Chemical & Biomolecular Engineering 505

Advanced Engineering Mathematics

Fall 2008

Tuesday & Thursday 11:10 a.m. – 12:25 p.m.

DO 314

Instructor: Dr. Stephen J. Paddison

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Office Hours: Wednesdays 2:00 - 4:30 p.m., DO 321, or by appointment.

Textbook: Arvind Varma & Massimo Morbidelli, Mathematical Methods in Chemical Engineering

Attendance: Attendance is optional but **highly recommended**.

Lectures: Tuesday and Thursday: 11:10 AM – 12:25 PM; Dougherty 314. **Please no cell phones or pagers** during lectures. If you come late, please respect your fellow students and minimize disturbance.

Examinations: There will be a midterm exam and a final exam. The former will be a 3 hr exam scheduled outside the regular lectures and the latter a 4 hr comprehensive exam scheduled by the registrar's office. The examinations will be based upon class lectures (including handouts), textbook reading, and homework problems. **Failure to take the final exam will lead to a non-passing grade!** There will be NO make-up, early, or late exams!

Homework Problems: They will be assigned throughout the course with the typical frequency of one set every two weeks.

Grading:

Midterm Exam	25 %
Homework Problems	30 %
Participation	5 %
Final Exam	40 %

Final letter grades will be assigned according to the following scale: 85-100% = A, 70-84% = B, 55-69% = C, 40-54% = D, below 40% = F.

Misconduct: Cheating on examinations will not be tolerated. Anyone found cheating (copying another exam, asking others for answers, or using textbook or notes during exams) will be asked to leave and will receive a failing grade (i.e. F) for the course.

Extra Credit: There will be NO individual extra credit work assigned.

Course Objectives: Mathematics is the foundation of any serious engineering endeavor. Mastering mathematical tools will enable the engineer to understand and analyze through modeling the behavior of diverse systems and problems. The objective of CBE 505 is to expose the student to a spectrum of mathematical methods typically used to solve chemical engineering problems. The emphasis of the course will be concerned with analytical techniques which allow for the derivation of closed form solutions. There will also be a component of the course devoted to numerical methods of solution to equations for which there are no closed form solutions. An understanding of numerical methods is also important due to the increasing role that simulations play in the understanding of chemical and physical phenomena that are of interest to engineers. The following is a list of the topics that will be covering during the semester.

Topics:

(1) Matrices & their Applications: determinants, solution of systems of linear algebraic equations; types of matrices; the adjoint, inverse, transpose and rank of matrices; eigenvalues and eigenvectors; expansion of arbitrary vectors; solving linear algebraic equations and 1^{st}-order linear ordinary differential equations; applications

(2) Nonlinear Ordinary Differential Equations: existence and uniqueness theorem, linearization, definitions of stability, autonomous and nonautonomous systems, classification of the steady state, Liapunov's direct method, Hopf bifurcation theorem

(3) Theory of Linear Ordinary Differential equations: initial value problems, boundary value problems, and eigenvalue problems

(4) Series Solutions & Special Functions: Legendre equation & polynomials, extended power series method of Frobenius, Bessels's equation and Bessel functions of the 1^{st} and 2^{nd} kind; modified Bessel functions

(5) Partial Differential Equations: initial and boundary conditions; 1^{st} and 2^{nd} order partial differential equations; the kinematic wave equation

(6) Numerical Methods: solution of linear and nonlinear algebraic equations; Euler and Runge-Kutta method for solution of ordinary differential equations; elliptic, parabolic hyperbolic partial differential equations; Crank Nicholson Method, Runge-Kutta method for nonlinear parabolic partial differential equations