Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: MATH
Course and Section #: 4620-002
Course Title: Numerical Analysis II
Credits: 4

Course Description

Topics will include numerical solutions of initial-value problems and boundary-value problems for ordinary differential equations, numerical solutions to partial differential equations and nonlinear systems of equations, approximating eigenvalues.

Course Attributes

This course has the following attributes:
☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☒ Elective Core Requirements in Program
☐ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Dr. Harish Bhatt

Student Learning Outcomes

Upon successful completion, students should be able to:

1. Compute the numerical approximation of the IVP for ODE
2. Find the numerical approximation of the BVP for ODE
3. Approximate eigenvalues and vectors
4. Compute the numerical solution of the nonlinear system of equations
5. Find the numerical solutions to partial differential equations

Course Materials and Texts

1. Textbook: Numerical Analysis 10th edition - by Richard Burden, Douglas Faires and Annette Burden Author's companion website **Numerical Analysis 1 Burden (http ://sites.google.com/site/numericalanalysis1burden)**
2. MATLAB **(https://www.mathworks.com/academia/tah-portal/utah-valley-university-31508419.html)**
3. Laptop

Course Requirements

Course Assignments, Assessments, and Grading Policy

- Homework (40% of the overall grade)
- One Midterm Exam (20% of the overall grade)
- Class Participation (5% of the overall grade)
- Project (10% of the overall grade)
- Final Exam (25% of the overall grade)

General Description of the Subject Matter of Each Lecture or Discussion

Syllabus, Review of Prerequisites

Chapter 5: Initial-Value Problems for Ordinary Differential Equations

- 1: The Elementary Theory of IVP
- 2: Euler's Method
- 3: Higher-Order Taylor Methods
- 4: Runge-Kutta Methods
- 6: Multistep Methods
- 9: Higher-Order Equations and Systems of Differential Equations
- 10: Stability
- 11: Stiff Differential Equations

Chapter 9: Approximating Eigenvalues

- 1: Linear Algebra and Eigenvalues
- 2: Orthogonal Matrices and Similarity Transformations
- 3: The Power Method
- 4: Householder's Method
- 5: The QR Algorithm
- 6: Single Value Decomposition

Chapter 10: Numerical Solutions of Nonlinear Systems of Equations

- 1: Fixed Points for Functions of Several Variables
- 2: Newton's Method

Chapter 11: Boundary-Value Problems for Ordinary Differential Equations

- 1: The Linear Shooting Method
- 2: The Shooting Method for Nonlinear Problems
- 3: Finite Difference Methods for Linear Problems
- 4: Finite Difference Methods for Nonlinear Problems
- 5: The Rayleigh-Ritz Method

Chapter 12: Numerical Solutions to Partial Differential Equations

- 1: Elliptic Partial Differential Equations
- 2: Parabolic Partial Differential Equations
- 3: Hyperbolic Partial Differential Equations

Required Course Syllabus Statements

Generative AI

In this course, you can optimize your learning experience with the help of AI tools like **Wolfram Alpha (https://www.wolframalpha.com/)**, **Symbolab (https://www.symbolab.com/)** , **Khanmingo (https://www.khanmigo.ai/)** , and **thetawise (https://thetawise.ai/chat)** . With Wolfram Alpha, access computational knowledge to solve complex mathematical problems and generate step-by-step solutions. Symbolab provides interactive step-by-step solutions, aiding in understanding problem-solving processes. Khanmingo offers personalized practice exercises and video lessons tailored to your needs, while thetawise utilizes adaptive learning algorithms to provide personalized tutoring sessions and practice materials. These tools collectively support your problem-solving skills, and overall success in your math coursework.

However, you should note that the material generated by these tools may be inaccurate, incomplete, or otherwise problematic. For example, an AI tool might incorrectly simplify a complex trigonometric identity, leading to a wrong solution. Additionally, relying too much on AI may inhibit your own independent thinking and creativity, potentially hindering your overall learning and understanding of mathematical concepts, so use it thoughtfully to enhance rather than replace your learning process.

Using Remote Testing Software

☒ This course does not use remote testing software.

Exams: There is one midterm exam and one final exam (not comprehensive), both of which will be

take-home, open-book, and open notes (but only the course textbook and your own notes). Failure to take (or turn in) a final exam will result in a failing grade for the course, regardless of other grades. Exam dates will be announced at least one week in advance, but a tentative exam schedule is given in the Table above.

Note: In general, there are no makeup tests. If you miss a test and you do not have an excellent WRITTEN excuse (from a doctor, for example), you will get a zero on the test. In the rare event that a makeup test is given, the makeup test may be more difficult than the original test.

☐ This course uses remote testing software.

Discussion

Students are encouraged to regularly attend class and actively participate in group discussions while solving assigned problems. Class participation accounts for 5% of the overall grade.

Projects:

There will be projects related to real-world applications that account for 10% of the total grade.

Homework Problems

Homework assignments will be weekly or semi-monthly, but they will take considerable time to complete. They will be a mixture of theory, applications, and coding. Late homework will be penalized. Solutions should be clearly labeled and in order. Make sure any handwritten exercises are legible and show your work. Collaboration is encouraged, but you must submit your own assignment. Everything you turn in should be in your own words and you should thoroughly understand everything you write down. For coding assignments, you can take help from the codes provided by the authors, but you need to write your own codes. Submission of the exact codes provided by the authors' will receive zero points. Also, late submissions will not be accepted in the normal situation.

Instructions for Online Assignment Submission:

Prepare your answers:

- Solve problems on scratch paper, clean up your steps, and write your answers clearly on white/ruled papers. Answers without steps will not receive zero points.
- Label the number of each problem.
- Sort your answers in the same order as in the announced problem list.

Prepare a PDF version of your homework:

- If you typed your homework in LaTeX or wrote your homework in a note-taking app, then directly export it as a single PDF.
- If you wrote your homework on traditional papers, then you need to scan your homework into a single PDF file. You can use ClearScanner or any similar apps to scan and crop it properly. Grading is based on the scan only, so make the quality as good as possible.

- If computer programming is involved, you need to upload the executable codes and output PDF into the same homework folder (MATLAB and Python editors can print code and output as PDFs directly).
- You can only upload a single PDF. So, you may use the **online tool (https://pdfjoiner.com/)** to combine your written solution and the output PDFs into one.

Instruction for online submission:

- Rename the PDF by your UVID number. For example, if your ID is 123-45678, then name your file as 12345678.pdf.
- Homework must be submitted on **Canvas (https://icollege.gsu.edu/)** . After you click on the course page on Canvas, click on "Assignment" tab. Submit your PDF file to the folder labeled by the homework number. This folder is open for submission until the due time.
- You can update your submission any time before it's due. Only the last PDF you upload will be kept in the system. Double-check what you uploaded. The grading is completely based on it.
- Homework sent to the instructor's email will not be graded.

- **Note:** Submissions not complying with all rules above will not be accepted or graded at the instructor's discretion. In this case, the student receives zero points for the assignment (no resubmission accepted). No exceptions.

Required University Syllabus Statements

Accommodations/Students with Disabilities
Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Definitions and Examples:

Definition: Academic integrity is a basic principle which requires that students take credit only for ideas and efforts that are their own. Cheating, plagiarism, fabrication, and other forms of academic dishonesty are often defined as the submission of materials in assignments, exams, or other academic work that is based on sources that are prohibited by the faculty member or in ways that do not properly cite the source of a student's ideas and content. Further information on what constitutes academic dishonesty is detailed in**UVU Policy 541: *Student Code of Conduct* (https://policy.uvu.edu/getDisplayFile/5bedd0ef7b23736d542192e3)** .

Definition: The act of using or attempting to use or providing others with unauthorized information, materials or study aids in academic work. Cheating includes, but is not limited to, passing examination answers to or taking examinations for someone else, or preparing or copying others' academic work.

Examples include but are not limited to:

- Submission of work that is not the student's own for papers, assignments or exams.
- Submission or use of falsified data.
- Theft of or unauthorized access to an exam.
- Use of an alternate, stand-in or proxy during an examination.
- Use of unauthorized material including textbooks, notes or computer programs in the preparation of an assignment or during an examination.

- Supplying or communicating in any way unauthorized information to a "homework help site" such as CourseHero or to another student in the preparation of an assignment or during an examination.
- Collaboration in the preparation of an assignment. Unless specifically permitted or required by the instructor, collaboration will usually be viewed by the university as cheating. Each student, therefore, is responsible for understanding the policies of the department offering any course as they refer to the amount of help and collaboration permitted in preparation of assignments. Submission of the same work for credit in two courses without obtaining the permission of the instructors beforehand.

Definition: Plagiarism is the act of presenting another person's ideas, research or writing as your own.

Examples include but are not limited to:

- Using another person's exact language without the use of quotation marks and proper citation.
- Rearranging another's ideas or material and presenting them as original work without providing proper citation. Submitting another's work as one's own; this includes purchasing work from sources such as the internet.
- Submitting a translation of someone else's words claiming them as one's own Failing to acknowledge collaborators on homework and laboratory assignments.
- Duplicating or submitting work that was originally prepared for another class without the explicit permission of the instructor; or knowingly aiding another student who is engaged in plagiarism.

Resources: Citation guide (https://uvu.libguides.com/citations)

Definition: The use of invented information or the falsification of research or other findings.
Examples include but are not limited to:

- Citation of information not taken from the source indicated. This may include the incorrect documentation of secondary source materials.
- Listing sources in a bibliography not used in the academic exercise.
- Submission in a paper, thesis, lab report or other academic exercise of falsified, invented, or fictitious data or evidence, or deliberate and knowing concealment or distortion of the true nature, origin, or function of such data or evidence.
- Submitting as your own any academic exercise, (e.g., written work, printing, sculpture, etc.) prepared totally or in part by another.

Equity and Title IX
Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation
UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.
To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.

General Disclaimer

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.