Math 230 - Differential Equations
Spring 2005 Course Syllabus
James Jones, Professor of Mathematics
Mathematics & Sciences Division
Richland Community College

Course Meeting Information
Section 01 meets from 5:30 pm to 7:20 am on Mon and Wed in room S137.

Instructor Information
James Jones, Professor of Mathematics.
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Office Hours
Monday: 12:20 - 1:10 pm, 4:30 - 5:20 pm
Wednesday: 1:00 - 1:50 pm, 4:30 - 5:20 pm
Friday: 12:20 - 1:10 pm

Texts

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)
Math 230, Differential Equations, does NOT satisfy the Illinois Articulation Initiative Definition of a General Education Mathematics Course. However, it does satisfy the conditions of two Illinois Articulation Initiative Majors courses. It can count as either MTH 912, Differential Equations, or EGR 904, Differential Equations.

Here are the course descriptions from the IAI website [http://www.itransfer.org/](http://www.itransfer.org/)

**MTH 912: Differential Equations (3-4 semester credits)**
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.

**EGR 904: Differential Equations (3-4 semester credits)**
Topics include 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, plus 2 or 3 of the following: systems of linear differential equations, solution by 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: Calculus II

**General Course Objectives**
While learning calculus 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

A topical outline appears at the end of this syllabus.

**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, individual or 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.

Late assignments lose 10% of their value per class period. The instructor reserves the right to apply this rule to missed exams as well as regular assignments.

**Attendance Policy**
Regular attendance is essential for satisfactory completion of this course. 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, will be administratively dropped from the class at midterm. Students whose attendance is occasional or sporadic may be 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". The instructor has the ability, but not responsibility, to drop students who are not regularly attending at any time during the semester. The safest way to make sure you're not dropped for non-attendance is to continue to attend classes.

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) is to 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. Under certain circumstances, arrangements can 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
e-mail. This notification must occur before the next class period begins. At the instructor’s discretion,
the student may receive a zero, make up the exam with (or without) penalty, or substitute the final exam
score for the missed exam.

Calculators
A TI-89 or TI-92 calculator is highly recommended for this course. There are computers in the
classroom with Derive on them, and these may be used by students who don’t have the TI-92 calculator.
Calculators may be used to do homework. Calculators may be used on exams and/or quizzes in class
unless otherwise announced.

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.

Homework
Homework out of the book is not collected for a grade. However, success in the class is correlated to
the amount of homework done. Do not expect to master the subject without doing homework. Students
have the option of doing the homework and replacing their lowest test score with the homework.

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 C136. 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

<table>
<thead>
<tr>
<th>Hours</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Introduction to Differential Equations</strong></td>
</tr>
<tr>
<td></td>
<td>• Definitions and terminology</td>
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<td></td>
<td>• Initial-value problems</td>
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<td>• Differential equations as mathematical models</td>
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<td>8</td>
<td><strong>First-Order Differential Equations</strong></td>
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<td>• Solution curves without a solution; direction fields, autonomous first-order differential equations</td>
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<td>• Separation of variables</td>
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<td>• Linear equations</td>
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<td>• Exact equations</td>
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<td>• Solutions by substitutions</td>
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<td>• Numerical methods; Euler's method, numerical solvers</td>
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<td>4</td>
<td><strong>Modeling with First-Order Differential Equations</strong></td>
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<td>• Linear models; exponential growth and decay, Newton's law of cooling, mixture problems</td>
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<td>• Non-linear models; logistic growth, chemical reactions</td>
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<td>• Systems of differential equations; radioactive series, mixtures, predator-prey models</td>
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<tr>
<td>14</td>
<td><strong>Higher-Order Differential Equations</strong></td>
</tr>
<tr>
<td></td>
<td>• Linear differential equations; initial-value and boundary-value problems, homogenous equations, non-homogeneous equations</td>
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<td></td>
<td>• Reduction of order</td>
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<td>• Homogenous linear equations with constant coefficients</td>
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<td>• Undetermined coefficients; supposition approach, annihilator approach</td>
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<td>• Variation of parameters</td>
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<td>• Cauchy-Euler equation</td>
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<td>• Solving systems on linear equations using elimination</td>
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<td>• Non-linear differential equations</td>
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<tr>
<td>5</td>
<td><strong>Modeling with Higher-Order Differential Equations</strong></td>
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<tr>
<td></td>
<td>• Linear models with initial value problems; spring/mass systems with free undamped motion, free damped motion, and driven motion</td>
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<td>• Linear models with boundary value problems</td>
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<td></td>
<td>• Nonlinear models</td>
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<td>7</td>
<td><strong>Series Solutions of Linear Equations</strong></td>
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<tr>
<td></td>
<td>• Review of power series</td>
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<td>• Solutions about ordinary points</td>
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<td>• Solutions about singular points</td>
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<td>• Special functions; Bessel's Equation, Legendre's Equation</td>
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<td>10</td>
<td><strong>The Laplace Transform</strong></td>
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<td>• Definition of the Laplace transform</td>
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<td>• Inverse transforms and transforms of derivatives</td>
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<td>• Operational properties of the transform</td>
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<td>• The Dirac Delta function</td>
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<td>6</td>
<td><strong>Systems of Linear First-Order Differential Equations</strong></td>
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<td>• Preliminary theory; supposition principle, independence, general solutions</td>
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<td>• Homogenous linear systems; distinct real eigenvalues, repeated eigenvalues, complex eigenvalues</td>
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<td>• Nonhomogeneous linear systems; undetermined coefficients, variation of parameters</td>
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<td>• Matrix exponentials</td>
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<td>4</td>
<td><strong>Numerical Solutions of Ordinary Differential Equations</strong></td>
</tr>
<tr>
<td></td>
<td>• Euler's method</td>
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<td>• Improved Euler's method</td>
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<tr>
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<td>• Runge-Kutta methods (RK4)</td>
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