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

Course Syllabus: Applied Mathematics II - AMCS 202

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	AMCS 202
Course Title	Applied Mathematics II
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	04:00 PM - 05:30 PM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Maria Alexandra Gomes	Alexandra.Gomes@KAUST.EDU.SA	+966128080652		Available to students anytime I am in my office and/or e-mail for an appointment.

Teaching Assistant(s)

Name	Email
TBA	TBA

Course Information

Comprehensive Course Description	This course is part of a fast-paced two-course sequence in graduate applied mathematics with emphasis on analytical techniques. 1. Review of complex numbers and functions. Analyticity, the Cauchy-Riemann equations. Contour integrals. The Cauchy-Goursat theorem, the Cauchy integral formula. Taylor series, singularities, Laurent series. Classification of isolated singularities. Residues and their applications. 2. Fourier and Laplace integrals and transforms. Applications to ordinary and partial differential equations. 3. Review of linear algebra. Inner product and matrix operations. Gaussian elimination. LU decomposition. Column space, null space and rank when solving Ax=b. Projections and orthogonalization (least squares method and Gram-Schmidt). Basis. Eigenvectors and Eigenvalues. Numerical methods for linear algebra problems, matrix norms and condition number.
Course Description from Program Guide	Prerequisites: Advanced and multivariate calculus and elementary complex variables. AMCS 201 and 202 may be taken separately or in either order. Part of a fast-paced two (2)-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. No degree credit for AMCS majors.

Goals and Objectives	At the end of the course, the student should: 1. be able to manipulate complex numbers in arithmetic operations, set a complex number in polar form, calculate powers and roots of complex numbers; 2. be able to identify sets in the complex plane; 3. be able to work with functions of a complex variable, calculate contour integrals, use the Cauchy-Goursat theorem and Cauchy's integral formulas; 4. be able to decide on the convergence or divergence of a series, expland a function into a Taylor and/or a Laurent series; 5. be able to calculate zeros, poles and residues, and make use of the residue theorem; 6. be able to calculate the Laplace transform, the inverse transform and the transform of derivatives and integrals of functions; 7. understand convolution and the Dirac distribution and be able to use them as tools in engineering applications; 8. be able to calculate Fourier integrals; 9. be able to use both the Laplace and Fourier transforms in solvind ordinary and partial differential equations; 10. be able to do perform Gaussian elimination on a linear system of equations with scaled partial pivoting to get to the LU decomposition of the system matrix 11. be able to give the linear least squares solution of a system of linear equations; 12. be able to calculate eigenvectors and eigenvalues, use the power method, inverse and shifted inverse power method.
Required Knowledge	Advanced and multivariate calculus and elementary complex numbers.
Reference Texts	D. G. Zill, M. R. Cullen: Advanced Engineering Mathematics, 3rd edition, 2006; E. Kreyszig: Advanced Engineering Mathematics, 9th edition, 2006; G. Strang: Linear Algebra and its Applications, 5th edition 2016; Ward Cheney, David Kincaid, Numerical Mathematics and Computing, 7th international edition, 2013, Cengage Learning.
Method of evaluation	**10.00**% - Homework /Assignments **60.00**% - Tests **30.00**% - Final exam
Nature of the assignments	The final grade has contributions from three 80-minute tests, each worth 20%, one final exam, and homework. The tests will be held during lecture time on March, 6, April, 10 and May, 5. All tests and the final exam are closed book and closed notes. Single side of A4- or letter-sized cheat sheet is allowed in each test. The same size, double-side cheat sheet is allowed in the final exam. Homework will be given roughly every other week.
Course Policies	Students are expected to attend all classes, tests and final exam. Absences should be notified in advance and should comply with the university policies. Students that do not show up for a test or for the exam should expect a zero in that assessment except for exceptional cases (such as sick leave or other university/advisor approved activities). The students can discuss the homework problems in group but should work out the details individually. Identical homework will be considered as plagiarism and will be marked as zero. Late homework will not be graded except for exceptional cases (such as sick leave or other university/advisor approved activities).
Additional Information	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.

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 01/28/2019 Wed 01/30/2019	Complex numbers.
2	Mon 02/04/2019 Wed 02/06/2019	Complex functions, analyticity and the Cauchy-Riemann equations.
3	Mon 02/11/2019 Wed 02/13/2019	Contour integrals, Cauchy-Goursat theorem and Cauchy's integral formulas.
4	Mon 02/18/2019 Wed 02/20/2019	Sequences and series. Convergence and divergence. Taylor and Laurent series.
5	Mon 02/25/2019 Wed 02/27/2019	Singularities. Residue theorem.
6	Mon 03/04/2019 Wed 03/06/2019	Real integrals from complex integrals. Test 1.
7	Mon 03/11/2019 Wed 03/13/2019	Fourier series and Laplace transform.
8	Mon 03/18/2019 Wed 03/20/2019	Laplace and Fourier integrals and transforms.
9	Mon 03/25/2019 Wed 03/27/2019	Application of Laplace and Fourier integrals and transforms to differential equations.
10	Mon 04/01/2019 Wed 04/03/2019	Spring break.
11	Mon 04/08/2019 Wed 04/10/2019	Matrix operations. Gaussian elimination. LU decomposition. Test 2.
12	Mon 04/15/2019 Wed 04/17/2019	Ax=0 and Ax=b. Column space, null space and rank.
13	Mon 04/22/2019 Wed 04/24/2019	Projections (least squares) and orthogonalization (Gram-Schmidt).
14	Mon 04/29/2019 Wed 05/01/2019	Norms and condition number. Eigenvectors and eigenvalues.
15	Mon 05/06/2019 Wed 05/08/2019	The power method. Test 3.
16	Mon 05/13/2019 Wed 05/15/2019	Review for final exam.
17	Mon 05/20/2019 Wed 05/22/2019	Final exam.

Note

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