

# **ME102 – Finite Elements Analysis of** **Heat Transfer and Fluid Flow with** **COMSOL**

**Fall quarter 2019 – UCSB**

**Instructor: Prof. E. Matthys**

This class will be focused on numerical modeling of heat transfer and fluid flow phenomena, rather than on Finite Element Analysis (FEA) in general. This will be achieved primarily through hands-on work with the COMSOL Multiphysics package, a user-friendly but industrial-strength software for FEA. You will learn to solve practical engineering problems involving Conductive and Convective -and to a more limited extent Radiative- Heat Transfers, as well as Fluid Mechanics phenomena, through the use of custom-built numerical models in COMSOL. It is *NOT* expected that the students be already familiar with FEA software or COMSOL to take this class, and they will be progressively introduced to the needed concepts and user-interface issues pertinent to COMSOL in particular and to FEA techniques in general. We will review briefly some basic Heat Transfer, and Fluid Flow as needed as we move along; but will not look in depth at the theory behind FEA. We will look extensively, however, at modelling implementation issues that are likely to lead to difficulties in practice, such as meshing for example. Importantly, we will analyze numerical solutions with the goal to improve our understanding of the physics of the problems investigated, as well as to improve model-building and simulation skills. Of interest also will be design, parametric, and optimization studies. The lectures will consist primarily of real-time model development and results analysis. A significant part of the class work will be the development of numerical models of a practical or industrial engineering piece of equipment or situation, through creative student projects. It is expected that by the end of the class you will be familiar and comfortable enough with the FEA software that you will be readily able to model complex problems such as those encountered in Senior Design class projects, industrial internships, lab work, and later in your engineering careers. You are especially encouraged to take the class if you will be conducting Fluid and Heat Transfer work for your Capstone Design project or Research projects, as the ability to conduct robust modelling will be a strong asset for those endeavors in particular. These modelling skills are also highly prized by the Industry.