

# MEC 320: Numerical Methods in Engineering Design and Analysis

## Course Syllabus (Spring 2019)

### Course Information

**Time:** Tuesdays and Thursdays: 11:30AM – 12:50 PM

**Location:** Frey 102

**Credits:** 3

**Pre-requisites:** 1) MEC 102 or MEC 111 or MEC 112 or CSE 114 or CSE 130 or 130 or ESG 111 or ESE 124 or BME 120, 2) AMS 261 or MAT 203, 3) AMS 361 or MAT 303

**Book:** Numerical Methods for Engineers by Steven C. Chapra, 7<sup>th</sup> edition, REQUIRED WITH MCGRAW-HILL CONNECT ACCESS

**Description:** This course emphasizes the implementation of numerical methods for computer-aided solutions to the 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.

**Grading:** 9 HW Assignments: 12%  
Attendance: 5%  
6 Programming Assignments: 35%  
Midterm I: 12%  
Midterm II: 12%  
Final Exam: 24%

**Statement on Academic Dishonesty:** Academic dishonesty is an extremely serious offense and will not be tolerated in any form. Academic dishonesty in general is the presentation of intellectual work that is not originally yours. Examples include, but are not limited to, copying or

### Instructor Information

**Name:** Professor Benjamin Lawler

**Office Location:** Light Engineering 131

**E-mail:** benjamin.lawler@stonybrook.edu

**Office Hours:** Tue & Thu 1:00 PM – 3:00 PM

**TA Office Hours:** Location: Light Eng. 158

John Gandolfo: Tue & Thu Wed 9:00 – 11:00 AM

Graduate TAs: Mon 10:00AM – Noon

Mozhgan Rahimi Boldaji and Ziming Yan

Lecture				Assignment # Due	
#	Date	Description	Chapters	HW	Programming
1	1/29/2019	Intro, Syllabus, and Motivation	1 & 3		
2	1/31/2019	Error and the Taylor Series	4		
3	2/5/2019	Root Finding	5		
4	2/7/2019	Root Finding	5...6	1	
5	2/12/2019	Root Finding	6		
6	2/14/2019	Root Finding	4...6	2	
7	2/19/2019	Linear Algebraic Equations	9		1: Root Finding
8	2/21/2019	Linear Algebraic Equations	9...10		
9	2/26/2019	Linear Algebraic Equations	10	3	
10	2/28/2019	Linear Algebraic Equations	11		
	3/3/2019	Not a Lecture Day		4	2: Algebraic Eq.
	3/5/2019	Midterm I			
11	3/7/2019	Optimization	13		
12	3/12/2019	Optimization	14		
13	3/14/2019	Optimization	15		
	3/19/2019	Spring Break			
	3/21/2019				
14	3/26/2019	Curve Fitting, Interp., & Fourier	17		
15	3/28/2019	Curve Fitting, Interp., & Fourier	17...18	5	3: Optimization
16	4/2/2019	Curve Fitting, Interp., & Fourier	18		
17	4/4/2019	Curve Fitting, Interp., & Fourier	19		
18	4/9/2019	Flex Day - Review		6	4: Curve Fiting
	4/11/2019	Midterm II			
19	4/16/2019	Numerical Integr. & Differ.	21		
20	4/18/2019	Numerical Integr. & Differ.	21...22		
21	4/23/2019	Numerical Integr. & Differ.	22...23		
22	4/25/2019	ODEs and Intro to Finite Element	25	7	5: Integr. & Differ.
23	4/30/2019	ODEs and Intro to Finite Element	25...26		
24	5/2/2019	ODEs and Intro to Finite Element	26...27	8	
25	5/7/2019	ODEs and Intro to Finite Element	27		
26	5/9/2019	Review		9	6: ODEs
	5/21/2019	Final Exam: 11:15 PM to 1:45 PM Location: TBD			

plagiarizing class assignments including homework, reports, designs, and other submitted materials; copying or otherwise communicating answers on exams with other students; bringing unapproved aids, either in physical (written) or electronic form to an exam; obtaining copies of an exam prior to its administration, etc. Academic dishonesty violates both the ethical and moral standards of the Engineering profession and all infractions related to academic dishonesty will be prosecuted to the fullest via the CEAS CASA committee. For you, the honest student, academic dishonesty results in lower class curves, hence a depression in your GPA and class standing, while cheapening the degree you earn.

### **Course Learning Objectives:**

Upon completion of this course, students will be able to:

- 1) Numerically find roots of nonlinear scalar equations.
- 2) Numerically solve systems of linear algebraic equations.
- 3) Interpolate and extrapolate a data set.
- 4) Differentiate and integrate numerically.
- 5) Pose and understand the nature of an optimal design problem.
- 6) Solve unconstrained and constrained optimization problems numerically.
- 7) Find numerical solutions of two-point BVP's.
- 8) Find numerical integrations of ODE IVP's.
- 9) Use methods of curve fitting.

ABET Student Outcomes: **1.** “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics” – Strongly supported, and **2.** “an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors” – Supported

### **DISABILITY SUPPORT SERVICES (DSS) STATEMENT**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (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 Disability Support Services. 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 are 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/uaa/academicjudiciary/>

### **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 Judicial Affairs 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.

### **MAKE UP EXAM POLICY AND FINAL EXAM POLICY:**

All exams will be closed book and closed notes, except for a student-made formula sheet (a “cheat sheet”). An exam absence will be scored as a zero, unless a valid excuse with appropriate documentation is presented within one week following the exam. If you are sick, see your doctor and get a note. No makeup exams, unless arranged prior to the exam or with a valid excuse and documentation. You must bring two or more pencils, and a department-approved scientific calculator to each exam. There will be one final exam (which will follow the university's final exam schedule).