# ENGR 240: Applied Numerical Methods

# Syllabus Spring 2021

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building #4 office #210

Credits: 5

Class Time: TBD, & Canvas online classroom

Office Hours:

***NWIC MISSION STATEMENT***

*Through education, Northwest Indian College promotes   
Indigenous self-determination and knowledge*

**Course Prerequisites:** ENGR 110

# Required Text

None.

# Course Description

Explores numerical solutions to problems in engineering and science using modern scientific computing tools. Focusing on the development of mathematical judgment in selecting and applying computational algorithms and communicating results. Introduces MATLAB programming for numerical computation.

# Course Outcomes

# At the completion of this course students will be able to:

1. Write and document MATLAB code with logical and iterative flow control and file input and output
2. Utilize vector/matrix paradigm in MATLAB to write commands to manipulate data and implement numerical solution algorithms
3. Produce plots of numerical data using MATLAB's various data visualization functions
4. Describe the consequences of finite precision and the inherent limits of the numerical methods
5. Select and apply appropriate numerical methods to problems in engineering using algorithms, accuracy requirements, and available computational resources

# NWIC Institutional Outcomes

1. Effectively communicate in diverse situations, from receiving to expressing information, both verbally and non-verbally

1. Meet the technological challenges of a modern world
2. Work cooperatively toward a common goal

**Course Requirements and Expectations**

Students who have a valid issue that prevents them from attending class need to notify the instructor prior to the start of class, email messaging is preferred but phone message is acceptable. It is understood in some situations an absence will be unavoidable. In those situations students will be given the opportunity to make up attendance and participation by watching recordings of the class session that has been missed. Embedded in the recorded class session will be participation questions. If those questions are answered and submitted to the instructor within 1 week of the scheduled class session, attendance and participation points will be awarded based on the agreement reached between student and instructor.

Any exceptions to this attendance policy must be approved by the Department Chair and the instructor in writing before the start of the quarter.

***It will not be possible to earn a passing grade if a student misses more than 30% of this class without notifying the instructor.***

**Evaluation & Assessment**

|  |  |
| --- | --- |
| Class Preparation and Participation | 10% |
| Projects | 10% |
| Programming Assignments | 30% |
| Midterms | 30% |
| Final Exam | 20% |

Grading will be on a percentage system as detailed below:

* 1. Class Preparation and Participation – Classroom lecture, discussion, worksheets, and demonstrations will build on the content in the lecture and videos, explore student questions, and provide some additional programming examples. You should study relevant videos BEFORE the associated class session so you come to class prepared. weight – 10%
  2. Projects: Four two-week projects will involve deeper exploration of some of the numerical methods cover along with figure design and interpretation of results. Projects will be more open-ended than the weekly programming assignments and involve synthesis of course concepts and skills from throughout the quarter. You will present project work in short reports that include graphs of your results along with narrative interpretation and some reflection. ***You may work individually or with one other student on each project.*** weight – 10%
  3. Programming Assignments: Weekly programming assignments will draw primarily on the material presented in the lecture videos, but may also require you to figure some things out on your own (with questions to other students and the instructor strongly encouraged). ***Gaining confidence and skill in figuring out how to use a software tool in a way that has not been exactly demonstrated is one of the goals of this class. There is no way to show you everything that you can do with MATLAB, so the goal is to empower you to explore and experiment as you work through course assignments, with questions along the way strongly encouraged.***  weight – 30%
  4. Midterm Exams – There will be 2 midterm exams throughout the quarter – see Canvas for expected dates. No makeups will be allowed without prior permission given by instructor. weight – 30%
  5. Final Exam – Comprehensive exam at the end of the quarter. No makeups will be allowed without prior permission given by instructor. weight – 20%

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# Course and Assignment Schedule:

|  |  |
| --- | --- |
| Tentative Schedule | |
| **Week** | **Topics** |
| 1/3 | Intro to Mathematical Models  Scientific Computing  MATLAB Fundamentals |
| 1/8 | Structured Programming (loops and logic)  User-Defined Functions  Measures of Numerical Error |
| 1/15 | More sophisticated programming  Roots problems (nonlinear equations) |
| 1/22 | Computer Precision and Round-off Error  Linear Systems of Equations  Gauss Elimination  LU Factorization  MATLAB left division  Gauss-Seidel |
| 1/29 | Nonlinear Systems of Algebraic Equations  Curve Fitting Algorithms |
| 2/5 | **Exam 1 Tuesday**  Polynomial Interpolation  LaGrange Polynomials  Splines |
| 2/12 | Numerical Integration  Numerical Differentiation  Truncation Error |
| 2/19 | Ordinary Differential Equations (ODEs)  Initial Value Problems (IVPs)  Basic One Step Methods  Systems of ODEs |
| 2/26 | **Exam 2 Tuesday**  Runge-Kutta Methods  Multi-Step Methods  Stiff Systems of ODEs  Adaptive Methods |
| 3/5 | Boundary Value Problems (BVPs)  Shooting Method  Finite Difference Method |
| 3/19 | **Final Exam Thursday** |

**Instructor(s) Discretion:**

Should it be deemed necessary, the instructor(s) of this course reserves the right to make alterations, at any time, to the course materials or what is contained within this syllabus in order to improve the course itself, the learning environment or the opportunity for student success. If such a change is made, it will be made in a timely manner so as not to impede the learning process or interfere, in any way, with student success.