RUTGERS UNIVERSITY
Department of Chemical and Biochemical Engineering

155:507 Analytical Methods in Chemical & Biochemical Engineering (3 credits) **Fall 2016**

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Class Timings: Wednesdays at 5:00-8:00 p.m.
Class Location: BME Room 102, 599 Taylor Road
Piscataway, NJ 08854

Course Description:
Matrices & Linear Algebra, First and higher order ODEs, Numerical solutions to ODEs, Systems of Differential Equations, Linear and nonlinear PDEs; Using Matlab (or other software packages) to solving chemical and biochemical engineering relevant problems.

Course Objectives and Outcomes: In this course, students will develop the necessary mathematical tools to address advanced chemical engineering problems using a quantitative formulation. Analytical solutions to deterministic mathematical models encountered in chemical and biochemical engineering, including environmental and safety systems. Emphasis is on purpose, philosophy, classification, development, and analytical solutions of models occurring in transport phenomena, thermochemical, and reactor systems.

ADVANCED MATHEMATICS TEXTBOOK (required for this course)
Zill, D.G. and Wright, W.S. Advanced Engineering Mathematics. Jones & Bartlett Publishers, Fifth edition.

ALTERNATIVE ADVANCED MATHEMATICS TEXTBOOK (not required for this course)
Kreyszig, E. Advanced Engineering Mathematics. Wiley, 10th Edition, 2011.

ADDITIONAL CHEMICAL ENGINEERING SPECIFIC REFERENCES (not required for this course)
Constantinides, A. and Mostoufi, N. Numerical Methods for Chemical Engineers with MATLAB Applications. Pearson.

Cutlip, M.B. and Shacham, M. Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel, and MATLAB, Pearson, Second edition.

Beers, Kenneth. Numerical Methods for Chemical Engineering: Applications in MATLAB®. New York, NY: Cambridge University Press, November 2006.

Loney, Norman W., Applied Mathematical Methods for Chemical Engineers, CRC Press – Taylor & Francis Group, Boca Raton, 2nd edition, 2007.

PREREQUISITES

Undergraduate differential and integral calculus and differential equations or permission of the graduate director.

SOFTWARE

MATLAB: This is a numerical computing software package that can be used for solving problems relevant to this course. It is installed on all computers in the Microcomputer Laboratory (rooms C233, C241, B125, and D110). Please note that students can also access Matlab in the campus computing labs or via http://apps.rutgers.edu. Material to help with learning how to use Matlab is available from MathWorks (www.mathworks.com) and the internet. The following books can also be used (students are expected to self learn using this software or other related software packages for solving problems for homework or projects);

D. Hanselman and B. Littlefield, "Mastering MATLAB 7," Pearson, NJ (2005)
W.J. Palm III, "Introduction to MATLAB 7 for Engineers: McGrawHill (2005)

Students are welcome to use other software packages (e.g., POLYMATH, Excel, Mathematica) as well.

CLASS PARTICIPATION, HOMEWORK AND GRADING POLICY

Homework problems will be assigned, collected, and graded on a regular basis during the semester. All homeworks will be posted on the Sakai course webpage. Students are requested to turn in their homework assignments in-class (unless specifically instructed otherwise). No late homeworks will be accepted. There are going to be several unannounced quizzes held in class. There will be one midterm exam, one final exam, and multiple projects. Class participation and attendance are both important to do well in this course (*additional instructions regarding class attendance and homework submission policy will be given in class*). The course grade will be determined as follows:

Homeworks (4)	20%
First exam	25%
Second exam	25%
Projects (2) & Multiple Quizzes	30%

ACADEMIC INTEGRITY

Students are expected to familiarize themselves with and adhere to the University policy on academic integrity at: http://academicintegrity.rutgers.edu/policy-on-academic-integrity.

It is understood that a student's name on any individual homework assignment, quiz, or exam indicates that he/she neither gave nor received unauthorized aid. On individual homework assignments, *authorized* aid includes discussing: 1) interpretation of the problem statement, 2) concepts involved in the problem, 3) approaches for solving the problem. Anything beyond this constitutes unauthorized aid and violates the academic integrity policy.

A student's name on a group assignment indicates that he/she contributed to the assignment. Quizzes and exams are tests of individual performance. The student is not permitted to obtain assistance from any other person (or persons) during quizzes or exams. The student must adhere strictly to the instructions provided by the professor regarding what is permissible to be used during the exam. Use of lecture notes, computers, laptops, and cell phones without prior authorization of instructor is **PROHIBITED** during exams.

Students caught cheating on homework assignments, projects, or exams will be reported to the graduate program director for disciplinary action in accord with the university policy on academic integrity!

COURSE MATERIAL COPYRIGHT

All course material posted on the Sakai course website is copyrighted and may not be posted on any other web site at or outside of Rutgers without permission from the course instructor. Noncompliance with this policy will be treated as a violation of the Code of Student Conduct and will be referred to the Office of Student Conduct for action.

COURSE TIMETABLE

The course will follow the timeline indicated below. Reading from the required textbook will be assigned before each class. Several chapters of the required textbook might not be covered in class. Additional reading will be assigned from other sources and maybe posted on the Sakai course website. Some lecture slides will be available to the students as pdf files on the Sakai web site, however, students are expected to prepare their own notes. Additional material may be distributed as handouts in-class. A week-by-week schedule of the course, lecture topics, textbook reading assignments, and relevant lecture description is given below *(please follow announcements on the Sakai course webpage for any changes to the following schedule!).* ***Students are advised to complete reading and practice problem assignments prior to attending the lecture to keep up!***

Week	Date	Lecture Topic	Description	Zill-Wright Book
Week 1	7-Sep	Introduction	Introduction to Formulation of Models in Chemical & Biochemical Engineering, Introduction to Matrix Algebra	Chapter 8
Week 2	14-Sep	Ordinary Differential Equations	ODEs (first- and higher-order ODEs, Linear and non- linear equations, Solution methods, Numerical solution to ODEs)	Chapter 1, 2
Week 3	21-Sep	Ordinary Differential Equations		Chapter 3
Week 4	28-Sep	Ordinary Differential Equations		Chapter 6
Week 5	5-Oct	Systems of Differential Equations	Systems of DEs (Critical points and steady state, phase trajectories, stability of linear systems, linearization Remaining topics from ODEs and Systems of DEs)	Chapter 10
Week 6	12-Oct	Systems of Differential Equations		Chapter 10
Week 7	19-Oct	Systems of Differential Equations		Chapter 11
Week 8	26-Oct	**Mid-term Exam 1**		
Week 9	2-Nov	Partial Differential Equations	PDEs (Orthogonal functions, Sturm-Liouville problem, Fourier series, Separable PDEs, Non-Cartesian coordinates, Diffusion, Wave and Laplace equation, Intro to Numerical solutions to PDEs)	Chapter 12, 13
Week 10	9-Nov	Partial Differential Equations		Chapter 13, 14
Week 11	16-Nov	Partial Differential Equations		Chapter 16
Week 12	23-Nov	Discussion of Additional Modeling Problems Relevant to Chemical and Biochemical Engineering (CBE), Classical Published Modeling Papers in CBE, and Student Research Presentations		
Week 13	30-Nov			
Week 14	7-Dec			
Week 15	14-Dec			
Week 16	21-Dec	**Finals-Week Exam 2**		