Course **CHE 531 – Mathematical Methods in Chemical Engineering**
Semester **Fall 2013**

Course Format And Credit hours: 3 hr Lecture
3 hr Credit

Pre-requisites Graduate standing in Chemical Engineering or by permission

Instructor: Dr. David J. Klinke II, 427 Engineering Sciences Building
304-293-9346, david.klinke@mail.wvu.edu

Class Schedule: Tuesday 9:30 – 10:45 am
Thursday 9:30 – 10:45 am

Location Room 249A Engineering Sciences Building

Office Hours: Tuesday 3:00-5:00 or by appointment

Course Goal:
In this course, students will learn to develop mathematical and analytical skills necessary to formulate and solve deterministic problems encountered in the Engineering Sciences. Special emphasis will be given to problems in the area of Chemical Engineering.

Course Objectives: Upon completion of this course, the students will be able to:

1. Recognize and identify the type of differential equation in terms of the concepts of linearity, homogeneity, and order.
2. Solve a variety of 1st order differential equations using the methods covered in the course.
3. Solve linear second order ODEs by formulating the complementary function and particular integral solutions.
4. Formulate and solve non-linear ODE problems using the method of Frobenius to give a series solution.
5. Formulate and solve non-linear ODE problems leading to solutions involving Bessel functions.
6. Formulate and solve PDE problems that involve similarity solutions.
7. Formulate and solve PDE problems using the separation of variables method and the application of the Sturm-Lioville theorem.
8. Formulate and solve ODEs and PDEs using Laplace transforms and Fourier transforms.

Textbook: Applied Mathematics and Modeling for Chemical Engineers, R.G. Rice and D.D. Do, Wiley, New York (1995)

Related Texts and Recommended Reading:

1. Advanced Engineering Mathematics, C.R. Wylie and L.C. Barrett, 5th Edition, McGraw-Hill, New York (1982)

2. Advanced Engineering Mathematics, E. Kreyszig, 6th Edition, Wiley, New York (1988)

3. Elementary Applied Partial Differential Equations, R. Haberman, 2nd Edition, Prentice-Hall Inc., Englewood Cliffs, NJ (1987)

4. Foundations of Applied Mathematics, M.D. Greenberg, Prentice-Hall Inc., Englewood Cliffs, NJ (1987)

5. Handbook of Mathematical Functions, Abromowitz and Stegun, Dover (1972)*

6. Mathematical Handbook of Formulas and Tables, M.R. Spiegel, Schaum's Outline Series (1968)R.B. Bird, W.E.

Grading :	Mid-term Exam	45 %	
	Homework Problem Sets	10 %	
	Final Exam	45 %	December 17, 2013 (11:00 am – 1:00 pm)
		100 %	

Grade Assignment :

100 – 90 A
89 – 80 B
79 – 70 C
69 – 60 D
59 – 0 F

Grading Policy : No make-up exams except by prior arrangement with instructor
Late assignment = no assignment
Exam grading appeals in writing on the day the exam is returned.

HW Assignments: Homework will be due at the start of class on Friday. Weekly homework assignments are an opportunity to develop intuition from new concepts by actively applying the new concepts to solve problems and answer questions. The process of actively struggling with the use of new ideas until you understand them is an effective and rewarding form of education. Homework assignments will be typically due one week after assignment and are due at the beginning of class or at the stated time. (Typically there will be 8 homeworks. Each will be worth the same amount resulting in the total worth equal to 10% of the final grade). Homework problems will be chosen for their educational value. **If you skip the process of personally struggling with the use of new concepts, you will have destroyed your most important educational experience.** Reading someone's solution to a problem is not educationally equivalent to generating your own solution. I encourage students to work together to understand the concepts in the homework. However, each student should work out his/her own solutions. Submitted homework should reflect your own work. Assignments that are obviously copied will receive no credit.

HW Format: Use a clean sheet of paper, one side of each page; begin each problem on a new page, and box the final answers. Staple the pages together and put your name, the problem set number, and the date on the top of the front page. Number and include your name on subsequent pages.

Tests: There will be one mid-term exam and a comprehensive final exam. All tests will be open-book, closed-notes.

Attendance Policy: Consistent with WVU guidelines, students absent from regularly scheduled examinations because of authorized University activities will have the opportunity to take them at an alternate time. Make-up exams for absences due to any other reason will be at the discretion of the instructor.

Social Justice Statement : "West Virginia University is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class. Please advise me and make appropriate arrangement with Disability Services (293-6700)."

Approximate Syllabus

Week	Date	Topic
1	8/20	Review of basic concepts - continuous and differentiable functions, limits, ordinary and singular points.
2	8/27	Introduction to ordinary differential equations (ODEs) – linearity, homogeneity, and order.
3	9/3	1st order ODEs – integrating factor methods and special cases
4	9/10	Introduction to 2nd order ODEs and the concept of superposition
5	9/17	2nd order ODEs – Linear, complementary functions and particular integrals
6	9/24	Series Solutions and the Method of Frobenius
7	10/1	Bessel Functions and Solutions to the Generalized Bessel Equation
8	10/8	**Mid-term Exam** - Introduction to Partial Differential Equations
9	10/15	**No class Tuesday** – Introduction to Partial Differential Equations
10	10/22	Similarity solutions and semi-infinite media solutions, introduction to the error function
11	10/29	Separation of Variables method, concepts of orthogonality and homogeneity, boundary conditions
12	11/5	**No class Tuesday** – AIChE - Sturm-Lioville theorem
13	11/12	Laplace's transforms - Fourier Series
14	11/19	Duhamel's theorem
	11/26	**Thanksgiving Break**
15	12/3	Miscellaneous topics including Finite Fourier Transforms and Green's Functions.
16	12/10	Tuesday only - Course review
	12/17	**FINAL EXAM 11 a.m. – 1 p.m.**