Math 230 - Differential Equations
Spring 2011 Course Syllabus

James Jones, Professor of Mathematics
Mathematics & Sciences Division
Richland Community College

Course Meeting Information

Section 01 meets from 11:00 am to 12:10 pm on Monday, Wednesday, and Friday in room S137.

Instructor Information

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Office Hours

These are the times I'm scheduled to be in my office. I often spend portions of my office hour in the classroom helping students, so if I'm not in my office, check room S137. If these times are not convenient for you, please see me to make an appointment for some other time.

    Monday: 8:30 - 9:20 am, 3:50 - 4:40 pm
    Wednesday: 8:30 - 9:20 am, 3:50 - 4:40 pm
    Friday: 8:30 - 9:20 am

Text

*   *Differential Equations with Boundary-Value Problems, seventh edition.* Dennis G. Zill, Michael R Cullen. Copyright 2009, Brooks/Cole. ISBN-13: 978-0-495-10836-8 (required)
*   *Differential Equations with Boundary-Value Problems Student Solutions Manual*. Warren S. Wright, Dennis G. Zill, Carol D. Wright. Copyright 2009, Brooks/Cole Publishing Company. ISBN 978-0-495-38316-1. (Optional)

Student Audience

Transfer students. Students pursuing degrees in engineering or mathematics.

Prerequisite

Successful completion (C or better grade) of Math 122, Calculus and Analytic Geometry II.

Course Description
MATH 230 - Differential Equations

Hours: 4 lecture - 0 lab - 4 credit

Math 230, Differential Equations, begins with some definitions and terminology and mathematical models used in a differential equations course. First-order and higher-order differential equations, along with the methods of solutions and their applications are introduced. Modeling with higher-order, Laplace transform, and systems of linear first-order differential equations are covered. At the end, students learn series solutions of linear equations. Numerical methods are covered throughout the course.

Applicable toward graduation where program structure permits.
- Certificate or degree: All certificates and all degrees.
- Group requirement: Mathematics
- Area of Concentration: Mathematics.

Illinois Articulation Initiative (IAI)
The Illinois Articulation Initiative is a statewide transfer agreement. Their website is at
http://www.itransfer.org.

Differential Equations is the Mathematics Majors course MTH 912. This is the IAI description for the course.

> The course must cover linear equations of the first order; linear equations with constant coefficients; the general linear equation; variation of parameters; undetermined coefficients; linear independence; the Wronskian; exact equations; separation of variables; and applications. In addition, the course must cover at least two or three of the following topics: systems of linear differential equations; solution of Laplace transforms; existence and uniqueness of solutions; solution by power series; oscillation and comparison theorems; partial differential equations; boundary value problems; numerical methods; and stability of solutions. Prerequisite: MTH 902, Calculus II.

General Course Objectives
While learning differential equations is certainly one of the goals of this course, it is not the only objective. Upon completion of this course, the student should be able to ...
- demonstrate comprehension and understanding in the topics of the course through symbolic, numeric, and graphic methods
- demonstrate the use of proper mathematical notation
- use technology when appropriate and know the limitations of technology
- work with others towards the completion of a common goal
- use deductive reasoning and critical thinking to solve problems

Specific Course Objectives
Upon completion of this course, the student should be able to ...
- classify differential equations by order, linearity, and homogeneity
- solve first order linear differential equations
- solve linear equations with constant coefficients
- use separation of variables to solve differential equations
- solve exact differential equations
- use variation of parameters to solve differential equations
- use the method of undetermined coefficients to solve differential equations
- determine whether a system of functions is linearly independent using the Wronksian
- model real-life applications using differential equations
- use power series to solve differential equations
- use Laplace transforms and their inverses to solve differential equations
- solve systems of linear differential equations using matrix techniques and eigenvalues
- use numerical methods to solve differential equations

Type of Instruction
Discussion, problem solving, student questions, student participation, oral presentations, and lecture. Students are expected to read the material before coming to class and are strongly encouraged to come to class with a list of questions and to ask these questions.

Method of Evaluation
Could include any of the following: problem solving exams, objective exams, essays, research papers, oral presentations, group projects, quizzes, homework.

Grading Policy
Letter grades will be assigned to final adjusted scores as follows:
A: 90-100%   B: 80 - 89%   C: 70-79%   D: 60-69%   F: below 60%

Consideration may be given to such qualities as attendance, class participation, attentiveness, attitude in class, and cooperation to produce the maximum learning situation for everyone.

The instructor will give you a grade sheet so that you can record your scores and keep track of your progress in the course. If you are concerned about your grades, see the instructor.

Assignments are due at the beginning of the class period on the date they are due. The instructor may allow you to turn them in later that day without counting them late, but do not count on his graciousness. Late assignments lose 20% of their value per class period. The instructor reserves the right to apply this rule to missed exams as well as regular assignments. No late work will be accepted after the final.

Attendance Policy
Regular attendance is essential for satisfactory completion of this course. Mathematics is a cumulative subject and each day builds on the previous day's material. If you have excessive absences, you cannot develop to your fullest potential in the course.

Students who, because of excessive absences, cannot complete the course successfully, are required to be administratively dropped from the class at midterm. If a student stops attending after midterm, it is the student's responsibility to withdraw to avoid an "F". Do not stop attending and assume that you will be withdrawn from the class by the instructor.

Although dropping students for non-attendance at midterm is required, students whose attendance is occasional or sporadic may be dropped from the class at any point during the semester at the instructor's discretion. The safest way to make sure you're not dropped for non-attendance is to continue to attend.

The student is responsible for all assignments, changes in assignments, or other verbal information given in the class, whether in attendance or not.

If a student must miss class, a call to the instructor (RCC's phone system has an answering system) should be made or an email message sent. When a test is going to be missed, the student should contact the instructor ahead of time if at all possible. Arrangements can usually be made to take the test before the scheduled time. If circumstances arise where arrangements cannot be made ahead of time, the instructor should be notified and a brief explanation of why given by either voice or email. This notification must occur before the next class period begins.

Technology

In this course, we will concentrate on understanding the concepts of differential equations. There will be instances when we will use the calculator or computer to aid in our understanding or remove some of the tediousness of the calculations (especially in the area of numerical approximations). There may be some projects, homework, or portions of a test that require you to use technology to complete.

Here are some of the technology tools that we may use.

Derive
Derive is an computer algebra system that can perform symbolic manipulation of algebraic expressions and equations. We will use Derive primarily as an aide to checking our calculations or when answers get really nasty. For the most part, you will be expected to perform the algebraic manipulations yourself. Richland has a site license for Derive version 6, but that license does not allow you to take a copy home. Derive is no longer available for purchase.

Maxima
Maxima is an open-source computer algebra system (CAS). Maxima is derived from the Macsyma system and is similar to other CAS systems like Maple. Although Richland owns a site license for Derive, students are unable to use it at home. Although not as polished as Derive, Maxima is free to use. For this reason, we will try to concentrate on using Maxima instead of Derive in the classroom. It is available at http://maxima.sourceforge.net

WinPlot
WinPlot is a free graphing software package for Windows written by Rick Parris at Phillips Exeter Academy in NH. The software is useful for creating graphs and it is easy to copy/paste the graphs into other applications. You may download the software by right-clicking your mouse on the word "WinPlot" at the top of the page http://math.exeter.edu/rparris/winplot.html and choosing save.

Additional Supplies

The student should have a pencil, red pen, ruler, graph paper, stapler, and paper punch. The student is expected to bring calculators and supplies as needed to class. The calculator should be brought daily. There will be a paper punch and stapler in the classroom.

Additional Help

The student is encouraged to seek additional help when the material is not comprehended. Mathematics is a cumulative subject; therefore, getting behind is a very difficult situation for the student. There are several places where you can seek additional help in your classes.

Instructor
I try to make myself as available to the students as I can. My office hours are listed at the beginning of this syllabus, but those are just the times I'm scheduled to be in my office. Grab me and ask me questions if you see me in the hallway. Ask questions before or after class. If I'm in my office and it's not my scheduled office hours, go ahead and stop in.

The instructor should be considered the authoritative source for material related to this class. If a tutor or other student says something that disagrees with the instructor, believe the instructor.

Study Groups
Probably the best thing you can do for outside help is to form a study group with other students in your class. Work with those students and hold them accountable. You will understand things much better if you explain it to someone else and study groups will also keep you focused, involved, and current in the course.

Student Learning Center
The Student Learning Center is located in rooms S116, S117, and S118. There is mathematics tutoring available in room S116. The Student Learning Center and the tutoring is a service that Richland Community College offers you free of charge.

Quality tutors for the upper level mathematics are difficult to find. Please consider forming a study group among your classmates.

Learning Accommodation Services
There are accommodations available for students who need extended time on tests, note takers, readers, adaptive computer equipment, braille, enlarged print, accessible seating, sign language interpreters, books on tape, taped classroom lectures, writers, or tutoring. If you need one of these services, then you should see Learning Accommodation Services in room C142. If you request an accommodation, you will be required to provide documentation that you need that accommodation.

Many of you will need additional time on tests. There is no need to go to learning accommodation services to request that. If you need additional time, just let me know and I'll allow you to continue working past the allotted time. You may need to move to another room as there may be another class coming into your room. If you're unable to finish the test by staying late, it may be possible to start the test earlier to gain additional time.

Feel free to bring a tape record to class and tape my lectures. If you need tutoring, then go to the Student Learning Center. For other services, see Learning Accommodation Services.

Academic Dishonesty
Each student is expected to be honest in his/her class work or in the submission of information to the College. Richland regards dishonesty in classroom and laboratories, on assignments and examinations, and the submission of false and misleading information to the College as a serious offense.

A student who cheats, plagiarizes, or furnishes false, misleading information to the College is subject to disciplinary action up to and including failure of a class or suspension/expulsion from the College.

Non-Discrimination Policy
Richland Community College policy prohibits discrimination on the basis of race, color, religion, sex, marital or parental status, national origin or ancestry, age, mental or physical disability (except where it is a bonafide occupational qualification), sexual orientation, military status, status as a disabled or Vietnam-era veteran.

Electronic Communication Devices
The Mathematics and Sciences Division prohibits the use of cell phones, pagers, and other non-learning electronic communication equipment within the classroom. All equipment must be turned off to avoid disturbances to the learning environment. If a student uses these devices during an examination, quiz, or

any graded activity, the instructor reserves the right to issue no credit for these assignments. The instructor needs to approve any exceptions to this policy.

Topical Outline

Hours   **Topic**

4   **Introduction to Differential Equations**
   - Definitions and terminology
   - Initial-value problems
   - Differential equations as mathematical models

11   **First-Order Differential Equations**
   - Solution curves without a solution; direction fields, autonomous first-order differential equations
   - Separation of variables
   - Linear equations
   - Exact equations
   - Solutions by substitutions
   - Numerical methods; Euler's method, numerical solvers

4   **Modeling with First-Order Differential Equations**
   - Linear models; exponential growth and decay, Newton's law of cooling, mixture problems, series circuits
   - Non-linear models; logistic growth, chemical reactions
   - Systems of differential equations; radioactive series, mixtures, predator-prey models, competition models, networks

15   **Higher-Order Differential Equations**
   - Linear differential equations; initial-value and boundary-value problems, homogenous equations, non-homogeneous equations
   - Reduction of order
   - Homogenous linear equations with constant coefficients
   - Undetermined coefficients; superposition approach, annihilator approach
   - Variation of parameters
   - Cauchy-Euler equation
   - Solving systems on linear equations using elimination
   - Non-linear differential equations

4   **Modeling with Higher-Order Differential Equations**
   - Linear models with initial value problems; spring/mass systems with free undamped motion, free damped motion, and driven motion; series circuit analogue
   - Linear models with boundary value problems
   - Nonlinear models

4   **Series Solutions of Linear Equations**
   - Review of power series
   - Solutions about ordinary points
   - Solutions about singular points
   - Special functions; Bessel's Equation, Legendre's Equation

Hours	Topic

11   **The Laplace Transform**
- Definition of the Laplace transform
- Inverse transforms and transforms of derivatives
- Operational properties of the transform; translations on the s-axis, translations on the t-axis
- Derivatives of a transform, transforms of integrals,
- Transforms of periodic functions
- The Dirac Delta function
- Systems of linear differential equations

7   **Systems of Linear First-Order Differential Equations**
- Preliminary theory; superposition principle, general solutions
- Linear independence/dependence; Wronskian
- Homogenous linear systems; distinct real eigenvalues, repeated eigenvalues, complex eigenvalues
- Nonhomogeneous linear systems; undetermined coefficients, variation of parameters
- Matrix exponentials

3   **Numerical Solutions of Ordinary Differential Equations**
- Euler's method
- Improved Euler's method
- Runga-Kutta methods (RK4)