

## Course Syllabus: Applied Mathematics II - AMCS 202

<b>Offering Department</b>	SLCM_Dept of Appl Math&Computational Sc
<b>Course Number</b>	AMCS 202
<b>Course Title</b>	Applied Mathematics II
<b>Academic Semester</b>	Summer 2023/2024
<b>Semester Start Date</b>	05/26/2024
<b>Semester End Date</b>	07/29/2024
<b>Class Schedule (Days &amp; Time)</b>	Applied Mathematics II  Lecture AMCS 202 Mon,Thu 09:00 - 12:00

### Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Maria Alexandra Gomes	Alexandra.Gomes@KAUST.EDU.SA		4303, 1, Al-Khawarizmi (bldg. 1)	
Sabine Sami El Khoury	SABINE.KHOURY@KAUST.EDU.SA			

### Teaching Assistant(s)

Name	Email
TBA	TBA

### Course Information

<b>Course Description</b>	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

<b>Learning Outcomes</b>	<ul style="list-style-type: none"> <li>- work with functions of a complex variable</li> <li>- calculate contour integrals</li> <li>- use the Cauchy-Goursat theorem and Cauchy's integral formulas</li> <li>- verify the convergence or divergence of series and expand a function into a Taylor and/or a Laurent series</li> <li>- calculate zeros, poles and residues and make use of the residue theorem</li> <li>- calculate the Laplace transform, the inverse transform and the transform of derivatives and integrals of functions</li> <li>- use both the Laplace and Fourier transforms in solving differential equations</li> <li>- perform Gaussian elimination on a linear system of equations with scaled partial pivoting to get to the LU decomposition of the system matrix</li> <li>- give the linear least squares solution of a system of linear equations</li> <li>- calculate eigenvectors and eigenvalues, use the power method, inverse and shifted inverse power method.</li> <li>- understand the notion of inner product spaces and their uses with polynomials</li> <li>- perform orthogonal projections, understand the Gram-Schmidt process, and perform the QR decomposition</li> <li>- understand the notion and use of positive definite matrices</li> <li>- perform the SVD of a matrix</li> </ul>
<b>Textbook/Materials</b>	<p>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.</p>
<b>Method of Assessments</b>	<p>40.00% - Exam 1  40.00% - Exam 2  20.00% - Problem sets</p>
<b>Nature of the Assignments</b>	Homework problem sets will be distributed through Blackboard. These are written assignments with a specific deadline (date and time).
<b>Course Policies</b>	<ol style="list-style-type: none"> <li>1. Homework should be submitted independently. Identical homework will be considered plagiarism and will be marked as zero.</li> <li>2. Late homework will not be graded except for exceptional cases. (Sick or other university/advisor-approved activities)</li> <li>3. Exams are closed books. Single side of A4- or letter-sized cheat sheet is allowed in both exams.</li> <li>4. Absences should be notified in advance and should comply with university policies.</li> <li>5. No calculators, mobile phones, or laptops are allowed during exams</li> </ol>
<b>Additional Information</b>	<p>Students taking this course as AMCS 202 will obtain standard letter grades (A-F). Students taking this course as AMCS 153 will obtain S or U grades.</p> <p>*Required Knowledge</p> <p>Multivariate calculus, basic concepts of linear algebra and elementary complex numbers.</p>

<b>Tentative Course Schedule</b> (Time, topic/emphasis & resources)		
<b>Week</b>	<b>Lectures</b>	<b>Topic</b>
1	Mon 05/27/2024 Thu 05/30/2024	Review of basic concepts in Linear Algebra: Matrix Multiplication CR
2	Mon 06/03/2024 Thu 06/06/2024	Elimination, LU factorization The Four Fundamental Subspaces
3	Mon 06/10/2024 Thu 06/13/2024	Orthogonality, Gram-Schmidt, Least squares QR decomposition
4	No schedule	Eid

Week	Lectures	Topic
5	Mon 06/24/2024 Thu 06/27/2024	Eigenvalues and eigenvectors. Diagonalization. Positive-definite matrices. Exam 1.
6	Mon 07/01/2024 Thu 07/04/2024	Complex numbers and their algebra. Complex functions, analyticity, and Cauchy-Riemann equations.
7	Mon 07/08/2024 Thu 07/11/2024	Contour integrals, Cauchy-Goursat theorem, and Cauchy's integral formulae. Sequences and series.
8	Mon 07/15/2024 Thu 07/18/2024	Taylor and Laurent series. Singularities and Residues Theorem.
9	Mon 07/22/2024 Thu 07/25/2024	Real integration with contour integration. Conformal Mappings. Exam 2.

### Note

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