Course Format

In-Person, MoWe 12:30–1:50pm
CEB 214 (Mondays), CEB 213 (Wednesdays)
Mondays are discussion days and Wednesdays are reserved for labs.

Instructor's Information

Sungju Moon, PhD

Primary Contact: Use the Inbox tool within Canvas
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Office Location: Dawson 223

Please note that all official University communication is conducted using NS-issued email addresses (e.g., @students.nevadastate.edu) in order to comply with the Family Educational Rights and Privacy Act (FERPA). If you need assistance finding or accessing your NSU email account, please see the relevant section on the LASB Course Policies and Guidelines page.

Office Hours

Tuesdays 1:00–2:00pm, Wednesdays 4:00–5:00pm and whenever my office door is open
Online meetings by appointment on Thursdays and Fridays.

E-mail & Classroom Response Time

You can generally expect a response to e-mails within 24–48 hours (or slightly longer over weekends or holidays). Feedback for completed discussions, quizzes, and assignments depends on the length and complexity of the activity and could take up to 10 days. For questions on the status of a completed assignment, discussion, or test please contact me.

Course Description

Theory and solution techniques for solving ordinary differential equations with constant and variable coefficients, systems of linear differential equations, and a variety of other methods and applications.

Required Text(s)

Lebl, J., *Notes on Diffy Qs*.
This is a free online textbook available at:
https://www.jirka.org/diffyqs/

Supplemental Materials

Certain assignments (such as labs) will require access to scientific computing software. The recommended option is GNU Octave, a free and open-source alternative to MATLAB. You can download and install Octave on your own computer from https://octave.org/. While most classroom demonstrations will be done in Octave, if you prefer, you may also use other scientific computing tools that you are more comfortable with such as MATLAB, Python, R, Fortran, or C++ to complete your assignments. The classroom computers are equipped with both GNU Octave and Spyder IDE.

Course Learning Outcomes

This course aims to strike the right balance between theoretical rigor and practical applications.

After finishing this course, you will be able to:

- Recognize different types of differential equations and their solvability conditions.
- Solve certain types of of ordinary differential equations and initial value problems by hand using standard techniques.
- Implement computational methods to obtain numerical solutions of various differential equations arising from real-life scenarios, test the stability of the solutions and equilibria, and visualize their behavior.
- Develop insights to use differential equations to model real-life problems.

Program Learning Outcomes

This course aligns with the following mathematics Program Learning Outcomes.

Program Learning Outcomes (PLO)	**Course Assignment or Activity**	**Level of Attainment**
PLO 2 (Perspective: Applications) Demonstrate an understanding of how the major areas of mathematics can be applied to contextual problems.	At some point in the course, students will complete an activity prompting them to describe a contextual problem that can be addressed using the tools, concepts, or techniques from this course.	1. The problem is inappropriate for the course content. 2. The problem is appropriate for the course content, but it is contrived or is very poorly explained. 3. The problem is appropriate for the course content, there is a direct connection between the problem and the content, and that connection is explaiend using general/non-specific language. 4. The problem is appropriate for the course content, and there is a direct connection between the problem and the content, and that connection is explained in a manner that reflects a technical understanding of the actual application.
PLO 7 (Personal Development: Collaboration) Work in groups to move collaboratively towards a shared goal.	At the start of the Modeling Project, students will be introduced to the "Collaboration in Mathematics" document. After the final reports are submitted, students will then be asked to respond to a series of prompts from this document, found in the section titled "How do we evaluate collaboration?".	1. The student indicates negative outcomes within the group context. 2. The student indicates neutral outcomes within the group context. 3. The student indicates the ability to identify positive collaborative outcomes within the group context. 4. The student indicates significant levels of positive collaboration outcomes in the group context.

Class Schedule

See Page 9 of the course syllabus for the tentative course calendar.
All dates are subject to change.

Assignment Description & Due Dates

Problem Sets (25%): Problem sets will be assigned on a regular basis. Your solutions must read as if you are explaining it to help a friend learn the material. While communication and collaboration among classmates are encouraged, each student must submit their own solution in their own words (i.e. do not "divide and conquer").

Two problems from each set will be randomly selected for grading and feedback. We will adopt standard-based grading with the following point-system: (0pt) little or no progress has been made, (1pt) an attempt has been made with major flaws and/or incomplete solutions, (2pts) most of the required ideas are present but there are issues with exposition, (3pts) a fully correct and well written solution.

Extracurricular Activities (15%): A portfolio of your extra-curricular activities, completed during the semester, will be submitted at the end of the term. See Page 7 for details.

Lab Assignments (25%): Each lab topic will typically be covered over the course of 2–3 weeks on "lab days" (Wed). The lab assignments will require using a scientific computing software tool. Although most of the activities will be covered in class, each lab assignment will require a final lab report. Lab reports must be accompanied by well-commented and runnable computer code. Students are encouraged to communicate and collaborate on the lab assignments. Lab reports can be submitted as a group consisting of at most three authors and must include a *Contribution Statement*.

Modeling Project (20%): Throughout the semester, students, in groups of 3–4, will work on a modeling problem of their choice and report their findings in the form of a presentation and summary report. The project can take inspiration from a real-life scenario or an in-depth extension of the lab assignments. The modeling project will replace the final exam.

Exam Description

Midterm Exam (15%): One midterm exam will take place in person during class time. The tentative date for the midterm exam is **Wed, Oct 8**.

Exam Debrief. Schedule an individual meeting with the instructor to pick up your graded midterm and discuss how the class is going for you. Opportunities for exam corrections may be made available during these meetings.

Late Work Policy

If for some reason you are absent due to an extenuating circumstance or medical situation, please report the incident using the Student Absence Notification System. Instructors will then review the information in the SANS to determine how, or whether it's possible, to address missed or late work.

The following assignments may *not* be turned in late for credit without explicit permission from the instructor:

- Problem Sets
- Lab Assignments
- Milestones for the Modeling Project
- Exams

You cannot receive a passing grade for the course without completing all major assessments, which include the midterm, labs, and term project milestones.

Attendance Expectations

There may be days you do not to attend classes or leave early due to past or ongoing crises or distressing circumstances. Disclosure of specific reasons or details is not expected, but it will be helpful if you could communicate with me about instances of missed sessions or work; this is because (1) frequent or prolonged inactivity with regard to course contents will negatively impact your learning, and (2) open communication will help us reformulate missed assignments to suit your situation. Missing five consecutive class sessions or assignments without prior or follow-up notice will prompt me to check in with you for a 'pulse check'. Please know that I am available to provide resources and connect you to support services.

Grading Criteria

Your grade will be determined by the following rubric:
(Course Point Totals)—100%

- Problem Sets (25%)
- Lab Assignments (25%)
- Modeling Project (20%)
- Extracurricular Activities (15%)
- Midterm Exam (15%)

Grading Scale (Letter Grade and Point Range):

A	93% or higher	B-	80%–82.99%	D+	67%–69.99%
A-	90%–92.99%	C+	77%–79.99%	D	63%–66.99%
B+	87%–89.99%	C	73%–76.99%	D-	60%–62.99%
B	83%–86.99%	C-	70%–72.99%	F	less than 60%

Accessing Grades and Instructor Feedback

To access your grades and find the instructor's feedback, click on Grades in the left menu. Scroll through the list until you find the new graded assignment (indicated by the blue dot to the left of the assignment name). Then click on the assignment name. You will see your grade. Below it you can click on Show Rubric to see the marked up rubric. Click on the paper title if you want to download the original document. (The instructor's marks or comments will not appear on the downloaded document.) Click on the box to the right of the paper title to see the Turnitin report. Click on View Feedback to see the paper marked up with the instructor's comments/corrections in DocViewer. The instructor's feedback is on the right. Accessing Grades will take you step-by-step through how to find all instructor feedback and see the marked-up paper and rubric.

Artificial Intelligence (AI) Policy

What Is AI? AI tools are applications and other generative technologies capable of producing content (e.g., generating, summarizing), offering feedback (e.g., revising, translating), researching, assisting with coding, or other tasks typically done by humans. Examples include, but are not limited to, ChatGPT, Grammarly, Bing Copilot, Google Gemini, Grok, Answers.AI, Quillbot, Claude AI, DeepL, DeepAI, DALL-E, etc.

AI Tools Banned on State-Owned Devices. The State of Nevada has banned (link) some AI tools (and other technology) due to security or intellectual property concerns. You cannot use these tools on University-owned computers or other devices:

- Grammarly (public version)
- DeepSeek AI

The State updates the banned technology list occasionally, so other tools may be added. You are responsible for checking the most updated list to ensure you are not using any banned tools on state-owned devices.

AI Use Policy for This Course.

- *Prohibited Uses.* As a student in this course, you are not allowed to use AI assignments in the following ways:
  - Generating full essays, reflections, or academic papers
  - Generating answers for homework assignments or quiz problems
  - Generating plots and graphs for assignments and projects
  - Submitting wholly AI-generated programming code

- *Permitted Uses.* You are allowed to use AI in the following ways:
  - Checking grammar and spelling
  - Tutoring or study help (e.g., generating example questions)
  - Generating artificial data to be used in mini-projects (with AI attribution)
  - Research assistance or finding sources
  - Brainstorming or outlining ideas for papers or projects (with AI attribution)
  - Converting from one programming language to another for testing purposes (with AI attribution)
  - Generating visualizations for your own use (not for submission)

If you are unsure how AI can be used for a specific assignment, talk to the instructor before you get started.

AI Citation. This class does not require a specific citation style. The example below, in AMS style, may be used for AI attribution:

> [1] OpenAI ChatGPT-version chat response to prompt "Your prompt goes here," 2025.
>
> In text citation example: "...according to ChatGPT [1]..."

Consequences for Misuse. Misuse of AI may result in plagiarism or academic misconduct penalties outlined in the NS Student Code of Conduct and/or the LASB Academic Conduct Policy (found under Resources & Policies). Continued misuse of AI in coursework or across courses will result in escalating consequences based on the severity and frequency of the violation, which could include receiving an F in this course, academic probation, suspension, or expulsion.

LASB Course Policies & Guidelines

All courses in the School of Liberal Arts, Sciences, and Business (LASB) are subject to LASB course policies and guidelines. You are responsible for reading, understanding, and abiding by these policies and guidelines.

Student Support & Resources

Academic Advising Center. The Academic Advising Center is a dedicated team of Advisors committed to your academic success at NS. By providing the right advice and guidance, we helps students meet their educational and personal objectives. Please visit Academic Advising Center.

Writing Center. Supporting every NS student's ability to improve their process and product, the Writing Center provides trained readers for all writers, all projects, in all disciplines, and during all stages.

Academic Success Center (Tutoring). The Academic Success Center (ASC) offers a range of services including free one-on-one and group tutoring sessions where students can review and practice course concepts and relevant study/test taking strategies with trained peer tutors.

NetTutor Online Tutoring—Did you know you can receive a free on-demand academic support at your convenience when the ASC is closed? You can submit a question or request a drop-in session for a specific subject with an e-instructor. The majority of NetTutor e-instructors have a Master's or Ph.D. in the field. You can access NetTutor through Canvas by selecting the "NetTutor Online Tutoring" on the left-side navigation bar in each of your courses.

Scorpion Success Network. If the instructor determines your performance in this class is placing you at academic risk, you may be referred to a member of the Academic Advising Center. An Academic Advisor will work with you to address issues and develop a student success strategy. Regardless of whether a referral has or has not been made, you are ultimately responsible for tracking your own progress in this course. If you would like to meet with an Advisor regarding any academic struggles you are experiencing, please contact Academic Advising at 702-992-2160 or at `studentsuccess@nevadastate.edu`.

Student Wellness Services. If you are struggling with hunger, unstable housing, safety, mental health worries, or ANY other concerns, contact Student Wellness. Email: `studentwellness@nevadastate.edu` | Call (702) 992-2514.

Disability Resources. At Nevada State University, we recognize our responsibility and embrace the opportunity to meet the unique educational needs of students with documented disabilities. The staff of the Disability Resource Center (DRC) is dedicated to providing a coordinated program of support services for students qualifying with disabilities under the Americans with Disabilities Act (ADA) and Section 504 Guidelines. Our mission is to ensure that all students qualifying with disabilities have equal access to participate in, contribute to, and benefit from all university programs, classes and activities. Confidential, sensitive, and individualized services are provided free of charge, on a case-by-case basis.

Any student who believes s/he may need accommodations, based on the impact of a documented disability, should contact the DRC Office to speak privately with the Director of the DRC about specific needs. To make an appointment, please contact the DRC office at (702) 992-2180 or by email at `drc@nevadastate.edu`.

Veteran Concerns. If you are a veteran who is struggling academically or have concerns please contact the DRC office at (702) 992-2180 or by email at `drc@nevadastate.edu`.

Extracurricular Activities & Portfolio Guide

Portfolio

At the end of the semester, you will submit a portfolio containing the extracurricular activities you completed during the term. Your portfolio should begin with a one-paragraph narrative summarizing your activities, followed by the supporting materials or artifacts.

You must complete at least 3 activities of distinct types from the list and include them in your portfolio. Each activity is worth up to 5 points, for a total of 15 points.

Grading Scale

- 5 points: Complete activity with strong supporting artifact and clear narrative
- 4 points: Complete activity, but portfolio entry is missing part of the artifact or has a flawed narrative
- 3 points: Activity completed with minor flaws
- 2 points: Activity completed with major flaws
- 1 point: Attempt made (artifact or narrative present, but not both, or both incomplete).

If you complete more than 3 activities (of any type), each additional one may earn up to 1 extra point for effort, but the total portfolio grade is capped at 15 points.

Activities List

1. **MDS Club Activities.** Participate in at least two different kinds of Math & Data Science (MDS) Club events, such as Math Colloquium, Astronomy Night, or Tuesday Tea, and write brief reflections (1–2 paragraphs each) about your experiences. Announcements for upcoming MDS Club events will also be posted on Canvas.

2. **Reading Reflections.** Pick up a popular science book related to course content and write a reflection (about 1 page-long) explaining how specific topics discussed by the author connect to some of the mathematical ideas or applications of differential equations discussed in class. You do not have to have read the entire book to write your reflection. Below are suggested readings and chapters to focus:
   - *Firmament* by Simon Clark (focus on Ch. 7 "Forecast")
   - *Sync* by Steven Strogatz (focus on Ch. 7 "Synchronized Chaos")
   - *Infinite Powers* by Steven Strogatz (focus on Ch. 9 "The Logical Universe")
   - *Jet Stream* by Tim Woollings (focus on Ch. 13 "Drivers")
   - *Einstein's Clocks, Poincaré's Maps* by Peter Galison (focus on Ch. 2 "Coal, Chaos, and Convention")
   - *Chaos: Making a New Science* by James Gleick (focus on Ch. 1 "The Butterfly Effect")
   - *The Tipping Point* by Malcolm Gladwell (focus on Ch. 7 "Case Study: Suicide, Smoking, and the Search for the Unsticky Cigarette")

   Alternatively, you may select an academic journal article (available through the library or interlibrary loan) and write a detailed review that highlights its connections to our course material. Your review should also include the basic bibliographic information for the article. This exercise may serve as preparation for your Modeling Project (term paper). Suggested journals to consider are listed below:

- *Rose–Hulman Undergraduate Mathematics Journal* (https://scholar.rose-hulman.edu/rhumj/)
- *Chaos: An Interdisciplinary Journal of Nonlinear Science* (https://pubs.aip.org/aip/cha)
- *SIAM Journal on Applied Dynamical Systems*, *SIAM Undergraduate Research Online (SIURO)*
- *Physical Review E* (https://journals.aps.org/pre/)
- *CODEE Journal* (https://scholarship.claremont.edu/codee/)
- *Electronic Journal of Differential Equations* (https://ejde.math.txstate.edu)

In this activity, "review" means engaging in a careful, detailed reading and summary of the article. The goal is to explain the content clearly, not to judge whether the article is "good" or "bad." Some journal articles may go beyond the scope of this class or your current mathematical background. Do not get discouraged by this! If there are sections you do not fully understand, you may simply state that in your review and focus on the parts you do follow. Thoughtful explanation and connection to our course material are what will earn you full credit.

3. **SCUDEM Challenge.** Enter to win this international team competition! Key details:
   - You must form a team of three and register. Registration is already open and closes on Sat, Oct 18, 2025, which is when the Challenge Period starts.
   - Registered teams and coaches receive a free MATLAB license.
   - Your team must submit the final 10-minute video by 11:59pm EST on Nov 11, 2025
   - The lab assignments from this course will provide you with excellent fundamentals as you prepare for this challenge.

   Please let me know at your earliest opportunity if you want to form a team to take on this challenge. More information can be found at https://qubeshub.org/community/groups/scudem. The final 10-min video will serve as your supprting artifact for this activity.

4. ***MyFavProbs* Project.** Choose a homework problem (with all of its parts) and prepare a fully typeset solution, complete with figures and detailed explanations. Be sure to restate the problem before your solution so the document is self-contained. Alternatively, you may create a hypothetical[1] final exam problem based on material from the second half of the course (after the midterm), and provide a complete solution. Your document must be typeset in LaTeX.

5. **Creative Visualization.** Create a visual, computational, or artistic representation using software (Python, Octave, Manim, etc.; include code) or a hand-drawn infographic. Provide a brief explanation of what your visualization demonstrates. This option may also support your Modeling Project (term paper). Alternatively, write a short story (e.g., Laplace Transforms for Babies), poem, video, or other artistic piece inspired by a course concept (e.g., chaos, predator-prey dynamics, superposition). Include a short commentary linking your work back to the mathematics.

6. **The Notetaker.** Produce a detailed set of typeset course notes. Notes may be shared with classmates as study aids for the midterm. Your document must be typeset in LaTeX.

7. **Software Guru.** Explore a tool or package not covered in depth in class (e.g., R's deSolve, Python's SymPy, MATLAB's ODE suite, C++ libraries). Produce a short "cookbook" with at least one worked example.

[1] Hypothetical because this course does not have a final exam.

Course Schedule

All Dates are Subject to Change

Date	Agenda	Assigned	Due
Mon, Aug 25	D1. Overview, Syllabus		
Wed, Aug 27	D2. Separable eqns (1.1–1.3)	PS 1	
Mon, Sep 1	Labor Day		
Wed, Sep 3	D3. Integrating factors		
Mon, Sep 8	D4a. 2nd order ODEs I (2.1–2.2)	PS 2	PS 1
Wed, Sep 10	Lab 1a. Numerical methods (1)		
Mon, Sep 15	D4b. 2nd order ODEs II	PS 3	PS 2
Wed, Sep 17	Lab 1b. Numerical methods (2)		
Mon, Sep 22	D5. Mehanical vibrations I (2.3–2.4)		PS 3
Wed, Sep 24	Lab 1c. Numerical methods (3)		
Mon, Sep 29	D5. Mehanical vibrations II (2.3–2.4)	PS 4	
Wed, Oct 1	Lab 2a. Visualization and stability (1)		Lab 1
Mon, Oct 6	D6. High-order theory (2.5)	Final Proj	PS 4
Wed, Oct 8	Lab 2b. Visualization and stability (2)		
Mon, Oct 13	D7. System of Eqns (3.8–3.9)		Final Proj: Topics
Wed, Oct 15	Midterm Review		
Mon, Oct 20	Midterm Exam		
Wed, Oct 22	Lab 3a. Population dynamics (1)		Lab 2
Mon, Oct 27	D8. Laplace transform I	PS 6	Final Proj: Toy Model
Wed, Oct 29	Lab 3b. Population dynamics (2)		
Mon, Nov 3	D8b. Laplace transform II		
Wed, Nov 5	Lab 4a. Infectious disease modeling (1)		Final Proj: Data
Mon, Nov 10	D8b. Laplace transform III		PS 6
Wed, Nov 12	Lab 4b. Infectious disease modeling (2)		Lab 3
Mon, Nov 17	D9. Power series methods (7.1–7.3)		
Wed, Nov 19	Lab 4c. Infectious disease modeling (3)		
Mon, Nov 24	D10. Method of Frobenius		
Wed, Nov 26	Work on Final Proj, Catch Up Buffer		Final Proj: Draft
Mon, Dec 1	D11. Nonlinearity and chaos	PS 7	
Wed, Dec 3	D12a. PDE I		Lab 4
Mon, Dec 8	D12b. PDE II		Final Proj: Slides
Wed, Dec 10	Final Presentation		PS 7