CHEE 3321(H): Analytical Methods

Spring 2016
Section: 20650
Lecture: 1-2:30pm, MW
Location: D2 E220
Catalog data: Cr. 3 (3-0)
Prerequisites: Prerequisites: MATH 2433 and CHEE 2331.
Description: Mathematical modeling and conservation equations, linear algebra, ordinary and partial differential equations with applications to chemical engineering systems. Credit may not be received for more than one of MATH 3331, MATH 3321 or CHEE 3321.

Instructor:
Dr. Jacinta C. Conrad (jcconrad@uh.edu), S226 Engineering Building 1
Office hours: T, 9:30–11:30am, immediately after class (MW 2:30–3pm), or by appointment

Teaching Assistants:
Tam Nguyen (tamtintx@yahoo.com), S44 Engineering Building 1
Office hours: Th, 9:30–11:30am *Problem session:* F, tentative time 9-10am, location TBD

Required Reading: Zill and Wright, *Advanced Engineering Mathematics*, any edition. (5th ed. (2013) available at bookstore and should be available through course reserve soon.)

Topics:

- Introductory concepts (Chapter 1)
  - Introduction
  - Modeling method
  - General conservation equation
  - Rate laws and differential equations (reaction rates, flux laws, etc.)
  - ChE applications: setting up models
- First-order differential equations and modeling concepts (Chapters 1 and 2)
  - Introduction to differential equations and terminology
  - Separable first-order ODEs
  - Linear and nonlinear first-order equations
  - Exact differential equations and integrating factors
  - Substitution methods
  - ChE applications
- Second-order differential equations and models (Chapters 3 and 5)
  - Introductory concepts and reduction of order
  - Linear homogeneous second-order ODEs with constant coefficients, linear boundary-value problems
  - Special cases: selected non-homogeneous and nonlinear second-order ODEs
  - Linear nonhomgeneous second-order ODEs, variation of parameters
  - Variable coefficients, series solutions, Bessel functions
  - Bessel function properties, generalized Bessel function solution

    - ChE applications
  - Linear algebra and applications (Chapters 7, 8, and 10)
    - Matrices and vectors, basic linear algebra and properties
    - Square matrices, inverse, determinants
    - Vectors, linear dependence and independence, rank
    - Solutions of linear algebraic equations; Gauss's method, Cramer's rule
    - Eigenvalues, eigenvectors, orthogonal and biorthogonal expansions
    - Coupled first-order equations: matrix method
    - ChE applications of vectors and matrices
  - Introduction to partial differential equations and models (Chapter 13)
    - Introductory concepts
    - Solution method using separation of variables
    - ChE applications

Evaluation: Grades will be determined on the basis of exams and quizzes. Note that homework will be assigned weekly but will not be collected or graded. Homework solutions will be posted on Blackboard each week.

- Quizzes: 20%
- Two exams: 25% each, total 50%
- Final exam: 30%

Quiz policies:

- Quizzes will be announced and given every week (almost).
- Missed quizzes will result in a score of zero.
- Quizzes are closed-book and closed-note.
- Cheating on a quiz will result in a score of zero.
- No electronic devices of any sort are permitted.

Exam policies:

- All exams are mandatory.
- No makeup exams will be given; missed exams will result in a score of zero.
- A note sheet consisting of one sheet of letter paper, front and back, is permitted for each exam.
- Cheating on an exam will result in a score of zero.
- All exams, save the final, will be given on Saturday.
- All regrade requests **MUST BE PUT IN WRITING**, and submitted at one time no later than one week after exams are returned.
- All questions on an exam submitted for regrading will be regraded.
- No electronic devices of any sort are permitted.

Exam dates:

- Exam 1: Saturday, February 27, 2016, 10am–12pm
- Exam 2: Saturday, March 26, 2016, 10am–12pm
- Final Exam: Monday, May 9, 2016, 2–5pm

Special dates:

- January 26, 2016: Last day to add a course.
- February 3, 2016: Last day to drop a course or withdraw without receiving a grade.
- March 14–19, 2016: Spring break
- April 1, 2016: Last day to drop a course or withdraw with a "W."

Academic dishonesty:

- Please see section 3.02 for the University of Houston policy on academic dishonesty.
- The instructor takes academic dishonesty *very seriously*.
- All items capable of transmitting and/or receiving wireless signals in an exam room are *expressly forbidden*. This includes but is not limited to: cell phones, pagers, PDAs, and laptops.
- Please note that *any* offense against the UH academic honest policy (including but not limited to cheating on quizzes and tests) will have severe consequences; violations will affect your grade in this course and may become part of your permanent record.

ABET Outcomes Assessment:

Outcome 1: Students will demonstrate an understanding of representing an engineering system in terms of a basic mathematical model, and of the types of equations typically encountered in chemical engineering. (e).

Outcome 2: Students will demonstrate the ability to solve linear ordinary differential equations applied to systems of interest to chemical engineers (a).

Outcome 3: Students will demonstrate a mastery of linear algebra especially as it relates to solving problems of interest to chemical engineering (a).

Outcome 4: Students will demonstrate the ability to solve simple linear partial differential equations by the method of separation of variables and Laplace transforms (a).

ABET Criterion 3: Program Outcomes and Assessment:

a an ability to apply knowledge of mathematics, science, and engineering

b an ability to design and conduct experiments, as well as to analyze and interpret data

c an ability to design a system, component, or process to meet desired needs

d an ability to function on multi-disciplinary teams

e an ability to identify, formulate, and solve engineering problems

f an understanding of professional and ethical responsibility

g an ability to communicate effectively

h the broad education necessary to understand the impact of engineering solutions in a global and societal context

i a recognition of the need for, and an ability to engage in, life-long learning

j a knowledge of contemporary issues

k an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice