

ERTH/OCN 312: Advanced Mathematics for Scientists & Engineers I ***Face-to-Face, Fall 2021***

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Prerequisites: MATH 242 or consent

Required Textbook: *Advanced Engineering Mathematics, 2nd Edition* by Michael. D. Greenberg

Through a combination of reading assignments, lectures, and practice both in class and out-of class, students will gain foundational skills in mathematical tools needed for future coursework and careers in science and engineering.

COURSE LEARNING OBJECTIVES:

- Become comfortable in applying mathematical operations commonly used to solve problems in calculus, vector calculus, and differential equations
- Develop familiarity in using computer programs (e.g., Matlab) for solving simple problems, visualizing data, and applying basic numerical methods
- Gain foundational knowledge needed to solve problems in future coursework leading to careers related to Earth Sciences, Ocean Sciences, Biology, and Engineering
- Be able to learn independently, solve problems creatively, and communicate math clearly and accurately

PROGRAMMATIC OBJECTIVES EMPHASIZED:

EARTH [student learning objectives:](#)

2. Students can apply technical knowledge of relevant computer applications, laboratory methods, field methods, and the supporting disciplines (math, physics, chemistry, biology) to solve real-world problems in geology and geophysics.

GES [student learning outcomes](#)

1. Define and explain the basic principles and concepts of chemistry, physics, biology, calculus, geology, geophysics, meteorology, and oceanography.
2. Apply their understanding of the fundamentals of science and mathematics to the description and quantification of the interactions of the atmosphere, hydrosphere, lithosphere, and biosphere, including humans.

Engineering [student learning outcomes:](#)

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to identify, formulate, and solve engineering problems
- An ability to communicate effectively

ACTIVE LEARNING FORMAT This is a "flipped" class. Lectures videos are to be viewed online *prior to class* to gain an overview of the key concepts and methods. Class will be used to cover questions, show example solutions, and to work on weekly homework assignments.

GRADING 10% class participation, 45% problem sets, 13% midterm 1, 13% midterm 2, 19% final.

WEEKLY PROBLEM SETS Reading will be reinforced by lectures and will provide background to do the problem sets. Weekly problem sets are due on Fridays at 3:30 p.m.

HONOR CODE AND CLASS CULTURE Our class culture will be built upon respectful, supportive, and honest interaction. You are encouraged to work together on your problem sets, but all work turned in for grading must be yours, and yours alone. Unless specifically designated, there will be no collaborations during exams. Cheating will not be tolerated. Blind copying of work will result in an automatic 0%. Everyone is responsible for upholding the EARTH/OCN 312 honor code.

Students are expected to uphold the University policy on conduct:

<http://www.hawaii.edu/policy/ep7.208>

GENERAL COURSE SYLLABUS

Introduction and Review

- Class Introduction
- Elementary functions: logarithms, exponentials, trigonometric
- Calculus: derivatives
- Calculus: integrals
- Taylor Series
- Functions of Multiple Variables and Partial derivatives
- Complex numbers and complex plain

Ordinary Differential Equations (ODEs)

- Coordinate Systems
- Introduction to ODEs and First-order ODEs
- Linear first-order ODEs
- Separable Equations
- Exact Equations and Integrating Factors
- Numerical Methods (Euler's method)
- Second-order ODEs
- Solution to Homogeneous Equation
- Application to Harmonic Oscillator
- Solution to Nonhomogeneous Equation

Matrices and Linear Algebra

- System of Linear Equations
- Matrices, Matrix Algebra, and Determinants
- Rank, Linear Dependence, and Solution to $\mathbf{Ax}=\mathbf{c}$
- Inverse Matrix and Cramer's Rule
- Linear Transformations, Change of Basis, Orthogonal Matrices
- Eigenvalue Problem

Vectors, Tensors, and Vector Calculus

- Diagonalization
- Vectors in 3D space
- Divergence
- Gradient, Curl, and combinations of the Grad operator
- Non-Cartesian Coordinates
- Double and triple integrals [§ 15.3]
- Divergence and Stokes theorems

DISABILITY ACCESS

Please feel free to talk to your instructor anytime about your performance in the course or possible ways you can improve. Excellent references are available on the web and there are support texts in the library and classroom. I encourage you to organize study groups with your fellow students. If you need disability-related accommodations, please notify the Office for Students with Disabilities (known as "Kokua"), located in the Queen Lili'uokalani Center for Student Services (Room 013). (808) 956-7511 E-mail: kokua@hawaii.edu <http://www.hawaii.edu/kokua/>

TITLE IX

The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX

Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the **confidential resources available here:** <http://www.manoa.hawaii.edu/titleix/resources.html#confidential>

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Uwono Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.