Fall 2024 Syllabus

MEC 507 Mathematical Methods in Engineering Analysis I

Instructor: Young-Seon Lee, PhD

Class Hour: Tu/Th 12:30 pm ~ 1:50 pm

Classroom: A116

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Office Hours: Mon/Wed 10:30 am ~ 12:00 pm, and Tue/Thu 5:00 pm ~ 6:30 pm
at B609 or virtual (Zoom), particular times are possible by arrangement.

Course Description, and Textbooks

Prerequisite: Graduate standing in an engineering major.

Textbook:

- Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett, ISBN 9781284240771 (International student version)
- Supplementary Handouts

Course Description: An introduction to mathematical theories, analysis, and solution techniques for fundamental engineering applications. This course is required for preparation for the Ph.D. math qualifying exam.

1. **Ordinary Differential Equations (ODEs):** Application to engineering problems, ODE's (local analysis), Classification of ODE's, Methods of Undetermined Coefficients, Variation of Parameters, Power Series Solutions of Regular and Singular Equations, Bessel, Legendre, Airy, and other special functions.
2. **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
3. **Calculation of Variation:** Basic concepts. Extremisation of functionals, Brachistochrome problem, isoperimetric problem, constrained extremisation, Hamilton's principle; applications.
4. **Partial Differential Equations:** Fourier Series/Transforms. The Sturm-Liouville problem. Diffusion and Wave equations. D'Alembert's solution.
5. **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 and contour integration

Course Learning Outcomes/Objectives
Upon completion of this course, students will be able to:
1. Understand fundamental concepts and application solution techniques for ODEs and PDEs relevant to engineering applications.
2. Understand fundamental concepts and employ methods to operate with matrices, vectors, and tensors.
3. Understand and employ methods to perform differentiation and integration in 3D scalar and vector fields over curves, areas, and volumes.

4. Understand and apply series expansions based on orthogonal functions (e.g., Fourier series) for harmonic analysis and solution of PDEs.
5. Understand and employ operations using complex numbers

Methods for Assessment of Learning Outcomes

The expected learning outcomes for the course will be assessed through grading activities that include homework, attendance, exam, quiz.

Exams: There are two midterms and one comprehensive final exam. No make-up exams will be allowed.

Calculators are **NOT** allowed in the exams. Every exam is a closed book.

- Midterm: TBA
- Final Exam: TBA

Grading: Your course grade will be determined by the following items:

Attendance=5%, Homework = 25%, Midterm = 30%, Final Exam = 40%

The final letter grade will be determined by the following scale:
A: 93% - 100%, A-: 90% - 92%, B+: 87% - 89%, B: 83% - 86%, B-: 80% - 82%, C+: 77% - 79%,
C: 73% - 76%, C-: 70% - 72%, D+: 67% - 69%, D: 63% - 66%, D-: 60% - 62%, F: < 60%

Attendance: You are required to attend every class regularly. The percentage of participation in each class should be more than 50% to be considered attending each class.

Attendance Policy
(1) All students of SUNY Korea are required to attend every class.
(2) Unexcused absences will affect seriously the students' final grades in the course.
(3) If a student has over 20% unexcused absence, the student's final course grade will be an F.
(4) Students should report the reason for absence to the instructor in advance, or immediately after the absence.
(5) When a student excuses his/her absence, the student must provide documentation of the reason for the absence to the instructor.
(6) The instructor of the course reserves the right to excuse absences.
(7) The course instructor may excuse the absence if the submitted documentation fulfills the conditions below.
i) Extreme emergencies (e.g. death in the family)
ii) Severe medical reasons with a doctor's note (Not a slight illness)
iii) Very important events (e.g. national conference, official school event)
(8) At the end of the semester, the course instructor should submit a copy of the attendance sheet to the Academic Affairs Office.

Absence due to officially approved trips: The person responsible for a student missing class due to a trip should notify the instructor of the departure and return schedule in advance of the trip. The student may not be penalized and is responsible for the material missed.

Concerns: If you have ANY problem related to the course, please feel free to discuss it with us. We truly want you to succeed in this course and will do whatever we can to help resolve the problem. You can talk to me before or after class, during office hours, or via email.

Students with Disabilities:
If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact One-Stop Service Center, Academic Building A201, (82) 32-626-1117. They will determine with you what accommodations if any, are necessary and appropriate. All documentation regarding your personal information will be kept confidential.

Academic Integrity:
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.

Conduct:
Stony Brook University expects students to maintain standards of personal integrity that are in harmony with the educational goals of the institution; to observe national, state, and local laws and University regulations; and 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.

Course Evaluations
Stony Brook University values student feedback in maintaining the high-quality education it provides and is committed to the course evaluation process, which includes a mid-semester assessment as well as an end-of-the-semester assessment, giving students a chance to provide information and feedback to an instructor which allows for development and improvement of courses. Please click the following link to access the course evaluation system: http://stonybrook.campuslabs.com/courseeval/

Tentative Class schedule:

MEC 507 **Fall 2024**

Week	Date	Topics		7th ed	
1	8-27, 8-29	Separable Equations, Linear Equations, Exact Equations,	**Ordinary Differential Equations**	2.2, 2.3, 2.4	
2	9-3, 9-5	Solutions By Substitutions, Linear Models, Nonlinear Models,		2.5, 2.7, 2.8	
3	9-9, 9-11	Theory of Linear Equations, Reduction of order, Linear Equations with Constant Coefficients		3.1, 3.2, 3.3	
4	9-17 (No class) **Chuseok)**, 9-19	Undetermined Coefficients, Variation of Parameters		3.4, 3.5	
5	9-24, 9-26	Cauchy-Euler Equations, Linear Models: Initial-value problems, Linear Models: Boundary-Value Problems		3.6, 3.8, 3.9	
6	10-1, 10-3 (No class)	Vectors in 2, 3-Space, Dot Product	**Vectors**	7.1, 7.2, 7.3	
7	10-8, 10-10	Cross Product, Vector Space, Gram-Schmidt Orthogonalization Process		7.4, 7.6	
8	10-15, 10-17	Systems of Linear Equations, Rank of Matrix, Properties of Determinants	**Matrices**	8.2, 8.3, 8.4, 8.5	
9	10-22, 10-24	The inverse of a Matrix, Cramer's Rule, Eigenvalue Problem,		8.6, 8.7, 8.8	
10	10-29, 10-31	Orthogonal Matrix, Diagonalization, Method of Least Squares		8.9, 8.10, 8.16	
11	11-5, 11-7	Extremization problems, Euler-Lagrange Equations	**Calculus of Variations**	Handouts	
12	11-12, 11-14	Brachistochrone Problem, Isoperimetric Problems, Lagrange Multiplier Technique, Variational Problem		Handouts	
13	11-19, 11-21	Theory of Linear Systems, Homogeneous Linear Systems, Solution by diagonalization	**Systems of Linear Differential Equations**	10.1, 10.2, 10.3	
14	11-26, 11-28	Nonhomogeneous Linear Systems, Heat Equation, Wave Equation	**Partial Differential Equations**	10.4, 13.3, 13.4	
15	12-3, 12-5	Laplace's Equation, Final Exam		13.5	