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

Course Syllabus: Applied Mathematics I - AMCS 201

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	AMCS 201
Course Title	Applied Mathematics I
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	01:00 PM - 02:30 PM | Sun Thu

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 the first part of a fast-paced two-course sequence in graduate applied mathematics for engineers and scientists, with an emphasis on analytical techniques. Review of practical aspects of linear operators - superposition, Green's functions, and eigenanalysis - in the context of ordinary differential equations. Series expansions of solutions of ordinary differential equations. Second-order linear partial differential equations of parabolic, hyperbolic, and elliptic type through separation of variables and Fourier series. The heat equation, the wave equation and Laplace's equation. The last part discusses the method of characteristics for linear and quasi-linear partial differential equations. Canonical form, shock wave and expansion wave.
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 practical aspects of linear operators (superposition, Greens functions, and eigenanalysis) in the context of ordinary differential equations, followed by extension to linear partial differential equations (PDEs) of parabolic, hyperbolic, and elliptic type through separation of variables and special functions. Integral transforms of Laplace and Fourier type. Self-similarity. Method of characteristics for first-order PDEs. Introduction to perturbation methods for nonlinear PDEs, asymptotic analysis, and singular perturbations. No degree credit for AMCS majors.

Goals and Objectives	At the end of the course, the student should a. understand the concepts of existence and uniqueness, linear independence and principle of superposition; b. master the basic techniques in solving ordinary differential equations, including integrating factor and variation of parameters; c. understand the concept of Green's function and master three ways of deriving it; d. understand the definition of Sturm-Liouville eigenvalue problems, the properties of eigenvalues and eigenfunctions, and orthogonality; e. be proficient in applying separation of variables and eigenfunction expansion in solving 2nd-order partial differential equations in one, two and three-dimensions with various geometries; f. master the method of characteristics in solving PDES, including the general method and the parameterized representation; g. grasp the methods of solving quasi-linear PDEs and understand the concepts of shock and expansion waves; h. master the classification of three prototypes of 2nd-order PDEs and be familiar with the transformation of equations from cartesian coordinates to canonical coordinates.
Required Knowledge	Advanced and multivariate calculus and elementary complex analysis.
Reference Texts	Main reference: Richard Haberman, Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, 5th edition, Pearson, 2013. Additional references: D. G. Zill, M. R. Cullen: Advanced Engineering Mathematics (3rd edition, 2006) E. Kreyszig: Advanced Engineering Mathematics (9th edition, 2006)
Method of evaluation	**40.00**% - Final exam **20.00**% - Quiz(zes) **25.00**% - Midterm exam **15.00**% - Homework /Assignments
Nature of the assignments	The 2 quizzes have a duration of 30 minutes and will be held at the beginning of the following Thursday lectures: March, 1 and April, 26. The 80-minute midterm will be held during lecture time on March, 22. All quizzes, test and the final exam are closed book and closed notes. Singe side of A4- or letter-sized cheat sheet is allowed in the midterm. The same size, double-side cheat sheet is allowed in the final exam. Homework will be given roughly on a weekly basis.
Course Policies	Students are expected to attend all classes, quizzes, midterm and final exam. Absences should be notified in advance and should comply with the university policies. Students that do not show up for a quiz, the midterm 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 201 will obtain standard letter grades (A-F). Students taking this course as AMCS 132 will obtain S or U grades.

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 01/28/2018 Thu 02/01/2018	Course and lecturer introduction. ODE.
2	Sun 02/04/2018 Thu 02/08/2018	ODE.
3	Sun 02/11/2018 Thu 02/15/2018	ODE. Green's functions.
4	Sun 02/18/2018 Thu 02/22/2018	Green's functions. Eigenvalue problem.
5	Sun 02/25/2018 Thu 03/01/2018	Eigenvalue problem. Quiz 1.
6	Sun 03/04/2018 Thu 03/08/2018	PDE: separation of variables.
7	Sun 03/11/2018 Thu 03/15/2018	PDE: separation of variables.
8	Sun 03/18/2018 Thu 03/22/2018	PDE: separation of variables. Midterm.
9	Sun 03/25/2018 Thu 03/29/2018	General PDE.
10	Sun 04/01/2018 Thu 04/05/2018	Spring break.
11	Sun 04/08/2018 Thu 04/12/2018	General PDE. Method of characteristics.
12	Sun 04/15/2018 Thu 04/19/2018	Method of characteristics.
13	Sun 04/22/2018 Thu 04/26/2018	Method of characteristics. Quiz 2.
14	Sun 04/29/2018 Thu 05/03/2018	Method of characteristics.
15	Sun 05/06/2018 Thu 05/10/2018	Method of characteristics.
16	Sun 05/13/2018 Thu 05/17/2018	Review.
17	Sun 05/20/2018 Thu 05/24/2018	Final exam.
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Note

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