

Math 230 – Differential Equations

Spring 2017 Course Syllabus

James Jones, Professor of Mathematics

Mathematics, Science, & Business Division – Richland Community College

Course Meeting Information

Section 01 meets 10:30 – 11:40 am on Monday, Wednesday, and Friday in room S137 on Richland's main campus. The Spring 2017 semester begins January 17, 2017, and ends May 19, 2017. This is a face-to-face course, but the Canvas learning management system will be used.

Instructor Information

James Jones, Professor of Mathematics

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Canvas: <https://richland.instructure.com>

The best way to contact the instructor outside of class is through Canvas or by email. Please do not leave a voice mail as it will not reach the instructor in time to help you.

Office Hours

I spend most of my office hours in the classroom, room S137. Meeting in the classroom provides greater access for students to get help with their assignments, homework, projects, quizzes, exams, and questions.

- Monday: 10:10 - 10:30a, 11:40a - 12:00n, 2:10 - 2:30p, 3:40 - 4:50p
- Wednesday: 10:10 - 10:30a, 11:40a - 12:00n, 2:10 - 2:30p
- Friday: 10:10 - 10:30a, 11:40a - 12:00n, 2:10 - 2:30p

Students are encouraged to come to class early each day and use that time to ask questions of the instructor, work on projects, or just socialize with other students in the course.

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.

Topical Outline

Introduction to Differential Equations – 5 hours

- Definitions and terminology
- Initial-value problems
- Differential equations as mathematical models

First-Order Differential Equations – 9 hours

- 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

Modeling with First-Order Differential Equations – 4 hours

- 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

Higher-Order Differential Equations – 14 hours

- Linear differential equations; initial-value and boundary-value problems, homogeneous equations, non-homogeneous equations
- Reduction of order
- Homogeneous 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

Modeling with Higher-Order Differential Equations – 4 hours

- 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

Series Solutions of Linear Equations – 7 hours

- Review of power series
- Solutions about ordinary points
- Solutions about singular points
- Special functions; Bessel's Equation, Legendre's Equation

The Laplace Transform – 10 hours

- 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

Systems of Linear First-Order Differential Equations – 6 hours

- Preliminary theory; superposition principle, general solutions
- Linear independence/dependence; Wronskian
- Homogeneous linear systems; distinct real eigenvalues, repeated eigenvalues, complex eigenvalues
- Nonhomogeneous linear systems; undetermined coefficients, variation of parameters
- Matrix exponentials

Numerical Solutions of Ordinary Differential Equations – 3 hours

- Euler's method
- Improved Euler's method
- Runga-Kutta methods (RK4)

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.¹
- demonstrate the use of proper mathematical notation.¹
- use technology when appropriate and know the limitations of technology.⁴
- work with others towards the completion of a common goal.^{1,3,4}
- use deductive reasoning and critical thinking to solve problems.²
- apply common sense to mathematical problems.²
- effectively communicate the student's understanding of the subject.^{1,4}

The numbered superscripts refer to the [Richland Cross-Disciplinary Outcomes](#) addressed by that objective.

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

Any of the following methods of evaluation may be used: problem solving exams, objective exams, essays, research papers, oral presentations, group projects, individual projects, quizzes, homework, and a learning portfolio.

Graded Assessments

There will be 500 points possible in the semester. Each of the following items is worth 100 points.

- **Exam 1:** First Order Differential Equations (Chapters 1-3)
- **Exam 2:** Higher Order Differential Equations (Chapters 4-5)
- **Exam 3:** Series Solutions and Laplace Transforms (Chapters 6-7)
- **Application Projects:** There are three student-designed projects in the semester. The first two projects are worth 25 points each and will cover applications of first order and second order differential equations respectively and involve a written paper. The final project will be worth 50 points and will cover applications of systems of differential equations (Chapter 8), involve a written paper, and a classroom presentation. The classroom presentation of the third project is in lieu of a final exam.
- **Learning Portfolio:** This electronic portfolio will allow you to collect artifacts of learning that demonstrate your understanding of the material. You are encouraged to make revisions and corrections to exams and projects and include those in the portfolio. Additional information about the portfolio will be provided on a separate handout.

Non-Graded Assessments

These items might be included in your portfolio, but they are generally just to help you learn the material and give you practice. Others might be for the instructor to assess where the class is in their learning and to see which topics need more or less coverage.

- **Quizzes:** These short quizzes cover material from the previous day's lecture and are designed to help the instructor and student assess understanding of the major concepts.
- **Homework:** These are mostly-odd problems from the book that you work and check your answers using the back of the book, the wiki, trusting your intuition, checking with other students, or asking the instructor. You won't master the material without practicing and that has historically been the role of homework. However, with the proliferation of the Internet and websites devoted to providing worked out solutions to textbook problems, requiring

students to turn in homework has lost its effectiveness. Problems on the exams are often similar to problems from the 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%

Standard rounding rules apply, so an 89.5% will be considered an "A".

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.

Grades will be maintained inside the Canvas learning management system. 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

If you miss the first day of class or any two consecutive days after that without communicating with the instructor, you may be dropped.

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 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, the student should notify the instructor by through Canvas or email. In extreme circumstances, you can leave a voice message, but I generally will not get

those in a timely fashion. If you do leave a voice message, be sure to follow up with an email.

If you must miss an exam, communicate with the instructor as soon as possible to develop an alternative plan.

Technology

The use of technology in this course is consistent with the Technology Statement in the [Illinois Mathematics & Computer Science Articulation Guide](#) (IMACC, 2016, p. 4). Technology is used to enhance the learning of Differential Equations, but it is not the focus of the instruction.

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.

Calculator

This class is an upper-level mathematics class and a graphing calculator is preferred. That said, differential equations does not use many of the typical features of a graphing calculator (graphing functions, finding values from the graph, displaying a table of values, and finding the definite integrals numerically), so a scientific calculator may be sufficient. A Texas Instruments TI-84 or TI 83 is the recommended calculator and will be used by the instructor for demonstration purposes.

The TI-89 or TI-Nspire CAS calculators have a computer algebra system (CAS) built in and offer advantages, especially if you plan on taking additional calculus or engineering courses. A word of caution: having an advanced calculator does not compensate for having weak calculus skills.

Calculators may be used to do homework and may be used on exams and/or quizzes in class unless otherwise announced.

Maxima

Maxima is an open-source computer algebra system that is free for you to download and use at home. It is available from <http://maxima.sourceforge.net/>

WinPlot

WinPlot is a free graphing software package for Windows written by the late 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.

Microsoft Excel

This spreadsheet application is useful for numerical methods such as Euler, Improved Euler, and Runge-Kutta 4. It is loaded on all of the student computers at Richland.

Microsoft Office 365, which includes Word, Excel, PowerPoint, Access, and Publisher, is available free to students enrolled in credit courses at Richland through the Microsoft Student Advantage program. More information is available at <https://jics.richland.edu/MicrosoftStudentAdvantage/>

Additional Supplies

The student should bring a pencil, paper, and calculator to class each day. You may occasionally want a ruler or graph paper. 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.

You may use a recording device to record the lectures. Feel free to use a camera or cell phone to take pictures of the boards if you have trouble getting all of the information into your notes.

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.

Mathematics Enrichment Center

The Mathematics Enrichment Center, located in W117, provides free walk-in tutoring for mathematics courses. There are additional locations available at the Clinton and Fairview extension centers.

Academic Success Center

The Academic Success Center consolidates several student services into one area. It is located in the south wing of the first floor next to the Kitty Lindsay Learning Resources Center (library).

Testing

The testing center is located in room S116. You must provide a photo identification and know the name of your instructor to use this service.

Tutoring

The tutoring center provides tutoring on a walk-in or appointment basis in room S118. Students seeking mathematics tutoring should visit the Mathematics Enrichment Center.

Accommodations

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 C148. If you request an accommodation, you will be required to provide documentation that you need that accommodation.

Online Learning

Despite the title, Online Learning provides help with much more than just your online courses. They provide technical support for students including answering questions about Canvas, myRichland, e-mail, cell phones, tablets, and laptops. They can also help troubleshoot your computer issues and make sure your computer is ready for course work.

They are located in room W143, but the best way to contact them is through the "Help" link in the lower-left corner of Canvas or at <http://www.richland.edu/online/helpdesk>.

Open Computer Labs

Students often wish to know where, besides the classroom, they can go to use the software. There are computers located in the Learning Resources Center and in the Academic Success

Center that you may use.

College & Division Policies

Academic Dishonesty Policy

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 Policy

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.

Other College Services

There are some additional services that Richland provides to its students. While they may not directly pertain to this class, you may benefit from them.

Learning Feedback System

At the end of each semester, students are invited to provide feedback to their instructors about the course. This includes things that went well and opportunities for improvement. This online feedback is anonymous and the instructor won't see it until grades have been turned in.

The Learning Feedback System (LFS) is primarily intended to provide feedback to the instructor. However, if you have a issues or concerns, you should not wait until the end of the semester to talk to your instructor. Please come to me at any time. The feedback system is

available at <https://people.richland.edu/feedback>.

myRichland

myRichland is the student information system portal and is located at <https://my.richland.edu>.

You may use it to find the course schedule, register for classes, check your grades, obtain unofficial transcripts, review financial aid, and other student services.

Library

The Learning Resources Center (LRC) has print and electronic resources available. They offer research assistance and information literacy sessions; they also have individual and group study areas.

Student Success Center

Temporarily located in the Workforce Development Institute (WDI) building, the Student Success Center is designed to be a one-stop shop for most student services. These include advising and registration, career services, counseling services, financial aid, veteran affairs, student records, and the transfer center.

There are a few other student services that are still in the main building. These include Campus Life, which supports new student orientation, clubs, organizations, and student leadership, and the TRiO program that offers academic and personal support to first-generation, low-income, and students with disabilities.

Directory of Student Services

The main phone number for Richland Community College is 217-875-7211. This is an automated system available 24 hours a day. If you would like to speak to an operator, then call 217-875-7200 during normal business hours.

Student Service	Location	Extension
Accommodations	C148	6379
Advising and Registration	WDI	6267
Campus Life	C131	6243
Career Services	WDI	6305, 6243
Counseling Services	WDI	6252
Financial Aid and Veteran Affairs	WDI	6274
Library	C152	6303
Online Learning Support	W143	6376
Mathematics Enrichment Center	W117	6383
Student Employment	WDI	6205
Student Records	WDI	6257
Student Support Services/TRiO Program	C143	6440
Testing	S116	6238
Transfer Center	WDI	6222
Tutoring	S118	6419
Veteran Services	WDI	6307, 6205

Richland Cross-Disciplinary Outcomes

The course objectives listed in this document make reference to these items.

1. The degree-seeking student will be able to communicate effectively (read, write, speak and listen).
2. The degree-seeking student will think critically and creatively.
3. The degree-seeking student will act professionally and responsibly.
4. The degree-seeking student will manage technology and evaluate information in various research and applied contexts.