ChEE 502 – Advanced Chemical Engineering Analysis

Fall XXXX Day/Time/Location TBD

INSTRUCTOR

Roberto Guzmán | guzmanr@arizona.edu | JWH 134D
Office Hours: Open Door Policy and by appointment

COURSE OBJECTIVES

The objectives of this course are to provide some fundamental mathematical tools necessary for understanding the solution to classical problems in fluid mechanics, heat transfer, and mass transfer. The course intends to be an applied mathematics course for Engineering (in particular for Chemical Engineering).

COURSE DESCRIPTION

In this course emphasis is given to Analytical Solutions of PDEs. Numerical Techniques will only be covered briefly. The emphasis of the course deals with exact and approximate analytical solutions to partial differential equations that arise in transport phenomena problems. The following is a brief outline of the topics to be covered.

1. Overview of Differential Equations
2. Problems in Chemical Engineering-Models
3. Second- order partial differential equations – separation of variables
4. Sturm-Liouville theory
5. Eigenfunction expansions and transform methods
6. Elliptic equations, analytical solutions - rectangular coordinates
7. Elliptic equations, numerical solutions**
8. Parabolic equations, analytical solutions - rectangular coordinates
9. Parabolic equations, numerical solutions**
10. Numerical solution of non-linear equations**
11. The extended power series method of Frobenius. Bessel Functions-cylindrical coordinates
12. Legendre polynomials - spherical coordinates
13. Integral transform methods: Laplace, Fourier Transforms
14. Special topics (i.e., Method of Moments, Method of Characteristics, Perturbation Methods

** Numerical Techniques will covered using mainly MATLAB.

TEXTBOOK

Rice, R.G. and D.D. Do. Applied Mathematics and Modeling For Chemical Engineers, 2nd Edition, Wiley, 2012.

Literature References:

1. "Foundations of Applied Mathematics" by M.D. Greenberg.
2. Richard Haberman. "Elementary Applied Partial Differential Equations", 3rd edition (1998). Prentice Hall
3. "Mathematical Methods in Chemical Engineering" by Varma and Morbidelli
4. "Advanced Calculus for Applications" by F.B. HILDEBRAND,
5. "Advanced Engineering Mathematics" by Kreyszig, any of 8th, 9th, 10th Editions.
6. "Numerical Analysis," by Burden and Faires, 5th Edition, PWS-KENT, Publishing Company
7. "Mathematical Methods for Physicists", by G. ARFKEN, 3rd edition (1985), Academic Press, NY.
8. "Advanced Engineering Mathematics", 2nd edition (1998) by M.D. Greenberg
9. Journal Articles, Literature Course Material and Class Notes

COURSE POLICIES

Course Evaluation

Homeworks

There will be homework assignments approximately every week. The final homework average will be **35%** of the final grade. It will include 4-5 computer problems.

HOMEWORK IS NOT OPTIONAL

Tests

There will be three tests, two Midterms (20% each) and a Final (25%). All tests will be closed book and closed notes. One or none of the tests might be take-home.

Exams (3 tests including the Final exam)	
First Test	**20%**
Second Test	**20%**
Final	**25%**

Course Grade Distribution

A > 90%	B > 80%	C > 70%	D > 60%

Absence Policy, Missed Examinations, Homework and Incompletes

Absence policy I: Students are expected to be regular and punctual in class and participate in ALL class sessions. The University believes that students themselves are primarily responsible for attendance; however, at the discretion of the instructor excessive or extended absences from class are sufficient reason for the instructor to recommend that the student be administratively dropped from the course. Extenuating circumstances causing absence should be discussed with the instructor before the absence occurs, not post-facto.

Absence Policy II: All holidays or special events observed by organized religions will be honored for those students who show proper affiliation with that particular religion. Absences pre-approved by the University of Arizona Dean of Students (or Dean's designee) will be honored.

Missed Examinations: In principle, there will not be make-up exams. If you miss one class exam, (if justified) you should talk to the instructor to make arrangements and take the exam as soon as possible. If you miss any of the exams, an explanation of your absence must be provided within one week of the date of the exam or you will be administratively dropped from the course.

Homework is not optional.

Incompletes: To qualify for an incomplete, you must have taken the two class exams, submitted all the homework and have obtained an average score in those exams and HW at least equal to the lowest passing score in the course. If you then miss the final for a reason that can be appropriately and reasonably documented you may receive a grade of I. Situations not covered by the above will be treated on an individual basis, but you should expect incompletes to be rare.

Textbook requirements:
There will not be a standard textbook. In the course we will use a combination of lecture notes produced from several textbooks and recent research articles from the literature. Course notes will be placed on the course web site (in D2L).

Number of required examinations and papers
There will be three examinations and no term paper is required in this course.

Policies regarding expected classroom behavior (e.g., use of pagers/cell phones). No cell phone or pagers use or texting during class is permitted.

Policies against plagiarism, etc., within the Student Code of Academic Integrity. All students are expected to abide by the Student Code of Conduct and Academic Integrity and dishonesty such as plagiarism, cheating, etc. as defined by the National Academy of

Sciences and specifically in the University of Arizona Student Code of Conduct: **http://deanofstudents.arizona.edu/policiesandcodes/studentcodeofconduct**

Policies against threatening behavior by students: Threatening Behavior by Students and Disruptive Behavior in an Instructional Setting. All students are expected to abide by the Student Code of Conduct regarding classroom behavior as described in the University of Arizona Student Code of Conduct: http://deanofstudents.arizona.edu/codeofacademicintegrity

There are no required extracurricular activities in this course.

Accessibility and Accommodations: It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Guidelines subject to change. The information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

ACCOMMODATIONS

Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu.

CODE OF ACADEMIC INTEGRITY

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://new.library.arizona.edu/research/citing/plagiarism.

UA NONDISCRIMINATION AND ANTI-HARASSMENT POLICY

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

SUBJECT TO CHANGE STATEMENT

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.