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

Course Syllabus: Real Analysis - AMCS 235

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	AMCS 235
Course Title	Real Analysis
Academic Semester	Spring
Academic Year	2017/2018
Semester Start Date	01/28/2018
Semester End Date	05/24/2018
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Sun Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Athanasios Tzavaras	athanasios.tzavaras@kaust.edu.sa	+966128080699	4418, 1, Al-Khawarizmi (bldg. 1)	By appointment

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This course is an introduction to measure and integration theory, the theory of metric spaces, and their applications to the approximation of real valued functions. The course starts with notions of convergence for sequences of continuous functions, the Ascoli-Arzela compactness theorem, and the Weierstrass approximation theorem. The main body of the course deals with the theory of measure and integration and limiting processes for the Lebesgue integral. The last part covers the topics of Differentiation, functions of bounded variation and Fourier Series. The course provides the main background needed in modern Advanced Mathematics related to Real Analysis. The topics to be covered are (i) Review of continuous functions, Metric spaces, Sequences of functions, uniform convergence, the Weierstrass approximation theorem, Compactness in metric spaces, the Ascoli-Arzela theorem. (ii) Lebesgue integral: sigma-algebras, measurable functions, measure, integrable functions, Lp spaces, modes of convergence, decomposition of measures (Radon-Nikodym), Generation of measures (Lebesgue, Lebesgue-Stieljes), (iii) Further topics in Real Analysis: Product measures (Tonelli, Fubini), Differentiation, functions of bounded variation, Approximation via convolutions.
Course Description from Program Guide	This course is an introduction to measure and integration, the theory of metric spaces, and their applications to the approximation of real valued functions. It starts with notions of convergence from sequences of continuous functions, the Ascoli-Arzela compactness theorem, and the Weierstrass approximation theorem. The main body of the course deals with the theory of measure and integration and limiting processes for the Lebesgue integral. The last part covers the topics of differentiation, functions of bounded variation and Fourier Series. The course provides the main background needed in modern Advanced Mathematics related to Real Analysis.
Goals and Objectives	The course provides the main background needed in modern Advanced Mathematics related to Real Analysis. It is a core course for the Applied Mathematics track of the AMCS program

Required Knowledge	The material provided in an undergraduate course on Advanced Calculus: limts, continuity, notion of derivative, Riemann integral, fundamental theorem of calculus, sequences of functions, pointwise and uniform convergence, series of functions, power series.
Reference Texts	Robert Bartle, The elements of integration and Lebesgue measure, 2nd edition, Wiley Classics Library, 1995. Gerald Folland, Real Analysis, Modern Techniques and Their Application, 2nd edition, Wiley, 1999. A.N. Kolmogorov and S.V. Fomin, Elements of the theory of functions and functional analysis, 1957, Dover books, published 1999. E.H. Lieb and M. Loss, Analysis, Graduate Studies in Mathematics, Vol 14, 2nd ed., AMS, 2001. Walter Rudin, Principles of Mathematical Analysis, McGraw Hill, 1976
Method of evaluation	**45.00**% - Exam 2 **10.00**% - Homework /Assignments **45.00**% - Exam 1
Nature of the assignments	Homework exercises
Course Policies	Attendance is required. Assignments will be handed out every week. They need to be retrned on the due date.
Additional Information	Course grade based mostly on midterm and final exam

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 01/28/2018 Wed 01/31/2018	weeks 1-3 Continuous functions, Metric Spaces, Sequences of functions, Uniform Convergence, Weierstrass Approximation, Compactness, Ascoli-Arzela
2	Sun 02/04/2018 Wed 02/07/2018	weeks 1-3 Continuous functions, Metric Spaces, Sequences of functions, Uniform Convergence, Weierstrass Approximation, Compactness, Ascoli-Arzela
3	Sun 02/11/2018 Wed 02/14/2018	weeks 1-3 Continuous functions, Metric Spaces, Sequences of functions, Uniform Convergence, Weierstrass Approximation, Compactness, Ascoli-Arzela
4	Sun 02/18/2018 Wed 02/21/2018	Week 4, 5: -algebras, measurable functions, measure
5	Sun 02/25/2018 Wed 02/28/2018	Week 4, 5: -algebras, measurable functions, measure
6	Sun 03/04/2018 Wed 03/07/2018	Week 6, 7: Lebesgue integral:, Monotone and Dominated Convergence theorems, L^p spaces
7	Sun 03/11/2018 Wed 03/14/2018	Week 6, 7: Lebesgue integral:, Monotone and Dominated Convergence theorems, L^p spaces
8	Sun 03/18/2018 Wed 03/21/2018	Week 8: Modes of convergence
9	Sun 03/25/2018 Wed 03/28/2018	Week 9, midterm, Generation of measures (Lebesgue, Lebesgue-Stieljes)
10	Sun 04/01/2018 Wed 04/04/2018	Spring Break - no classes
11	Sun 04/08/2018 Wed 04/11/2018	Week 10, 11, decomposition of measures, signed measures, Radon-Nikodym theorem,
12	Sun 04/15/2018 Wed 04/18/2018	Week 10, 11, decomposition of measures, signed measures, Radon-Nikodym theorem,
13	Sun 04/22/2018 Wed 04/25/2018	Week 12, Product measures (Tonelli, Fubini)
14	Sun 04/29/2018 Wed 05/02/2018	Week 13, 14, Differentiation, functions of bounded variation
15	Sun 05/06/2018 Wed 05/09/2018	Week 13, 14, Differentiation, functions of bounded variation
16	Sun 05/13/2018 Wed 05/16/2018	Week 15 Approximation via convolutions
17	Sun 05/20/2018 Wed 05/23/2018	
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Note

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