AEEE305 - Random Signals and Systems

Course Title	Random Signals and Systems				
Course Code	AEEE305				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	2 / 2				
Teacher's Name	Dr Antonis Papadakis				
ECTS	5	Lectures / week	3	Laboratories / week	
Course Purpose and Objectives	The aim of the course is to familiarize students with the theory of probability, random variables and stochastic processes and use the theoretical foundations to analyze and solve practical problems in electrical engineering with reference to examples from the fields of communications and control.				
Learning Outcomes	By the end of the course, students must be able to: 1. Recognize key concepts of set theory: Sample Spaces, Events, Set Theoretic Operations. 2. Present the axiomatic definition of Probability and use it introduce the concepts of Conditional Probability, Total Probability and Independence. 3. Apply Bayes' theorem and examine applications related to communication over noisy channels. 4. Define Discrete and Continuous Random Variables and related concepts such as the Probability Distribution Function, the Probability Density Function, the probability Mass Function, the Expectation and Variance of a Random Variable, Conditional Expectations, Moments. 5. Recognize key continuous random variables and their probability distribution functions such as the univariate Normal (Guassian), the uniform and the exponential and their significance in practical applications. 6. Recognize key discrete random variables such as the Bernoulli, geometric, Poisson and binomial and their significance in practical applications. 7. Analyze pairs of Random variables with reference to correlation, covariance and joint probability and distribution functions. 8. Define the fundamentals of random processes and analyse their properties with reference to autocorrelation and spectral density. 9. Response of Linear Time Invariant Systems to the application of stochastic Inputs.				

Prerequisites	AMAT122	Required	None
Course Content	***Combinatorial Analysis***: Arrangements, Permutations & Combinations (Binomial Coefficients), Binomial Theorem, Basic Principles of Probability Theory, Supersets, Subsets, Venn-Diagrams, Group Properties (Commutative, Associative, Distributive), De-Morgan Rules. ***Classic Probability Theory***: Conditional Probability & Identities, Theorem of total probability, Bayes Theorem, Independent Events. ***Discrete Random Variables***: Definition, Probability Mass Functions, Probability Distribution Function, Expectation of Discrete Random Variables, Variance, Properties of mean values, Standard Deviation, Key Discrete Random Variables (Bernoulli, Binomial, Poisson, Geometric) ***Continuous Random Variables***: Definition, Probability Density Function & Properties, Average Value and Variance, Key continuous random variables (Uniform, Exponential, Gaussian) ***Pairs of Random Variables:*** Joint Probability and Density Functions, Covariance, and Correlation, Independent Random Variables, Conditional Distributions, Central Limit Theorem. ***Random Processes:*** Definition, Autocorrelation, Spectral Density, Systems with Stochastic Inputs, Central Limit Theorem.		
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally.		
Bibliography	**Textbook** • R. Walpole, R. Myers, S. Myers and K. Ye Probability & Statistics for Engineers & Scientists, 8thEdition, Pearson Prentice Hall, 2007 • A. Papoulis, S.U. Pillai, Probability, random variables, and stochastic processes, Tata McGraw-Hill Education, 2002.		

	References • R. Johnson, Miller and Freund's Probability & Statistics for Engineers, 9th Ed., Pearson, 2016 • J. T. McClave, T. Sincich, W. Mendenhall, Statistics, 11th Ed., Prentice Hall, 2007.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, oral exam, quizzes, design assignments, design projects and laboratory experiments. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments 10% • Homework 10% • Mid-Term written exams 40% • Design Project 30% • Quizzes 10% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 30%, 40% and 30%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	English