# Math 680: Industrial Mathematics

## Fall 2020: Asynchronous - Meeting Schedules to be determined

**Instructor:** Dr. Daniel Anderson
(Room: 4411 Exploratory Hall, Tel: (703) 993-1482, Email: danders1@gmu.edu)
**Office Hours:** Online To Be Determined, and by appointment.

**Texts:** *Notes for Industrial Mathematics*, D.M. Anderson. Other useful (not required) references *Mathematical Models in the Applied Sciences*, A.C. Fowler (Cambridge University Press, 1997); *Advanced Mathematical Methods for Scientists and Engineers*, C.M. Bender and S.A. Orszag (McGraw-Hill, 1978); *Perturbation Methods*, E.J. Hinch

**Prerequisites:** Familiarity with ordinary and partial differential equations. Interest in scientific applications.

**Course Goals:** To develop mathematical techniques that can be used to solve problems arising in the physical sciences and/or in industrial settings. In particular, this course will focus on asymptotic and perturbation methods applied to problems selected mainly from the broad areas of heat transfer, fluid mechanics, and solidification. No prior knowledge of or experience with these application areas will be assumed. However, we shall try to develop as much as possible the skills required to formulate a sound mathematical model whose solution will provide answers and insight into the original problem.

**Topics:**

| | |
|---|---|
| Asymptotic and Perturbation Methods: | Landau order symbols, asymptotic and convergent series, regular and singular perturbation methods, matched asymptotic expansions, multi-scale methods |
| Heat Transfer in Solids and Liquids: | conservation laws, heat equation, similarity solutions, homogenization theory |
| Introduction to Fluid Mechanics: | Navier–Stokes Equations, boundary conditions, lubrication approximation, scaling analysis, viscous gravity currents, thin films |
| Solidification of a Pure Materials and Alloys: | The Stefan problem, free boundary problems, linear stability analysis |
| Additional Topics | Cryobiology, Chemical Filtration, ... |

**Grading Policy:** The course grade will be based on homework (60%) and a project (40%).

**Project**: This will involve the application of the mathematical methods developed in the class to a particular application area related to those discussed in class. Each student will present a preliminary plan for their project near the middle of the semester and a final version at the end of the semester. These will be zoom/webex/video presentations and the schedule is to be determined.

**Honor Code:** It is expected that each student in this class will conduct himself or herself within the guidelines of the Honor Code. All academic work should be done with the level of honesty and integrity that this University demands.