# *Differential Equations*

## SECTION I: Course Overview

**Course Code**: MATH350PRG
**Subject Areas**: Mathematics
**Prerequisites**: See below
**Language of Instruction**: English
**Contact Hours**: 60
**Recommended Credits**: 4

### COURSE DESCRIPTION

In this course you will cover material related principally to differential equations dealing with ordinary differential equations. These mathematics are an important tool in Science and Engineering and are commonly associated with understanding population dynamics, radioactive decay, and certain chemical reactions. The content of this course will thus focus on first-order differential equations, higher-order differential equations, Laplace transforms, and series solutions of linear differential equations.

In addition to the cognitive and knowledge skills listed above, students in this course will identify the relevance and practical applications of mathematics to various fields.

### LEARNING OBJECTIVES

Upon successful completion of this course, you will be able to:

- Compute solutions of linear, 1st order, and higher order differential equations.
- Solve linear differential equations with and without Power Series.
- Identify the Laplace transform of a given function.
- Interpret mathematical and/or logical modes such as formulas, graphs, tables, and schematics.

### PREREQUISITES

Prior to enrollment, this course requires you to have completed course work in calculus III.

## SECTION II: Instructor & Course Details

**INSTRUCTOR DETAILS**

**Name:** TBD
**Contact Information:** TBD
**Term:** SUMMER

## ATTENDANCE POLICY

This class will meet four times weekly for 125 minutes each session for 24 sessions. All students are expected to arrive on time and prepared for the day's class session.

CEA enforces a mandatory attendance policy. You are therefore expected to attend all regularly scheduled class sessions, including any field trips, site visits, guest lectures, etc. that are assigned by the instructor. The table below shows the number of class sessions you may miss before receiving a grade penalty.

| ALLOWED ABSENCES – SUMMER | | |
|---|---|---|
| **Courses Meeting X day(s) Per Week** | **Allowed Absence(s)** | **Automatic Failing Grade at X$^{th}$ absence** |
| Courses meeting **4** day(s) per week | **1** Absence | **4$^{th}$** Absence |

For every additional absence beyond the allowed number, your final course grade will drop down to the subsequent letter grade (ex: A+ to A). As a student, you should understand that the grade penalties will apply if you are marked absent due to tardiness or leaving class early. In the table below, you will find the grade penalty associated with each excessive absence up to and including automatic course failure.

| ATTENDANCE DOCKING PENALTIES | | | | |
|---|---|---|---|---|
| **Absence** | **1$^{st}$** | **2$^{nd}$** | **3$^{rd}$** | **4$^{th}$** |
| **Penalty** | **No Penalty** | **0.5 Grade Docked** | **1 Grade Docked** | **Automatic Failure** |
| **HIGHEST POSSIBLE GRADE AFTER ATTENDANCE PENALTIES** | | | | |
| **Grade** | **A+** | **A** | **A-** | **F** |

CEA does not distinguish between excused and unexcused absences. As such, no documentation is required for missing class. Similarly, excessive absences, and the grade penalty associated with each, will not be excused even if you are able to provide documentation that shows the absence was beyond your control. You should therefore only miss class when truly needed as illness or other unavoidable factors may force you to miss a class session later on in the term.

## GRADING & ASSESSMENT

The instructor will assess your progress towards the above-listed learning objectives by using the forms of assessment below. Each of these assessments is weighted and will count towards your final grade. The following section (Assessment Overview) will provide further details for each.

| | |
|---|---|
| **Class Participation** | **10%** |
| **Homework** | **30%** |
| **Midterm Examination** | **30%** |
| **Final Examination** | **30%** |

The instructor will calculate your course grades using the CEA Grading Scale shown below. As a CEA student, you should understand that credit transfer decisions–including earned grades for courses taken abroad–are ultimately made by your home institution.

| CEA Grading Scale | | | |
|---|---|---|---|
| **Letter Grade** | **Numerical Grade** | **Percentage Range** | **Quality Points** |
| A+ | 9.70 – 10.0 | 97.0 – 100% | 4.00 |
| A | 9.40 – 9.69 | 94.0 – 96.9% | 4.00 |
| A- | 9.00 – 9.39 | 90.0 – 93.9% | 3.70 |
| B+ | 8.70 – 8.99 | 87.0 – 89.9% | 3.30 |
| B | 8.40 – 8.69 | 84.0 – 86.9% | 3.00 |
| B- | 8.00 – 8.39 | 80.0 – 83.9% | 2.70 |
| C+ | 7.70 – 7.99 | 77.0 – 79.9% | 2.30 |
| C | 7.40 – 7.69 | 74.0 – 76.9% | 2.00 |
| C- | 7.00 – 7.39 | 70.0 – 73.9% | 1.70 |
| D | 6.00 – 6.99 | 60.0 – 69.9% | 1.00 |
| F | 0.00 – 5.99 | 0.00 – 59.9% | 0.00 |
| W | Withdrawal | N/A | 0.00 |
| INC | Incomplete | N/A | 0.00 |

## Assessment Overview

This section provides a brief description of each form of assessment listed above. Your course instructor will provide further details and instructions during class time.

**Class Participation (10%):** Student participation is mandatory for all courses taken at a CEA Study Center. The instructor will use the rubric below when determining your participation grade. All students should understand that attendance and punctuality are expected and will not count positively toward the participation grade.

| Class Participation Grading Rubric | |
|---|---|
| **Student Participation Level** | **Grade** |
| You make major & original contributions that spark discussion, offering critical comments clearly based on readings, research, & theoretical course topics. | **A+** (10.0 – 9.70) |
| You make significant contributions that demonstrate insight as well as knowledge of required readings & independent research. | **A/A-** (9.69 – 9.00) |
| You participate voluntarily and make useful contributions that are usually based upon some reflection and familiarity with required readings. | **B+/B** (8.99 – 8.40) |
| You make voluntary but infrequent comments that generally reiterate the basic points of the required readings. | **B-/C+** (8.39 – 7.70) |
| You make limited comments only when prompted and do not initiate debate or show a clear awareness of the importance of the readings. | **C/C-** (7.69 – 7.00) |

| | |
|---|---|
| You very rarely make comments and resist engagement with the subject. You are not prepared for class and/or discussion of course readings. | **D** (6.99 – 6.00) |
| You make irrelevant and tangential comments disruptive to class discussion. You are consistently unprepared for class and/or discussion of the course readings. | **F** (5.99 – 0.00) |

**Homework (30%):** Homework is assigned at every class to be handed in as indicated on the syllabus. You must show all of your work. No late homework will be accepted.

**Midterm Exam (30%):** One midterm exam will be given during around the 13th session of class.

**Final Examination (30%):** A comprehensive final examination will be administered at the conclusion of the term.

## EXPERIENTIAL LEARNING ACTIVITIES (AICAP)

CEA courses are designed to include a variety of experiential learning activities that will take you out of the classroom and allow you to explore your local, host city. These activities may include field studies, guest lectures and/or activities offered through our Academically Integrated Cultural Activities Program (AICAP). Please check the Forms of Assessment section to find out if AICAP activities are related to any specific form of assessment. The following experiential learning activities are recommended for this course:

- Guided visits

## REQUIRED READINGS

Reading assignments for this course will come from the required text(s) and/or the selected reading(s) listed below. All required readings–whether assigned from the text or assigned as a selected reading–must be completed according to the due date assigned by the course instructor.

I. **REQUIRED TEXT(S)**: You may purchase the required text(s) prior to departure or upon program arrival. The required text(s) are listed below:

   Dennis G. Zill and Warren S. Wright. *Differential Equations with Boundary-Value Problems*. 8th ed., 2014.

## ADDITIONAL RESOURCES

In order to ensure your success abroad, CEA has provided the academic resources listed below. In addition to these resources, each CEA Study Center provides students with a physical library and study areas for group work. The Academic Affairs Office at each CEA Study Center also compiles a bank of detailed information regarding libraries, documentation centers, research institutes, and archival materials located in the host city.

- **UNH Online Library**: As a CEA student, you will be given access to the online library of CEA's School of Record, the University of New Haven (UNH). You can use this online library to access databases and additional resources while performing research abroad. You may access the UNH online library here or through your MyCEA Account. You must comply with UNH Policies regarding library usage.
- **CEAClassroom – Moodle**: CEA instructors use Moodle, an interactive virtual learning environment. This web-based platform provides you with constant and direct access to the course syllabus, daily schedule of class lectures and assignments, non-textbook required readings, and additional resources. Moodle includes the normal array of forums, up-loadable and downloadable databases, wikis, and related academic support designed for helping you achieve the learning objectives listed in this syllabus.

During the first week of class, CEA academic staff and/or faculty will help you navigate through the many functions and resources Moodle provides. While you may print a hard copy version of the syllabus, you should always check Moodle for the most up-to-date information regarding this course. The instructor will use Moodle to make announcements and updates to the course and/or syllabus. It is your responsibility to ensure that you have access to all Moodle materials and that you monitor Moodle on a daily basis in case there are any changes made to course assignments or scheduling.

To access Moodle: Please log-in to your MyCEA account using your normal username and password. Click on the "While You're Abroad Tab" and make sure you are under the "Academics" sub-menu. There you will see a link above your schedule that says "View Online Courses" select this link to be taken to your Moodle environment.

| COURSE CALENDAR<br>*Differential Equations* | | | |
|---|---|---|---|
| **SESSION** | **TOPICS** | **ACTIVITY** | **STUDENT ASSIGNMENTS** |
| **1** | **Course Introduction:**<br>Review Syllabus, Classroom Policies<br>**Definition and Terminology**<br>**Initial-Value Problems**<br>**DE as Math Models** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 1 |
| **2** | **Review of Ch. 1**<br>**Solution Curves without a Solution**<br>**Separable Variables** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 2<br>Homework 1 issued |
| **3** | **Linear Equations**<br>**Exact Solutions**<br>**Solutions by Substitutions** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 2 |
| **4** | **A Numerical Method**<br>**Review of Ch. 2**<br>**Linear Models** | Lecture and In-Class Problem Solving | ***Homework 1 Due**<br>**Readings:**<br>Zill & Wright, Chapter 2-3<br>Homework 2 issued |
| **5** | **Nonlinear Models**<br>**Modelling with Systems of 1st Order ODEs**<br>**Review of Ch. 3** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 3 |
| **6** | **Preliminary Theory – Linear Equations**<br>**Reduction of Order** | Lecture and In-Class Problem Solving | ***Homework 2 Due**<br>**Readings:**<br>Zill & Wright, Chapter 4<br>Homework 3 issued |
| **7** | **Homogeneous Linear Equations**<br>**Underdetermined Coefficients** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 4 |

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|---|---|---|---|
| **8** | **Variation of Parameters**<br>**Cauchy-Euler Equation**<br>**Green's Function** | Lecture and In-Class Problem Solving | ***Homework 3 Due**<br>**Readings:**<br>Zill & Wright, Chapter 4<br>Homework 4 issued |
| **9** | **Solving Systems of Linear DEs**<br>**Non-Linear DEs**<br>**Review of Ch. 4** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 4 |
| **10** | **Linear Models:**<br>IVPs<br>**Spring/Mass Systems**<br>**Series Circuit Analogue** | Lecture and In-Class Problem Solving | ***Homework 4 Due**<br>**Readings:**<br>Zill & Wright, Chapter 5<br>Homework 5 issued |
| **11** | **Linear Models:**<br>BVP<br>**Nonlinear Models**<br>**Review Ch. 5** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 5 |
| **12** | **Review of Power Series**<br>**Midterm review** | Lecture and In-Class Problem Solving | ***Homework 5 Due**<br>**Readings:**<br>Zill & Wright, Chapter 6<br>Homework 6 issued |
| **13** | **MIDTERM EXAMINATION** | | |
| **14** | **Solutions About Ordinary Points** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 6 |
| **15** | **Solutions About Singular Points** | Lecture and In-Class Problem Solving | ***Homework 6 Due**<br>**Readings:**<br>Zill & Wright, Chapter 6 |
| **16** | **Definition of Laplace Transform**<br>**Inverse Transforms**<br>**Transforms of Derivative** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 7 |

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|---|---|---|---|
| **17** | **Operational Properties I, II**<br>**Translation on the x-Axis, t-axis**<br>**The Dirac Delta Function** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 7<br>Homework 7 issued |
| **18** | **Homogenous Linear Systems**<br>**Real Eigenvalues**<br>**Complex Eigenvalues** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 8 |
| **19** | **Non-Homogenous Linear Systems**<br>**Matrix Exponential**<br>**Review of Ch. 8** | Lecture and In-Class Problem Solving | ***Homework 7 Due**<br>**Readings:**<br>Zill & Wright, Chapter 8<br>Homework 8 issued |
| **20** | **Autonomous Systems**<br>**Stability & Linear Systems** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 10 |
| **21** | **Autonomous Systems as Mathematical Models**<br>**Linearization & Local Stability** | Lecture and In-Class Problem Solving | ***Homework 8 Due**<br>**Readings:**<br>Zill & Wright, Chapter 10<br>Homework 9 issued |
| **22** | **Euler Methods**<br>**Runge-Kutta Methods**<br>**Multistep Methods** | Lecture and In-Class Problem Solving | **Readings:**<br>Zill & Wright, Chapter 9 |
| **23** | **Higher-Order Equations**<br>**2nd order BVPs**<br>**Final Review** | Lecture and In-Class Problem Solving | ***Homework 9 Due**<br>**Readings:**<br>Zill & Wright, Chapter 9<br>Homework 10 issued – due at Final Examination |
| **24** | **FINAL EXAMINATION** | | |

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## SECTION III: CEA Academic Policies

The policies listed in this section outline general expectations for CEA students. You should carefully review these policies to ensure success in your courses and during your time abroad. Furthermore, as a participant in the CEA program, you are expected to review and understand all CEA Student Policies, including the academic policies outlined on our website. CEA reserves the right to change, update, revise, or amend existing policies and/or procedures at any time. For the most up to date policies, please review the policies on our website.

Class & Instructor Policies can be found here
General Academic Policies can be found here