# ME260 Aug. 3:0

# Topology Optimization

## Instructor

G. K. Ananthasuresh
Email: suresh@iisc.ac.in

## Teaching Assistant

Email:

**Department: Mechanical Engineering**

Course Time: Usually Tue. and Thu., 2:00 30 PM

Lecture venue: Usually ME classroom

Detailed Course Page: http://www.mecheng.iisc.ernet.in/~suresh/me260/

## Announcements

This course is offered in alternate years and when the students ask for it.

## Brief description of the course

This is an advanced course suitable for those who want to specialize in structural optimization.Students in aerospace

Background to the course

Topology optimization has come to be known as a method to numerically solve problems wherein the topology of a solid structure (and some other cases fluids too) gets determined. In the context of a structure, the method gives us the layout along with the detailed geometric form. It is called topology optimization because the tells us how many holes should be there for given quantitative specifications. Usually, the specifications are nominal--just what an user can easily specify. Just from those, the algorithm can give the complete structural optimal form-- the topology, shape, and size. So, "topology optimization" is somewhat of a misnomer as gives more than topology. But then, in practice, topology is the most useful outcome of this method. Hence, the name has stuck.

In this course, the emphasis will be on topology optimization of stiff structures and compliant (flexible)

mechanisms. The method itself is very general and applies to a number of problems.

The course contents deals with problem formulation, design parameterization, sensitivity analysis, algorithms for solving the problem, and implementation.

## Prerequisites

ME 256: Variational Methods and Structural Optimization

## Syllabus

Overview of homogenization method

Indicator function, SIMP, and other parameterization methods for topology optimization

Numerical methods used to solve topology optimization problems including optimality criteria method, convex linearization, method of moving asymptotes, etc.

Sensitivity analysis including parameter and shape derivatives; material and spatial derivatives

Multiphysics problems in topology optimization

## Course outcomes

After taking this course, the student would...

Be able to formulate and implement topology optimization of structures and compliant mechanisms

Be able to write sensitivity (gradients) for cost functionals with respect to design variables and shape-changing parameters

Be able to appreciate the connection between homogenization theory and topology optimization

Become familiar with numerical methods used in topology optimization

Be conversant with the contemporary literature in the field of topology optimization

## Grading policy

Assignments including a term-paper (50%)

Course project (50%)

## Assignments

The assignments in this course will entail implementing topology optimization problems by wiring Matlab/C//Fortran codes. The students are expected to read journal papers and reproduce the results of those

papers. Students are also expected to formulate a new topology optimization problem for their course project.

## Resources

"Topology Optimization: Theory, Methods, and Applications" by Bendsoe and Sigmund

"A Hands-On Introduction to Topology Optimization" by Amir M. Mirzendehdel and Krishnan Suresh

"Homogenization and Structural Topology Optimization: Theory, Practice and Software" by Behrooz Hassani and Ernest Hinton