MATH 720 - **Applied Mathematics I**
Fall 2014

Meeting times (lectures): TTh 11:40 AM – 12:55 PM at **LeConte (LC) 303B**.

Instructor: Dr**. Peter G. Binev** http://people.math.sc.edu/binev/
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Office hours: TTh 4:10 – 5:50 PM at LeConte 425, or by appointment.

Text: Practical Applied Mathematics - Modelling, Analysis, Approximation, by Sam Howison, Cambridge University Press, 2005.

Prerequisites: MATH 555, or equivalent.

Bulletin Description: Modeling and solution techniques for differential and integral equations from sciences and engineering, including a study of boundary and initial value problems, integral equations, and eigenvalue problems using transform techniques, Green's functions, and variational principles.

Learning Outcomes: Upon the successful completion of this course students will be able to:
- understand and implement different mathematical modeling techniques for scientific problems;
- know the basic theoretical setup for partial differential equations including Green's functions;
- apply the basic asymptotic techniques in analysis of dimensionless mathematical models.

Cell Phones: All cell phones ***must be turned off*** during the class.

Homework: A few homework problems will be assigned each class. The solutions will be discussed during the next class, so be prepared.

Projects: Chapters 4, 5, 6, 11, 14, 15, 19, and 21 from the book are case studies. Each student has to choose a project motivated by a problem described in one of these chapters. Some of the classes will be (partly) devoted to discussion of the projects that illustrate the techniques currently studied. Every student has to prepare a paper (at most 8 pages) based on the project by the end of November. The file should be send to binev@math.sc.edu no later than ***December 1***, 2014. The project is part of the Final Exam.

Discussions: The homework and the projects will be discussed in class. The participation in the discussions is important part of the course.

Midterm Exam: There will be a midterm exam in a form of a test on ***October 28***, 2014. The problems on the test will be similar to the ones from the homework. The test should give an idea about the problems on the Comprehensive Exam to students that take this course as part of a comprehensive sequence.

Final Exam: The final exam will be a combination of the project and its presentation. The date of the presentations will be fixed based on the schedule of the students.

Grading: The final grade will be determined from the homework and the participation in the discussions (30%), the midterm exam (20%), and the project/final (50%). The letter grades will be assigned as follows: A for at least 90%; B+ for at least 86%; B for at least 80%; C+ for at least 76%; C for at least 70%; D+ for at least 66%; D for at least 60%; F for less than 60%.

Academic Dishonesty: Cheating and plagiarism will not be allowed (see: http://www.housing.sc.edu/academicintegrity/)

ADA: If you have special needs as addressed by the Americans with Disabilities Act and need any assistance, please notify the instructor immediately.

Topics for MATH 720 – Fall 2014

Date	Section	Subject	Homework Problems
Aug. 21	1.3	Principles of modelling	p. 12 / 1, p.13 / 2
Aug. 26	1.3, 1.4	Conservation laws	p.13 / 3, 4
Aug. 28	2.2	Units and dimensions	p.21/1, p.25/10, p.26/12
	2.3	Electric fields and electrostatics	p.21/2, p.22/4, p.23/5
	3.1	Nondimensionalisation	p.42 / 1, p.43 / 2
	3.2	Navier–Stokes equations and Reynolds numbers	Subsection 3.1.3 (p. 34)
	3.3	Buckingham's Pi-theorem	
	Case Studies	hair modelling and cable laying; the thermistor; electrostatic painting	
	7.1-7.2	First-order quasilinear PDE	p.97/1, p.98/3, p.99/4
	7.3	Shocks	p. 100 / 5-6, p.101 / 7
	7.4	Charpitt's method	p.102 / 8, 10
	7.5	Second-order linear equations in two variables	p.102 / 11 or 12
	Case Studies	traffic modelling	
	9.1-9.3	The delta and Heaviside functions	p.134 / 1-2
	9.4-9.5	Balancing singularities	
	9.6	Green's functions	
	10.1-10.5	Theory of distributions	
	10.6	Extensions of the theory of distributions	
	Case Studies	the pantograph	
	12.1-12.2	Asymptotic expansions	
	12.3	Convergence and divergence	
	13.1-13.2	Regular perturbation expansions	
	13.3-13.4	Linear stability	
	13.5-13.6	Small perturbations of a boundary	
	Case Studies	electrostatic painting; piano tuning	
	16.1-16.2	Functions with boundary layers	
	16.3-16.4	Boundary layers: examples from ODEs	
	16.5	Boundary layers: examples from PDEs	
	Case Studies	the thermistor	
	18	Lubrication theory' analysis in long thin domains	
	18	Heat flows and advection–diffusion in a long thin domain	
	Case Studies	continuous casting of steel	
	20	Thin fluid layers: classical lubrication theory	
	20	Thin fluid sheets	
	Case Studies	turning of eggs during incubation	
	22	Multiple scales	
	23	Ray theory and the WKB method	