

Course Syllabus

1. Course number: 2101-680
2. Credits: 3
3. Course title: Applied Mathematics I
4. Faculty/Department: Faculty of Engineering
Department of Civil Engineering
5. Semester: First semester
6. Academic year: 2019
7. Instructors: Associate Prof. Dr. Suthum Suriyamongkol
Associate Prof. Dr. Tospol Pinkaew
Assistant Prof. Dr. Chatpan Chintanapakdee
8. Prerequisites: -
9. Course status: Core course
10. Program name: Master of Engineering or Ph.D.
11. Level: Graduate
12. Hours per week: 3 hours of lecture

13. Course content:

The course covers some major mathematical methods useful for civil engineering applications. The topics include ordinary differential equations, system of linear equations, matrix and its engineering application, eigenvalue problems, Fourier analysis, partial differential equations, boundary value problems and optimization techniques.

14. Course description:

14.1 Objectives:

Upon completing the course, students shall understand the relation between physics, engineering and mathematics; comprehend important concept of solution methods using both analytical and numerical techniques when the problems can be formulated using differential equations, partial differential equations and system of linear equations. In addition, students shall be able to apply the optimization techniques to various engineering problems.

14.2 Course outline:

Week	Topics
	PART 1 Linear Algebra (Dr.Chatpan)
1	<u>Matrix and vector</u> Review of definition and basic operations. Vector space. Linear independence. Linear combination of vectors.
2	<u>Linear system of equations I</u> Modeling of some physical problems using linear equations. Gauss Elimination. Row operations. Solution properties.
3	<u>Linear system of equations II</u> Solution methods using matrix: row reduction and inverse. Numerical difficulties in solving system of linear equations. Condition number.
4	<u>Least-square problem</u> Under- and over-determined system. Normal equation. QR and SVD decomposition
5	<u>Eigenvalue problem</u> Eigenvalues and eigenvectors. Finding of eigenvalues and eigenvectors. Numerical techniques using MATLAB. Diagonalization and its application.
	PART 2 Numerical Methods and Optimization (Dr.Tospol)
6	<u>Numerical Method I</u> Interpolation: Data fitting by polynomials, Root finding (solution of nonlinear equation): Newton-Raphson iteration, Bi-section, Golden section.
7	<u>Numerical Method II</u> Numerical Integration: Midpoint, Trapezoidal, Simpson rule, quadrature.
8	<u>Optimization I</u> Objectives of optimization. Generalized optimization problems. Optimal condition and type of optimality. Convex and concave functions. Single variable optimization: without and with constraints.
9	<u>Optimization II</u> Multivariable optimization: without and with constraints. Optimization using numerical search techniques. (Assignment #2)
	PART 3 Differential Equations (Dr.Suthum)
10	<u>Ordinary differential equations I</u> Modeling of some physical problems using ordinary differential equations. First order differential equations: general and particular solution, analytical solution methods.

11	<u>Ordinary differential equations II</u> Second order differential equations: forms of second order equations and solution method to constant coefficient equations.
12	<u>Ordinary differential equations III</u> Second order differential equations: solution method to functional coefficient equations. Numerical techniques for differential equations.
13	<u>Fourier analysis I</u> Fourier series: representation of periodic function and Euler formulas. Alternative formulas for Fourier coefficients.
14	<u>Fourier analysis II</u> Alternative forms of Fourier series. Applications of Fourier series. Fourier integrals and Fourier transforms.
15	<u>Partial differential equations I</u> The derivation of equations. Beam and wave equations. Characteristics and classification of partial differential equations. Boundary value problems. Solution method by separation of variables.
16	<u>Partial differential equations II</u> Orthogonal functions and general expansion problems. Numerical method for partial differential equations.

14.3 Teaching method: Lecture

14.4 Media: Board, transparencies and computer

14.5 Evaluation:

Part 1	Homework	8%
	Exam 1	25%
Part 2	Quiz	5%
	Exam 2	28%
Part 3	Exam 3	34%
Total		<u>100%</u>

15. References:

1. Kreyszig, E., "Advanced Engineering Mathematics," 8th edition, John Wiley.
2. Wylie, C.R. and Barrett L. C., "Advanced Engineering Mathematics," 6th edition, McGraw Hill.
3. O'Neil, P. V., "Advanced Engineering Mathematics," 4th edition, PWS publishing company.
4. James, G., "Modern Engineering Mathematics," 2nd edition, Addison Wesley.
5. Hanselman, D. and Littlefield, B., "Mastering MATLAB: A comprehensive tutorial and reference," Prentice-Hall.
6. Venkataraman, P., "Applied Optimization with MATLAB Programming."