EECE 4694 - Numerical Methods and Computer Applications

Textbook:	(*Optional*) **Numerical and Analytical Methods with MATLAB for Electrical Engineers, 1st edition, © 2012** Author: *William Bober and Andrew Stevens*, Publisher: *CRC Press*, ISBN- 10: 1439854297 / ISBN- 13: 978-1439854297 **Note:** *NEU Library has an e-book copy of the textbook as well*
	(Other Reference) **Numerical Methods for Engineers**, Raymond P. Canale and Steven C. Chapra, any edition from 3rd to 7th, McGraw-Hill, ISBN-13: 978-0073401065
Software:	Matlab can be downloaded from the Northeastern.edu website: [MATLAB Download - Northeastern Portal]()
Prerequisite:	MATH 2341. Differential Equations and Linear Algebra for Engineering, or permission from the instructor

Course Description and Overview: This course presents numerical techniques used in solving scientific and engineering problems with the aid of digital computers. The course offers a clear understanding of the ideas and techniques underlying the numerical algorithms, and pitfalls encountered when performing numerical operations on computational systems.

Topics include numerical solutions of linear as well as nonlinear systems of equations; the theory of numerical integration and differentiation; numerical solution of ordinary differential equations; theory of interpolation; the theory of least squares; and numerical optimization techniques. The course emphasizes algorithm development, implementation with MATLAB and Python, and practical applications in the areas of electrical and computer engineering.

Assessment and Grading:

- **Homework** consisting of math problems, short answer questions, and programing exercises in MATLAB or Python will be assigned weekly and should be completed individually. Late homework may be turned in up to two days later with a 20% late penalty.

- There will be two larger **design and programming projects** which are more programming intensive.

- The course has two **midterm exams** and a **final exam**. The exams will be administered in class and will be closed book and closed notes.

- Grading will follow approximately the divisions shown below:

Homework	25%
Midterm Exams x2	30%
Project Assignments x2	20%
Final Exam	25%

Your numerical semester grade is converted to a letter grade based on the following scale (your numerical grade is rounded up to the nearest percent):

93%-100% = A   90%-92% = A-   87%-89% = B+   83%-86% = B   80%-82% = B-   77%-79% = C+
73%-76% = C   70%-72% = C-   67%-69% = D+   63%-66% = D   60%-62% = D-   range < 59% = F

Course Policies

Attendance and Punctuality

Attendance to lecture sessions in-person is highly recommended to fully participate in class activities and exercises. Please use the course textbooks also to read through the topics presented in class.

Punctuality in the classroom is indispensable and constitutes a basic rule of respect toward your classmates and your instructor.

Computing and Course Resources
This course will use the Northeastern University Canvas Course Management System accessible through MyNortheastern or by going to https://canvas.northeastern.edu/, Check the course site regularly for class materials and additional resources.

Course Topics:
Unit 1 - Basics of Matlab and Matrix Operations – Ch2
- Review of MATLAB
- Review of Matrices and Matrix operation
    - Addition/Subtraction of Matrices
    - Multiplication of Matrices
    - Element-wise operations
    - Determinant
    - Triangular Matrices

Unit 2 - Review of Linear Algebra – Ch3
- Systems of linear equations
- Gauss elimination
- Gauss Elimination with Partial Pivoting
- Inverse Matrix and PLU Decomposition

Unit 3 - Numerical Integration – Ch5
- Trapezoidal Rule
- Simpson's Rule (1/3 & 3/8 Rules)
- Romberg Integration
- Adaptive Quadrature
- Gaussian Quadrature

Unit 4 - Ordinary Differential Equations (ODE) – Ch6
- Initial value problems
- Euler and Modified Euler formulas
- Runge-Kutta methods First order and Second order
- Boundary value problems
- Finite differences and gradients

Unit 5 - Interpolation and Curve Fitting – Ch9
- Least-Squares Regression
    - Linear functions
    - Polynomial functions
    - Nonlinear functions
- Interpolation
    - Newton's Divided Difference Polynomials
    - Lagrange Polynomials
    - Splines Interpolation

Unit 6 - Optimization – Ch10
- Unconstrained Optimization
    - Golden section search
    - Gradient descent methods
    - Newton's method
- Constrained optimization: Linear Programming
    - Graphical solutions
    - The simplex method
    - Lagrange multipliers
    - Interior-point methods

Accommodations for Disabilities:
Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify to participate fully in the activities of the university. Students with documented disabilities who may need accommodations, or any student considering obtaining documentation should visit the DRC website at www.northeastern.edu/drc or contact their staff at 617.373.2675.

Statement on Academic Integrity:
A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The Academic Integrity Policy can be found in the undergraduate student handbook (pages 38-41), or from the Office of Student Conduct & Conflict Resolution (OSCCR) http://www.northeastern.edu/osccr/academic-integrity-policy/. I encourage you to familiarize yourself with it. If a student violates this policy in any way, I reserve the right to impose a sanction of failure on the assignment/assessment or failure in the course. If you have questions about appropriate citations, please ask.

Have fun and learn something new…!