جامعة الملك عبدالله للعلوم والتقنية
King Abdullah University of Science and Technology

Course Syllabus: Applied Mathematics II - AMCS 202

Offering Department	Dept of Appl Math&Computational Sc
Course Number	AMCS 202
Course Title	Applied Mathematics II
Academic Semester	Summer 2024/2025
Semester Start Date	06/01/2025
Semester End Date	08/05/2025
Class Schedule (Days & Time)	Applied Mathematics II Lecture AMCS 202 Mon,Thu 09:00 - 12:00, Building 9 - Classroom 3125 (41)

Instructor(s)				
Name	**Email**	**Phone**	**Office Location**	**Office Hours**
Jenny Xiaoe Li	JENNY.LI@KAUST.EDU.SA			
Maria Alexandra Gomes	Alexandra.Gomes@KAUST.EDU.SA		4303, 1, Al-Khawarizmi (bldg. 1)	Every time I am in my office or email for appointment.

Teaching Assistant(s)	
Name	**Email**
TBA	TBA

Course Information	
Course Description	Prerequisites: Advanced and multivariate calculus and elementary complex variables. AMCS 201 and 202 may be taken separately or in either order. No degree credit for AMCS majors. Part of a fast-paced two-course sequence in graduate applied mathematics for engineers and scientists, with an emphasis on analytical technique. A review of linear spaces (basis, independence, null space and rank, condition number, inner product, norm and Gram-Schmidt orthogonalization) in the context of direct and iterative methods for the solution of linear systems of equations arising in engineering applications. Projections and least squares. Eigenanalysis, diagonalization and functions of matrices. Complex analysis, Cauchy-Riemann conditions, Cauchy integral theorem, residue theorem, Taylor and Laurent series, contour integration and conformal mapping.
	At the end of the course, students should be able to: -manipulate complex numbers in arithmetic operations -set a complex number in polar form and identify sets in the complex plane -calculate powers and roots of complex numbers

Learning Outcomes	- work with functions of a complex variable -calculate contour integrals -use the Cauchy-Goursat theorem and Cauchy's integral formulas -verify the convergence or divergence of series and expand a function into a Taylor and/or a Laurent series -calculate zeros, poles and residues and make use of the residue theorem -calculate the Laplace transform, the inverse transform and the transform of derivatives and integrals of functions -use both the Laplace and Fourier transforms in solving differential equations -perform Gaussian elimination on a linear system of equations with scaled partial pivoting to get to the LU decomposition of the system matrix -give the linear least squares solution of a system of linear equations -calculate eigenvectors and eigenvalues, use the power method, inverse and shifted inverse power method. -understand the notion of inner product spaces and their uses with polynomials -perform orthogonal projections, understand the Gram-Schmidt process, and perform the QR decomposition -understand the notion and use of positive definite matrices -perform the SVD of a matrix
Textbook/Materials	Saff, Snider: Fundamentals of Complex Analysis and Engineering, 3rd edition, 2014; D. G. Zill: Advanced Engineering Mathematics, 6th edition, 2018; E. Kreyszig: Advanced Engineering Mathematics, 9th edition, 2006; G. Strang: Linear Algebra and its Applications, 5th edition 2016; G.Strang: Linear Algebra for Everyone, 2020; Ward Cheney, David Kincaid, Numerical Mathematics and Computing, 7th international edition, 2013, Cengage Learning.
Method of Assessments	20.00% - Homework /Assignments 40.00% - Exam 1 40.00% - Exam 2
Nature of the Assignments	Homework problem sets will be distributed through Blackboard. These are written assignments with a specific deadline (date and time).
Course Policies	1. Homework should be submitted independently. Identical homework will be considered plagiarism and will be marked as zero. 2. Late homework will not be graded except for exceptional cases. (Sick or other university/ advisor-approved activities) 3. Exams are closed books. Singe side of A4- or letter-sized cheat sheet is allowed in both exams. 4. Absences should be notified in advance and should comply with university policies. 5. No calculators, mobile phones, or laptops are allowed during exams
Additional Information	.

Tentative Course Schedule
(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 06/02/2025 Thu 06/05/2025	Review of basic concepts in Linear Algebra: Matrix Multiplication CR
2	No schedule	Eid break.
3	Mon 06/16/2025 Thu 06/19/2025	Elimination, LU factorization. The Four Fundamental Subspaces.
4	Mon 06/23/2025 Thu 06/26/2025	Orthogonality, Gram-Schmidt, Least squares QR decomposition.
5	Mon 06/30/2025 Thu 07/03/2025	Eigenvalues and eigenvectors. Diagonalization. Positive-definite matrices. Exam 1 on July 3.
6	Mon 07/07/2025 Thu 07/10/2025	Complex numbers and their algebra. Complex functions, analyticity, and Cauchy-Riemann equations.

Week	Lectures	Topic
7	Mon 07/14/2025 Thu 07/17/2025	Contour integrals, Cauchy-Goursat theorem, and Cauchy's integral formulae. Sequences and series.
8	Mon 07/21/2025 Thu 07/24/2025	Taylor and Laurent series. Singularities and Residues Theorem.
9	Mon 07/28/2025 Thu 07/31/2025	Real integration with contour integration. Conformal Mappings. Exam 2.

Note
The instructor reserves the right to make changes to this syllabus as necessary.