conditions are deﬁned in the Matlab code and they need to be edited for the given problem.

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>

*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 . 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. This structure is fully described in Assignment #1.

*The problem*: In the topology optimization using the SIMP method for the minimization of the strain energy function c as defined in the lecture. For this assignment, do not employ sensitivity filtering by setting suitable parameter “rmin”. You shall conduct the following studies:

1. Solutions without penalization. The parameter “penal” is the penalization power. It will be set to equal to 1. “volfrac” is the volume fraction, and it is specified to be 0.30. You will find optimal design for the two cases of finite element mesh, and show your optimal design in grey-scale.
   1. A mesh of  quadrilateral elements will be used.
   2. A mesh of  quadrilateral elements will be used.
2. Solutions with penalization. The parameter “penal” is the penalization power. It will be set to equal to 3. “volfrac” is the volume fraction, and it is specified to be 0.30. You will find optimal design for the two cases of finite element mesh, and show your optimal design in grey-scale.
   1. A mesh of  quadrilateral elements will be used.
   2. A mesh of  quadrilateral elements will be used.
3. The parameter “penal” is set to equal to 5. “volfrac” is the volume fraction, and it is specified to be 0.30. You will find optimal design for the two cases of finite element mesh, and show your optimal design in grey-scale.
   1. A mesh of  quadrilateral elements will be used.
   2. A mesh of  quadrilateral elements will be used.
4. Based on the designs you have obtained above, briefly discuss the effects of the penalization parameter “penal” and the FEM mesh on the obtained optimization results.

