



Mathematics
Houston Community College
Northeast College – Northline Campus

Math 2320: Ordinary Differential Equations
CRN 11935 – Spring 2017

Room 228 | 9:30 am – 11:00 am | Tuesday and Thursday

3 hour lecture course / 48 hours per semester / 16 weeks

Textbook: A First Course in Differential Equations with Modeling Applications, 10th Ed, by
Dennis Zill

ISBN-13: 9781111827052

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Office location and hours: Northline Campus Room 321; Mon and Wed, 9:30 am – 10:00 am; Tue and Thu, 11:00 am -12:00 pm; otherwise by appointment.

Catalog Description: MATH 2320 Ordinary Differential Equations. Ordinary differential equations, including linear equations, systems of equations, equations with variable coefficients, existence and uniqueness of solutions, series solutions, singular points, transform methods, and boundary value problems; application of differential equations to real-world problems.

Prerequisites

MATH 2414.

Course Goal

This course provides the background in sciences for further study in mathematics and its applications.

Course Student Learning Outcomes (SLO):

- 1) Identify homogeneous equations, homogeneous equations with constant coefficients, and exact and linear differential equations.
- 2) Solve ordinary differential equations and systems of equations using:
 - a) Direct integration
 - b) Separation of variables
 - c) Reduction of order
 - d) Methods of undetermined coefficients and variation of parameters
 - e) Series solutions
 - f) Operator methods for finding particular solutions
 - g) Laplace transform methods
- 3) Determine particular solutions to differential equations with given boundary conditions or initial conditions.
- 4) Analyze real-world problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics, including problems related to population dynamics, mixtures, growth and decay, heating and cooling, electronic circuits, and Newtonian mechanics.

Learning outcomes

Students will:

- 1) Verify that a function is a solution for a given differential equation.
- 2) Derive a differential equation from a given physical situation.
- 3) Determine by inspection at least two solutions of a given initial-value problem.
- 4) Solve a given differential equation by separation of variables or by using an appropriate substitution.
- 5) Solve given exact differential equations subject in indicated initial conditions.
- 6) Solve the given Riccati equation.
- 7) Determine whether a set of functions are linearly dependent or independent on $(-\infty, \infty)$.
- 8) Determine whether an n th-order differential equation is homogeneous, or nonhomogeneous.

- 9) Apply the superposition principle for homogeneous and nonhomogeneous equations.
- 10) Given a differential equation and one solution, find the second solution.
- 11) Solve a given differential equation by undetermined coefficients.
- 12) Find a linearly independent function that is annihilated by a given differential operator.
- 13) Solve given differential equations by variation of parameters or by involving Cauchy-Euler equation.
- 14) Solve the given system of differential equations by either systemic elimination or determinants.
- 15) Use the Laplace transform to solve a given system of differential equations.
- 16) Rewrite a given system in normal form.
- 17) Solve a given system of equations by either Gaussian elimination or Gauss-Jordan elimination.
- 18) Solve a given system of linear first-order equations using matrices.
- 19) Solve a given system of homogeneous linear systems.
- 20) Use the method of undetermined coefficients to solve a given system on $(-\infty, \infty)$.
- 21) Use variation of parameters to solve a given system of equations.
- 22) Use matrix exponentials.
- 23) Find the Laplace Transform of a given function.
- 24) Find the inverse Laplace Transform of a given function.
- 25) Given a Laplace Transform of an integral, evaluate the transform without evaluating the integral.
- 26) Use the Laplace transform to solve the given differential equation subject to the given boundaries.

Core Objectives

Given the rapid evolution of necessary knowledge and skills and the need to take into account global, national, state, and local cultures, the core curriculum must ensure that students will develop the essential knowledge and skills they need to be successful in college, in a career, in their communities, and in life. Through the Texas Core Curriculum, students will gain a foundation of knowledge of human cultures and the physical and natural world, develop principles of personal and social responsibility for living in a diverse world, and advance intellectual and practical skills that are essential for all learning.

Critical Thinking Skills: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.

Communication Skills: to include effective development, interpretation and expression of ideas through written, oral and visual communication.

Empirical and Quantitative Skills: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions.

CALENDAR

APPROXIMATE TIME	TEXT REFERENCE
<p>Unit I – Introduction to Differential Equations (4 Hours)</p> <p>This unit presents the basic terminology. The instructor should emphasize the various notation used to represent derivatives of functions, the difference between an ordinary derivative and a partial derivative, and the order of a differential equation. Students are introduced to initial value problems. Implicit and explicit solutions are investigated.</p>	<p><i>Sections: 1.1, 1.2, 1.3</i></p>
<p>Unit II – First-Order Differential Equations (7 Hours)</p> <p>This unit presents various types of solutions of first-order differential equation. The instructor should emphasize how to identify and solve linear, separable, exact, homogeneous, and Bernoulli equations. Graphical solutions and Newton’s approximations are also discussed.</p>	<p><i>Sections: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6</i></p>

Unit III – Modeling with First-Order Differential Equations *Sections: 3.1, 3.2, 3.3*
(3 Hours)

This unit includes a study of various applications including linear models, nonlinear models, and modeling with systems of first-order differential equations.

Unit IV- Higher-Order Differential Equations *Sections: 4.1, 4.2, 4.3, 4.4, 4.5 4.6,*
(12 Hours) *4.7, 4.8, 4.9, 4.10*

This unit examines the underlying theory and solution methods for certain types of higher-order linear equations. Green's functions are discussed as an application for solution linear initial-value and boundary-value problems. This unit concludes with solutions of systems of linear differential equations by elimination and with a brief examination of nonlinear higher-order equations.

Unit V – Series Solutions of Linear Equations *Sections: 6.1, 6.2, 6.3, 6.4 (optional)*
(4.5 Hours)

This unit includes the basic concepts of solving higher-order differential equations with variable coefficients by the use of infinite series. Two infinite series methods for finding solutions of homogeneous linear second-order differential equations are studied.

Unit VI – The Laplace Transform *Sections: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6*
(9 Hours)

This unit includes the basic concepts of Laplace transforms. The instructor should emphasize the definition of the Laplace transform, using tables of Laplace transforms to find transforms of functions and derivatives and to calculate inverse transforms, using translations on the x-axis and translations of the t-axis, and solving a differential equation by applying Laplace transforms to the equation. Operational functions, including derivatives of a transform, transforms of integrals, and the transform of a period function are covered, as well as the Dirac Delta function. This unit concludes with a discussion of the use of Laplace transforms to solve linear systems of differential equations.

Unit VII – Systems of Linear First-Order Differential Equations *Sections: 8.1, 8.2, 8.3, 8.4*
(5 Hours)

This unit includes the basic concepts of solving linear first-order differential equations with constant coefficients. The instructor should emphasize using eigenvalues and eigenvectors in order to develop a solution set to homogeneous linear systems, nonhomogeneous linear systems. This unit concludes with a discussion the matrix exponential.

Unit VIII – Numerical Solutions of Ordinary Differential Equations *Sections: 9.1, 9.2, 9.3, 9.4, 9.5*
(3 Hours) *Optional*

This optional unit discusses numerical solutions of ordinary differential equations and error analysis.

All examinations will be announced at least one week in advance. A student should expect an exam every four weeks.

The date for each exam will be discussed in class.

Instructional Methods

Lecture, Board work and Discussion.

The course is a traditional lecture-type course, in which student- participation is welcome. The learning atmosphere is community-based. Students work in groups to assist each other in completing homework, projects, and presentations. Field trips are taken to industries, museums and firms where students obtain hand-on experience related to various topics learned during the semester. A student in this class is expected to read the textbook, submit assignments on the due dates, study for the exams, attend class regularly and participate in class discussion, and to retain the course material beyond the end of the semester.

My teaching style takes the form of lectures and recitation so be prepared for lots of notes. I expect you to participate in classroom discussions.

I will present the main terminology and rules of each section and then work several example problems about that material. I also may ask students to work problems from each section on the board or in groups.

Student Assignments

Home Work: Home work will be assigned regularly. Practice is absolutely essential to mastery of mathematics. Be prepared to ask questions about any problems you are unable to work and any material in the text you do not understand. Whenever possible, try to read the sections to be covered before the lecture period. All home work should be kept in notebook form and available at any time for inspection. Put your name on every page of your work. Your success in this course significantly depends on practicing and understanding the home works. Although some of the home works may not be collected but you are required to do them. Credits are earned for doing and understanding your homework.

Tests: Three tests and final examination will be given. Make-up tests may be given under appropriate circumstances (with verifiable document)

Homework assignments will be given at the end of every class period. Questions relating to these assignments will be answered at the beginning of each class.

Assessments

Final Grade: You will be evaluated on your performance as follow

Three Exams	300 pts.
Final Examination	<u>200 pts.</u>
Total	500 pts.

The final grade will be determined according to the following formula:

$$\text{Final Grade} = \frac{(3 \text{ Exams} + \text{Final Exam})}{5}$$

HCC Policy Statement - ADAServices to Students with Disabilities

Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Disability Services Office at his or her respective college at the beginning of each semester. Faculty members are authorized to provide only the accommodations requested by the Disability Support Services Office. Persons needing accommodations due to a documented disability should contact the ADA counselor for their college as soon as possible. For questions, please contact Donna Price at 713.718.5165. To visit the ADA Web site, please visit www.hccs.edu then click Future students, scroll down the page and click on the words Disability Information.

Kim Ingram, (713) 718-8420

HCC Policy Statement: Academic Honesty

Cheating: Cheating can result in dismissal from the entire Houston Community College System. Any student who cheats will be dropped from the course with a grade of F. Any communication, referring to books, notes, or leaving classroom during examinations will be considered cheating.

A student who is academically dishonest is, by definition, not showing that the coursework has been learned, and that student is claiming an advantage not available to other students. The instructor is responsible for measuring each student's individual achievements and also for ensuring that all students compete on a level playing field. Thus, in our system, the instructor has teaching, grading, and enforcement roles. You are expected to be familiar with the University's Policy on Academic Honesty, found in the catalog. What that means is: If you are charged with an offense, pleading ignorance of the rules will not help you. Students are responsible for conducting themselves with honor and integrity in fulfilling course requirements. Penalties and/or disciplinary proceedings may be initiated by College System officials against a student accused of scholastic dishonesty. "Scholastic dishonesty": includes, but is not limited to, cheating on a test, plagiarism, and collusion.

Cheating on a test includes:

- Copying from another students' test paper;
- Using materials not authorized by the person giving the test;
- Collaborating with another student during a test without authorization;
- Knowingly using, buying, selling, stealing, transporting, or soliciting in whole or part the contents of a test not yet administered;
- Bribing another person to obtain a test that is to be administered.

Plagiarism means the appropriation of another's work and the unacknowledged incorporation of that work in one's own written work offered for credit.

Collusion mean the unauthorized collaboration with another person in preparing written work offered for credit. Possible punishments for academic dishonesty may include a grade of 0 or F in the particular assignment, failure in the course, and/or recommendation for probation or dismissal from the College System. (See the Student Handbook)

HCC Policy Statements

Class Attendance - It is important that you come to class! Attending class regularly is the best way to succeed in this class. Research has shown that the single most important factor in student success is attendance. Simply put, going to class greatly increases your ability to succeed. You are expected to be on time at the beginning of each class period. For complete information regarding Houston Community College's policies on attendance, please refer to the Student Handbook. You are responsible for materials covered during your absences. Class attendance is checked daily. Although it is your responsibility to drop a course for nonattendance, the instructor has the authority to drop you for excessive absences.

A student is allowed four unexcused absences. Three under 20 minute late will count as one absence. If a student is over 20 minutes late or leave before class dismissal that student will be considered absent.

If you are not attending class, you are not learning the information. As the information that is discussed in class is important for your career, **students may be dropped from a course after accumulating absences in excess of six (6) hours of instruction.** The six hours of class time would include any total classes missed or for excessive tardiness or leaving class early.

You may decide NOT to come to class for whatever reason. As an adult making the decision not to attend, you do not have to notify the instructor prior to missing a class. However, if this happens too many times, you may suddenly find that you have "lost" the class.

Poor attendance records tend to correlate with poor grades. If you miss any class, including the first week, you are responsible for all material missed. It is a good idea to find a friend or a buddy in class who would be willing to share class notes or discussion or be able to hand in your work if you unavoidably miss a class

HCC Course Withdrawal Policy

If you feel that you cannot complete this course, you will need to withdraw from the course prior to the final date of withdrawal. Before, you withdraw from your course; please take the time to meet with the instructor to discuss why you feel it is necessary to do so. The instructor may be able to provide you with suggestions that would enable you to complete the course. Your success is very important. Beginning in fall 2007, the Texas Legislature passed a law limiting first time entering freshmen to no more than **SIX** total course withdrawals **throughout** their educational career in obtaining a certificate and/or degree.

To help students avoid having to drop/withdraw from any class, HCC has instituted an Early Alert process by which your professor *may* “alert” you and HCC counselors that you might fail a class because of excessive absences and/or poor academic performance. It is your responsibility to visit with your professor or a counselor to learn about what, if any, HCC interventions might be available to assist you – online tutoring, child care, financial aid, job placement, etc. – to stay in class and improve your academic performance.

If you plan on withdrawing from your class, you **MUST** contact a HCC counselor or your professor prior to withdrawing (dropping) the class for approval and this must be done **PRIOR** to the withdrawal deadline to receive a “W” on your transcript. ****Final withdrawal deadlines vary each semester and/or depending on class length, please visit the online registration calendars, HCC schedule of classes and catalog, any HCC Registration Office, or any HCC counselor to determine class withdrawal deadlines. *Remember to allow a 24-hour response time when communicating via email and/or telephone with a professor and/or counselor. Do not submit a request to discuss withdrawal options less than a day before the deadline.*** If you do not withdraw before the deadline, you will receive the grade that you are making in the class as your final grade.

The last day to withdraw is Monday April 3, 2017

Repeat Course Fee

The State of Texas encourages students to complete college without having to repeat failed classes. To increase student success, students who repeat the same course more than twice, are required to pay extra tuition. The purpose of this extra tuition fee is to encourage students to pass their courses and to graduate. Effective fall 2006, HCC will charge a higher tuition rate to students registering the third or subsequent time for a course. If you are considering course withdrawal because you are not earning passing grades, confer with your instructor/counselor as early as possible about your study habits, reading and writing homework, test taking skills, attendance, course participation, and opportunities for tutoring or other assistance that might be available.

Classroom Behavior

Decent and orderly behavior is expected.

As students in this class, it is your responsibility to develop and maintain a positive learning environment for everyone. Your instructor takes this responsibility very seriously and will inform you if your behavior makes it difficult for your classmates to perform their duties. As a fellow learner, you are asked to respect the learning needs of your classmates and assist your instructor in achieving this critical goal. Use of foul languages and display of any illegal item is highly prohibited.

Turn off your cell-phones or put it on silent/vibration mode. No texting during lectures. Refrain from talking to your classmates during lectures.

Use of Camera and/or Recording Devices

As a student active in the learning community of this course, it is your responsibility to be respectful of the learning atmosphere in your classroom. To show respect of your fellow students and instructor, you will turn off your phone and other electronic devices, and will not use these devices in the classroom unless you receive

permission from the instructor.

Use of recording devices, including camera phones and tape recorders, is prohibited in classrooms, laboratories, faculty offices, and other locations where instruction, tutoring, or testing occurs. Students with disabilities who need to use a recording device as a reasonable accommodation should contact the Office for Students with Disabilities for information regarding reasonable accommodations.

Instructor Requirements

I expect every student to be in class on time and every day. I will try to give you as much notes as possible so that you won't have to spend a lot of time reading the textbook. You are required to do your homework assignments and exam reviews before they are due. Questions on the homework assignments will be answered at the beginning of every class period.

Two note books (one for Hw and one for Lecture) and a text book are needed for the class.

Grading Scale

90 - 100 = A

80 - 89 = B

70 - 79 = C

60 - 69 = D

Below 60 = F

Personal Communication Device Policy:

All personal communication devices (any device with communication capabilities including but not limited to cell phones, blackberries, pagers, cameras, palmtop computers, lap tops, PDA's, radios, headsets, portable fax machines, recorders, organizers, databanks, and electronic dictionaries or translators) must be muted or turned off during class. Such activity during class time is deemed to be disruptive to the academic process. Personal communication devices are to not be on the student desk during examinations. Usage of such devices during exams is expressly prohibited during examinations and will be considered cheating (see academic honesty section above).

Student Course Reinstatement Policy:

Students have a responsibility to arrange payment for their classes when they register, either through cash, credit card, financial aid, or the installment plan. Faculty members have a responsibility to check their class rolls regularly, especially during the early weeks of a term, and reconcile the official class roll to ensure that no one is attending class whose name does not appear on it. Students who are dropped from their courses for nonpayment of tuition and fees who request reinstatement after the official date of record (OE Date) can be reinstated by making payment in full and paying an additional \$75 per course reinstatement fee. A student requesting reinstatement should present the registrar with a completed **Enrollment Authorization Form** with the signature of the instructor, department chair, or dean who should verify that the student has been attending class regularly. Students who are reinstated are responsible for all course policies and procedures, including attendance requirements.

Resources:

Free tutoring is available in Northline Campus **Room 423** Additional help is also available through <http://northeast.hccs.edu/northeast/academic-transfer/mathematics> and through Student Support Services.

Students can get free assistance, 24 hours a day, 7 days a week, in Math, English and other subjects, at www.hccs.askonline.net. Typically, posted questions are answered by an HCC tutor or faculty within 24 hours (usually under 6 hours). There are also several online math resources that you can find with an internet search. You may also find information on the Learning Web site accessible through your specific HCCS campus website.

EGLS₃ -- Evaluation for Greater Learning Student Survey System

At Houston Community College, professors believe that thoughtful student feedback is necessary to improve teaching and learning. During a designated time, you will be asked to answer a short online survey of research-based questions related to instruction. The anonymous results of the survey will be made available to your professors and division chairs for continual improvement of instruction. Look for the survey as part of the Houston Community College Student System online near the end of the term. Visit www.hccs.edu/EGLS3 for more information.

Administration contact information

College - Level Math Courses

Chair of Math	Jaime Hernandez	SW Campus	713-718-2477	Stafford, Scarcella, N108
- Secretary	Tiffany Pham	SW Campus	713-718-7770	Stafford, Scarcella, N108
Math Assoc. Chair	Clen Vance	CE Campus	713-718-6448	San Jacinto Building, Rm 369
Math Assoc. Chair	Ernest Lowery	NW Campus	713-718-5512	Katy Campus Building, Rm 112
Math Assoc. Chair	Mahmoud Basharat	NE Campus	713-718-2438	Codwell Hall Rm 105

Developmental Math Courses

Chair of Dev. Math	Susan Fife	SE Campus	713-718-7241	Felix Morales Building, Rm 124
- Secretary	Carmen Vasquez	SE Campus	713-718-7056	Felix Morales Building, Rm 124
Dev. Math Assoc. Chair	Marisol Montemayor	SE Campus	713-718-7153	Felix Morales Building, Rm 124
Dev. Math Assoc. Chair	Jack Hatton	NE Campus	713-718-2434	Northline Building, Room 321

For issues related to your class, please first contact your instructor.

If you need to contact departmental administration, then contact the appropriate Associate Chair.

If further administrative contact is necessary, then contact the appropriate Department Chair.