MTH444/MTH544 - Fundamentals of Applied Mathematics II (Spring 2014)

When: Monday, Wednesday, and Friday 3:00PM-3:50PM
Where: MATH 150

Instructor: Avner Peleg
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Office hours (tentative): Monday 11:00AM-12:00noon, Wednesday 4:00PM-5:00PM.

Textbook: Introduction to the Foundations of Applied Mathematics, Mark H. Holmes, Springer, first edition (2009).

Prerequisites: MTH241, MTH306 and MTH309, all with grade C or higher.
MTH443/MTH543 is recommended.

Tentative syllabus: Chapters 5-9 in the textbook.

Course description: This course together with MTH443/MTH543 presents the reasoning used in the construction of mathematical models for physical phenomena and the mathematical methods used in analyzing and interpreting the models. The MTH444/MTH544 course covers models for traffic flow as well as the mathematical description of solids and fluids in the framework of continuum mechanics.

Learning outcomes: The students should understand the following concepts and know how to implement them in the derivation, analysis, and interpretation of continuum mechanics models for solids and fluids and in modeling traffic flow.

(1) Traffic flow: density and flux, velocity and the continuity equation, velocity-density relations and different types of dynamic behavior, method of characteristics, shock waves, cellular automata modeling, particle kinetics modeling.
(2) Continuum mechanics – one spatial dimension: material and spatial coordinates, material derivative, conservation of mass and the continuity equation, momentum equation and stress, energy equation, constitutive laws for an elastic material, restrictions on constitutive laws.
(3) Elastic and viscoelastic materials: linear elasticity, solution of linear elastic problems by the method of characteristics and by Laplace transforms, viscoelasticity, constitutive laws for a viscoelastic material, equations of motion, solution of viscoelastic problems.
(4) Continuum mechanics – three spatial dimensions: material and spatial coordinates, material derivative, general balance law, continuity equation, incompressibility, linear momentum equation and the stress tensor, angular momentum, energy equation, constitutive laws, Newtonian fluids, the Navier-Stokes equation.
(5) Fluids: introduction, steady flow, plane Couette flow, Poiseuille flow, vorticity, irrotational flow, ideal fluids, potential flow, potential flow past a cylinder, boundary layers.

Homework: Homework will be assigned each week. Selected homework problems on each assignment will be graded. Homework is an important component of the course and is worth 30% of the final grade. Notice that: (1) Late homework will not be accepted. (2) It is your responsibility to show your work and to present it in readable form. Unreadable answers or answers without justification will not receive credit.

Exams: There will be one midterm exam and a final exam. The midterm exam is scheduled for Monday, March 31 between 3:00PM-3:50PM in Math 150. The final exam is scheduled for Wednesday, May 14 between 3:30PM-6:30PM in Math 150. The weight of the midterm exam is 30%, and the weight of the final is 45%.

Grades: Homework – 30%, Midterm – 30%, Final – 45%.

The final number grade will be translated to a letter grade, and the translation will not be worse than:
85-105 A, 70-84 B, 60-69 C, 50-59 D, 0-49 F.
The boundaries for plus/minus grades (A-, B+, B-, etc.) will be determined only after the final exam.

Computational (numerical) problems: Some of the assigned homework problems might involve numerical calculations. You may use any computer software to solve these problems. When you submit the solution you should include a description of the software and a list of commands that you used.

MTH544 students: In accordance with the graduate school policy, graduate students will have additional coursework, consisting of additional homework and/or exam problems.

Course web site: http://www.math.buffalo.edu/~apeleg/mth544.html
This web site will be updated with announcements, homework assignments and other useful resources.

Attendance: Students are expected to attend every scheduled class. All students attending the class must be registered for the class.

Make-up exams: There will be no make-up exams for the midterm. If due to severe circumstances beyond your control (car accident, illness, etc.), you will not be able to take the midterm exam, please call me immediately (before the exam) and let me know your situation. If you have a good reason and can present convincing documentation as to why you are not able to take the midterm exam, your final grade will be calculated without taking into account the midterm exam.

Academic integrity: Students are expected to behave in accordance with the university policy on academic integrity. The guiding principle of academic integrity is that a student's submitted work must be the student's own. Cheating and plagiarism will result in formal charges.

Incomplete: A grade of incomplete (I) will be assigned only under extraordinary circumstances, which are beyond the student's control (like a non-elective surgery during the last week of class).

Students with disabilities: If you have a diagnosed disability (physical, learning or psychological), which will make it difficult for you to carry out the coursework as outlined, or requires accommodations such as recruiting note takers, readers, or extended time on exams and/or assignments, please advise me during the first two weeks of the course, so that we may review possible arrangements.

Some important dates:
Mon Feb 3: (a) Last day to add/drop the course (no record will appear on your transcript if you drop the course). (b) Last day to file “Petition to make up an Incomplete” with the Math Department.
Mon Mar 17 through Sun Mar 23: No class (Spring Recess).
Fri Apr 11: Last day to resign from the course (an “R” will appear on your transcript).
Fri May 9: Last MTH444/MTH544 class.