

MEC 507, Fall 2023 (SBU)

Mathematical Methods in Engineering Analysis I

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Class Time and Location: Thursdays: 5:30 PM – 8:20 PM, HUMANITIES 2047 WEST CAMPUS

Instructor: Professor Foluso Ladeinde

Office Location: Heavy Engineering 224

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

Instructor Office Hours (Tentative): Tuesdays, 10:00 AM – 12:00 Noon, 1:00 – 2:00 PM

Textbook: Handouts

Prerequisite: Graduate standing in mechanical engineering and/or permission of the instructor.

Number of Credits: 3

Course Description: An introduction to the use of mathematical analysis techniques for the solution of engineering analysis techniques for the solution of engineering analysis problems and the simulation of engineering systems. Both continuous and discrete methods are covered. Initial and boundary value problems for ordinary and partial differential equations are treated.

1. **Functions of complex variables:** Cauchy-Riemann equations (analytic functions), harmonic functions, multi-valued functions and branch cuts, Cauchy theorem and integral formula, Taylor and Laurent series (singularities), residue theorem, contour integration, conformal mapping and its applications in engineering.
2. **Calculus of variations:** Basic concepts. Extremisation of functionals, Brachistochrone problem, isoperimetric problem, constrained extremization, Hamilton's principle; applications. Philosophy of approximation and quantitative methods if time permits.
3. **Linear Mathematics:** Vector space (dimension and basis), inner product (normed vector spaces), Gram-Schmidt orthogonalization, projections, change of basis, linear operator, linear equations, eigenvalue problems and diagonalization.
4. **Ordinary and partial differential equations (ODEs/PDEs) - ODE solution methods per se, and to solve partial differential equations via Separation of Variables and Transforms:** Sturm-Liouville theory, ODE's (local analysis), Classification of ODE's, Methods of Undetermined Coefficients, Variation of Parameters, Series Solutions of Regular and Regular Singular Equations, Bessel, Legendre, Airy, and other special functions.

Green's Functions. (For these topics, students are required to review, on their own, the methods of separation of variables for partial differential equations, Fourier Series, and Laplace Transforms from their undergraduate classes.)

Tentative Course Flow (Subject to Change):

WEEK	TOPIC	DATES
Week 1.	Complex Variables	8/28-9/1
Week 2.	Complex Variables	9/4-9/8
Week 3.	Complex Variables	9/11-9/15
Week 4.	Calculus of Variations	9/18-9/22
Week 5	Calculus of Variations	9/25-9/29
Week 6	(Midterm I: 10/03/2023; Thursday)	10/05
	Fall Semester Break	10/09, 10/10 (Mon., Tues.)
Week 7.	Calculus of Variations/Linear Mathematics	10/12
Week 8	Linear Mathematics	10/16 - 10/20
Week 9.	Linear Mathematics	10/23 – 10/27
Week 10.	Linear Mathematics/ODEs and PDEs	10/30-11/03
Week 11.	(Midterm II: 11/09/2023; Thursday)	11/09
Week 12.	Ordinary & Partial Differential Equations	11/13-11/17
Week 13.	Thanksgiving Break – No Classes	11/22-11/26 (Wed – Sun.)
Week 14.	Ordinary & Partial Differential Equations	11/27-12/01
Week 15.	Ordinary & Partial Differential Equations	12/04-12/08
	Last Day of Class at SBU	12/11
	FINALS Week at SBU	12/11 – 12/21
	Final Exam in Course	TBD
	Semester End: Official End of Term	12/21 (Thursday)

Class Delivery Details

Class Delivery Mode: In-Person

Homework assignments will be posted on Brightspace or sent to you by email. You should submit your solutions electronically via Brightspace. All exams will take place in-person, in either

structured or Take-Home format. Details will be provided to you in due course of time.

Copyright Statement: Lecture notes, video recordings, examinations, homework problems and their solutions, and other materials 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 Brightspace 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 Brightspace.
- 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.

Join Zoom Meeting

<https://stonybrook.zoom.us/j/98428611701?pwd=WHc4SWF3RldmbUJkQjMyL2I1bEdjUT09>

Meeting ID: 984 2861 1701

Passcode: 221111

Homework: Approximately one homework assignment in two weeks. Homework will be due one week after it has been 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 in this course.

Grading Scheme (Subject to Change):

Midterm I: 25%
Midterm II: 25%
Final (Cumulative): 35%
Homework Assignments: 10%
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 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.

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, at least as much as is feasible.