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

Course Syllabus: Stochastic Processes - AMCS 241

Offering Department	Dept of Appl Math&Computational Sc
Course Number	AMCS 241
Course Title	Stochastic Processes
Academic Semester	Spring 2025/2026
Semester Start Date	01/25/2026
Semester End Date	05/20/2026
Class Schedule (Days & Time)	Stochastic Processes Lecture AMCS 241 Tue 08:30 - 11:30, Building 9 - Lecture Hall 2325 (153)

Instructor(s)				
Name	**Email**	**Phone**	**Office Location**	**Office Hours**
Mohamed-Slim Alouini	slim.alouini@kaust.edu.sa			

Teaching Assistant(s)	
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Course Information	
Course Description	This course presents the fundamentals of probability theory and stochastic processes. Contents of this course are relevant to several disciplines including statistics, communications and information systems, computer engineering, signal processing, machine learning, bioinformatics, econometrics, and mathematical finance. Contents: I- Review of Probability theory Introduction and basic probability; Discrete Random Variables; Continuous Random Variables; Multivariate Distributions; Moment- generating functions and characterstic functions; Inequalities and bounds for random variables. II- Introduction to Random Processes Introduction and basic concepts; stationarity and ergodicity; covariance functions; Poisson processes; Gaussian processes; Spectral representations; Linear filters; Integration and differentiation of stochastic processes; ARMA models; Markov chains; Queuing theory.
	AMCS 241 is an introductory graduate course. Students will learn the fundamentals of probability theory and stochastic processes. The main goal is for the students to thoroughly

Learning Outcomes	understand the covered topics and be able to apply them. The course prepares the students for more advanced and specialized courses.
Textbook/Materials	S. Kay, Intuitive Probability and Random Processes using Matlab, Springer, 2006. Available as E-BOOK: https://link.springer.com/book/10.1007%2Fb104645 H. Kobayashi, B. L. Mark, and W. Turin, Probability, Random Processes, and Statistical Analysis, Cambridge, 2012. Available as E-BOOK: https://www.cambridge.org/core/books/probability-random-processes-and-statistical-analysis/1909C657E4758038B54C4235B3AD0FDF Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Third Edition, Prentice-Hall, 2008. Probability, Random Processes, and Statistical Analysis by H. Kobayashi, B. L. Mark and W. Turin. Stationary stochastic processes for scientists and engineers by G. Lindgren, H. Rootzén and M. Sandsten.
Method of Assessments	15.00% - Homework /Assignments 35.00% - Midterm exam 50.00% - Final exam
Nature of the Assignments	Problems to be solved at home on a weekly basis
Course Policies	- All exams are required. The exams are closed books and closed notes. However, you are allowed to bring one sheet of notes (both sides), formulas, or any other information you would like to put on the page (no photocopy is allowed). This note sheet should be limited to one sheet of paper (8.5 x 11 inches: A4 format) for exam 1. You can bring 2 such sheets for the final exam. Students who do not show up for an exam should expect a grade of zero on that exam, and no late submissions of the project assignment are accepted. - If you dispute your grade on any exam or the project, you may request a re-grade (from the TA for the homework or from the instructor for the exams) only within 48 hours of receiving the graded exam. - Incomplete (I) grade for the course will only be given under extraordinary circumstances such as sickness, and these extraordinary circumstances must be verifiable. The assignment of an (I) requires first an approval of the dean and then a written agreement between the instructor and student specifying the time and manner in which the student will complete the course requirements.
Additional Information	Prerequisites: Adequate background in basic probability (including random variables and distributions), linear algebra, multivariate calculus, Fourier transform, z-transform and Laplace transform. Students should be competent in writing rigorous proofs and should understand terms such as "if and only if", sufficient conditions, necessary conditions, etc. Important note: The course may be time-demanding, especially for those without the required background and mathematical fluency. A student who has deficiencies in his or her background can still take the course. However, the price will be more time spent on the course, or less acquired knowledge, or both. This course involves tutorial sessions and significant self-study and reading from handouts and references.

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Tue 01/27/2026	Introduction and basic probability theory
2	Tue 02/03/2026	Random variables
3	Tue 02/10/2026	Simulation/Generation of RVs + Inequalities
4	Tue 02/17/2026	Two RVs - Multiple RVs - Multivariate Gaussians
5	Tue 02/24/2026	Probability bounds and convergence

Week	Lectures	Topic
6	Tue 03/03/2026	Exam 1
7	Tue 03/10/2026	Introduction to random processes I
8	No schedule	Introduction to random processes II
9	No schedule	The Poisson process and spectral representations
10	Tue 03/31/2026	Spectral representations and Gaussian processes
11	Tue 04/07/2026	Birth death process
12	Tue 04/14/2026	Queuing theory
13	Tue 04/21/2026	Integration and differentiation of stochastic processes
14	Tue 04/28/2026	Markov processes
15	Tue 05/05/2026	Review session
16	Tue 05/12/2026	Final exam

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