SYLLABUS

MEC 320: Numerical Methods in Engineering Design and Analysis

Spring 2021 (SBU)

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Class Time and Location: Tu, Th: 11:30 AM – 12:50 PM (ZOOM Meeting ID: 974 5926 1149 Passcode: 299275)

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

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

Instructor Office Hours (Tentative): Tu, Th: 1:00 – 2:30 PM (ZOOM Meeting ID: 950 8281 4887, Passcode: 583428)

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.

Schedule (Subject to Change):

Week	Description	Date	Chapters	Programming Assignments
Week 1	Introduction: Modeling, Computers, Programming/Software, and Error Analysis	2/1-2/5	1,3,4	
Week 2	Roots of Non-Linear Equations	2/8-2/12	5	
Week 3	Roots of Non-Linear Equations	2/15-2/19	6	
Week 4	System of Linear Algebraic Equations	2/22-2/26	9	1: Root Finding
Week 5	System of Linear Algebraic	3/1 - 3/5	9, 10	

	Equations			
Week 6	System of Linear Algebraic Equations	3/8 - 3/12	10,11, Other Sources	
Week 7	Optimization	3/15 - 3/19	13…14	
Week 8	Optimization Midterm: March 25 (Thursday)	3/22 - 3/26		2: Optimization
Week 9	Accommodation – No Classes	3/29 - 4/4		
Week 10	Optimization, Curve-Fitting	4/5-4/9	14…15; 17	
Week 11	Curve Fitting	4/12 - 4/16	17…19	
Week 12	Numerical Integration and Differentiation	4/19 - 4/23	21…22	3: Integration & Differentiation
Week 13	Numerical Integration and Differentiation, ODEs	4/26 - 4/30	22…24;25	
Week 14	ODEs, Review of Course End of Classes May 8 (Saturday)	5/3 – 5/7	25.	
Weeks 15/16	Finals May 11 – 19 Final Exam in MEC 320: Tuesday, May 18, 11:15 AM – 1:45 PM Commencement 5/21 (Friday)			

Online Class Delivery Requirements:

Online Live Lectures: All classes in this course will be delivered online as a precaution against infection by the coronavirus. **The online classes will be scheduled during the regular class time originally allocated for the course by the university at the beginning of the semester.**

The classes will be delivered in Zoom Web Conferencing software package. The meeting ID and password needed for you to participate will be contained in the invitations.

Assignments, lecture notes, and other course materials will be emailed to you or uploaded to Blackboard

If you experience any technical difficulties that could prevent you from attending the online meetings, please contact the TAs for this course or DoIT. DoIT can be reached by calling (631) 632-9800. The contact emails for the TAs have been given to you in prior communications from me.

Assignments will be posted on Blackboard. You should submit your solutions electronically via Blackboard. You will be taking an online final exam, in either structured or Take-Home format. Details will be provided to you in due course of time.

In summary:

a) I will deliver the lectures online using the Zoom web conferencing software package. Please see the meeting ID and passcode above
b) I will use a whiteboard to display lecture contents and write on the board as I would in a conventional class
c) I will deliver the lectures exactly at the scheduled times for the course
d) I will try to record the lectures in Zoom, as backup, and for the benefit of students who might not be able to attend class. However, students are required to attend class, not only because of the nature of the subject matter of the course, but also because, for technology-related reasons, I cannot guarantee that the lectures will be successfully recorded and available to students
e) Office hours will be conducted using Zoom. Please see the meeting ID and passcode above
f) Exams will either be take-home (sent by email/Blackboard and student solutions collected via email/Blackboard) or via Blackboard, with/without Respondus. Details will be communicated to students during the semester

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:

- Participation in the online live class meetings is required.
- 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

Homework: Approximately one homework assignment per week or fewer.
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: All exams will be scheduled as described above
No makeup exam unless arranged prior to the exam.

Grading Scale: Will grade on a curve

Revised Grading Scheme (Subject to Change):

Midterm: 25%
Final: 30% (Comprehensive)
Homework: 10%
Programming Assignments: 30% (MATLAB)
Attendance: 5% (Based on the Last Day of In-Person Class)

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.

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, Eighth 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 10. Curve-Fitting (Least Squares & Fourier Approximations) 11. Applications to Engineering Systems

Important Statement about Absences (New)

Students are expected to attend every class, report for examinations, and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or labs, the student is responsible for reviewing recorded lectures and/or seek notes from a classmate. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click here.

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 University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

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.