SYLLABUS

MEC 320: Numerical Methods in Engineering Design and Analysis

Spring 2022 (SBU)

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Class Time and Location: Tu, Th: 11:30 AM – 12:50 PM (In-Person, EARTH&SPACE 001 WESTCAMPUS)

Instructor: Professor Foluso Ladeinde **Office Location:** Heavy 224

Preferred E-mail Address: foluso.ladeinde@stonybrook.edu

Instructor Office Hours (Tentative): Tu, Th: 4:30 – 6:00 PM

https://stonybrook.zoom.us/j/93825171557?pwd=Um5lNC9walJwaWxLMlRYZUR1bG91Zz09
Meeting ID: 938 2517 1557
Passcode: 604246

TAs: HyeJin Oh **TA Office Hours**: TBD

Credits: 3

Pre-requisites: MEC 102 or CSE 114 or CSE 130 or ESG 111 or ESE 124; AMS 261 or MAT 203; AMS 361 or MAT 303.

Textbook: 1. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw-Hill, Eighth Edition
2. Lecture notes on Optimum Design

Course Description:

This course emphasizes the implementation of numerical methods for computer-aided solutions to problems that arise in engineering design and analysis. Methods include interpolation, extrapolation, curve fitting, and integration and techniques for solving non-linear equations, systems of linear equations, and differential equations. Optimization in engineering design is covered from the formulation of design specifications and criteria to analyzable models, through to numerical implementation. (3 credits)

Revised Schedule (Subject to Change):

Week	Description	Date	Chapters	Programming Assignments
Week 1	Introduction: Modeling, Computers, Programming/Software, Taylor Series, and Error Analysis	1/24-1/28	1,3,4 Other Refs.	
Week 2	Roots of Non-Linear Equations	1/31-2/4	5	
Week 3	Roots of Non-Linear Equations	2/7-2/11	6	

Week 4	System of Linear Algebraic Equations	2/14-2/18	9	1: Root Finding
Week 5	System of Linear Algebraic Equations	2/21–2/25	9, 10	
Week 6	System of Linear Algebraic Equations	2/28 - 3/4	10,11, Other Sources	
Week 7	Optimization	3/7 - 3/11	13…14	
Week 8	**SPRING BREAK**	**3/14-3/18**		
Week 9	Optimization	3/21 - 3/25		2: Optimization
Week 10	Optimization	3/28 - 4/1	14…15	
Week 11	Optimization, Curve-Fitting	4/4-4/8	14…15; 17	
Week 12	Curve Fitting	4/11 - 4/15	17…19	
Week 13	Numerical Integration	4/18 - 4/22	21…22	3: Integration & Differentiation
Week 14	Numerical Integration, Differentiation of PDEs, ODEs	4/25 - 4/29	22…24;25	
Week 15	ODEs, Review of Course End of Classes May 7 (Saturday)	5/2 – 5/6	25.	
Weeks 16/17	Finals May 10 – 18 Commencement 5/20 (Friday)			

Copyright Statement: Lecture notes, video recordings, examinations, homework problems and their solutions, and other items shared with you in the course of lecture delivery – be it in-person or online - constitute intellectual properties (IPs). Therefore, sharing these materials in any shape or form without a signed, written permission from me (Professor Foluso Ladeinde) constitute infringement for which a legal recourse is available in the court of law. This option will be exercised in the event of an IP infringement.

Course Rules:

- You will need to learn to use Blackboard and Zoom. Please visit SBU's DoIT to do this: https://sites.google.com/stonybrook.edu/keeplearning
- Please keep abreast of class announcements, which would come from emails and/or Blackboard
- Office Hours is primarily via Zoom at the link below. However, you are more than welcome to schedule in-person meetings with me during office hours.

https://stonybrook.zoom.us/j/93825171557?pwd=Um5lNC9walJwaWxLMlRYZUR1bG91Zz09
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Homework: Approximately two homework assignments every three weeks.
Homework will be due one week after it is assigned.
Late homework will receive half credit before the solutions are posted and will not be accepted after that.

Exams: Midterm exams will be scheduled in-person.
No makeup exam unless arranged prior to the exam.

Grading Scale: Will grade on a curve

Revised Grading Scheme (Subject to Change):

Midterm I: 15%
Midterm II: 15%
Final: 25% (Comprehensive)
Homework: 10%
Programming Assignments: 30% (MATLAB)
Attendance: 5%

Homework and exams are to be done individually. Homework must be neat and orderly so that your work can be followed clearly. Solutions which are not clearly written and easy to follow (based on the judgment of the instructor) will not be graded.

Student Accessibility Support Center Statement
If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.
Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities

Academic Integrity Statement
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and

Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Until/unless the latest COVID guidance is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.

Allowed Calculators

Following the Mechanical Engineering Department's mandatory calculator policy, **only** the following calculators will be allowed to be used on the midterm and final exams. There will be no exceptions. This list of calculators is identical to that allowed for the *National Council for Examiners for Engineering and Surveying* (NCEES) Fundamentals of Engineering (FE) exam that many of you will take in your senior year, as well as the Professional Engineering (PE) exam that you may take several years from now. The sooner you become comfortable on one of these calculators, the better. If you have any questions on this policy please feel free to contact me. The NCEES policy on calculators can be found here: http://www.ncees.org/exams/calculators/ .

Casio:	All **fx-115** models. Any Casio calculator must contain **fx-115** in its model name.
Hewlett Packard:	The **HP 33s** and **HP 35s** models, but no others.
Texas Instruments:	All **TI-30X** and **TI-36X** models. Any Texas Instruments calculator must contain either **TI-30X** or **TI-36X** in its model name.

Make-up classes:

In the event that, for any reasons, I am not able to attend one or more of our regularly scheduled classes, as is the case when I go to conferences or attend to urgent family issues, I will make all efforts to get a substitute who is competent in teaching this course. Otherwise, I will make up missed classes at a mutually convenient time. I will announce suggested make up times well in advance, and make sure that they are reasonable for everyone.

MEC 320: Numerical Methods in Engineering Design and Analysis	
Credits: 3	Contact Hours: 3 hour lectures per week
LEAD COORDINATOR: TBD	**TEXTBOOK:** Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw-Hill, Seventh Edition or Latest Edition **SUPPLEMENTAL MATERIAL:** Lecture notes on optimum design
BULLETIN DESCRIPTION: This course emphasizes the implementation of numerical methods for computer-aided solutions to problems that arise in engineering design and analysis. Methods include interpolation, extrapolation, curve fitting, and integration and techniques solving non-linear equations, systems of linear equations, and differential equations. Optimization in engineering design is covered from the formulation of design specifications and criteria, to analyzable models, through to numerical implementation.	
PREREQUISITES: MEC 102, MAT 203, MAT 303	**THIS COURSE IS** Required

COURSE LEARNING OBJECTIVES	**PIs**	**ASSESSMENT TOOLS**
1. Be able to numerically find roots of nonlinear scalar equations	1a	Exams and Programming Assignments
2. Be able to numerically solve systems of linear algebraic eqns.	1a	Exams and Programming Assignments
3. Be able to interpolate and extrapolate a data set	1a	Exams and Programming Assignments
4. Be able to differentiate and integrate numerically	1a	Exams and Programming Assignments
5. Be able to pose and understand the nature of an optimal design problem	1c	Exams and Programming Assignments
6. Be able to solve unconstrained and constrained optimization problems numerically.	1d	Exams and Programming Assignments
7. Be able to find numerical solutions of two-point BVP's	2e	Exams and Programming Assignments
8. Be able to find numerical integrations of ODE IVP's	2e	Exams and Programming Assignments.
9. Be able to use methods of curve fitting	2e	Exams and Programming Assignments

STUDENT OUTCOMES SUPPORTED	1	2	3	4	5	6	7
	3	2					
	3 – Strongly supported 2 – Supported 1 – Minimally supported						

COURSE TOPICS

1. Introduction: Modeling, Computers, Programming/Software, and Error Analysis
2. Roots of Non-Linear Scalar Equations
3. Systems of Linear Algebraic Equations using direct and iterative methods
4. Interpolation (Lagrange and Newton Polynomials); Richardson extrapolation
5. Numerical Differentiation and Integration Methods
6. Introduction to Optimum Design
7. Numerical Methods for Optimization, Constrained Optimization, Linear Programming
8. Numerical Solutions of two-point BVP's by finite difference & shooting
9. Numerical Solutions of IVP's (ODE's), R-K & predictor corrector