

## Probability and Random Variables

Course Name	Course type (credit/hours)	Elective course(3/3)		Course code	C007
	Target students Division/major/grade	Electrical and Computer Engineering/Junior		Opening semester	2019 1ST SEMESTER
	Class time and classroom	Tue B(WH317-1)Thu A(WH317-1)		English Grade	A(100%English)
Reference to this course	Prerequisite courses				
	Related basic courses	Signals and Systems			
	Recommended concurrent courses				
	Related advanced courses	Digital Communication Systems, Digital Signal Processing			
Instructor	Name (title/division)		Sangsin Na(Professor, Electrical and Computer Engineering)		
	Office Room Number	406 Woncheun Hall	Office phone Number	2366	e-mail
	Office hours		Homepage address		
Teaching Assistant	Name (title/division)				
	Office Room Number		Office phone Number		e-mail

### 1. Introduction

The course covers the definition of probability, concepts of joint and conditional probabilities and random variables. Students will learn the concepts of the probability density function, the expected values and moments of random variables and their operations. The theory of random variables will be extended to random processes which are given as functions of time. Students will learn theories of correlation functions, spectral density functions, and their applications to the analysis of the responses of linear systems to random input signals.

### 2. Course Objectives

The objectives of the course are to understand theories on probability and mathematical modeling of random variables and processes and to use them to analyze the responses of linear systems to random inputs. In order to accomplish these objectives, the following skills are emphasized:

- 1) mathematical modeling of probabilistic phenomena
- 2) ability to formulate probabilistic problems
- 3) ability to solve the problems using probabilistic operations
- 4) ability to analyze random signals
- 5) ability to analyze system responses to random input signals

### 3. Class types and activities

- 1) We will focus on practical methods of applying theories to problems
- 2) We will use various examples and exercise problems to understand theories
- 3) We will use a computer to model and analyze random data and signals
- 4) We will use a computer to simulate responses of linear system to random processes

### 4. Teaching Method

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> lecture                          | <input type="checkbox"/> discussion and debate              |
| <input type="checkbox"/> team project(presentation and case studies) | <input type="checkbox"/> experiments(role-playing,etc)      |
| <input type="checkbox"/> designing and production                    | <input type="checkbox"/> on-site learning(on-site training) |
| <input type="checkbox"/> others                                      |   |

### 5. Support Systems in Use

- |  |   |   |
|--|---|---|
| <input checked="" type="checkbox"/> AjouBb               | <input type="checkbox"/> automatic recording system | <input type="checkbox"/> web-based assignment |
| <input type="checkbox"/> cyber lecture                   | <input type="checkbox"/> online content             |   |
| <input type="checkbox"/> class behavior analyzing system | <input type="checkbox"/> others                     |   |

### 6. Teaching Tools

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> PBL(Problem Based Learning) | <input type="checkbox"/> CBL(Case Based Learning) | <input type="checkbox"/> TBL(Team Based Learning)           |
| <input type="checkbox"/> UR(Undergraduate Research)  | <input type="checkbox"/> FL(Flipped Learning)     | <input type="checkbox"/> DSAL(Data Science Active Learning) |
| <input type="checkbox"/> others                      |   |   |

### 7. Knowledge and ability required for taking this course

- 1) basic knowledge of set theories and probability
- 2) calculus and linear algebra
- 3) basic knowledge of solution to linear differential equations
- 4) basic linear systems theory including the Fourier transform
- 5) programming skill---basic Matlab

## 8. Method of Evaluation

Evaluation Item	The Number of Times	Evaluation Proportion	Remarks
Attendance			
midterm exam	1	25%	Midterms: 25% (School Schedule)
final exam	1	25%	Final Exam: Tuesday, June 11, 6:30--8:30 pm
quiz	~10	x%	Quizzes and assignments x+y=50%
presentation			
discussion			
homework		y%	Quizzes and assignments x+y=50%
etc			
study hours	3		

## 9. Textbook and supplementary material

Main/Sub	Title (Web-site)	Writer	Publisher	Publication year
Main	Fundamentals of Applied Probability and Random Processes, 2nd Edition	Oliver Ibe	Academic Press	2014

## 10. Class system and Class shedule

Plan to cover the materials in the following order:

axiomatic definition of probability → derivation of probabilistic functions → random variables and probabilistic distribution → probability density function → expected values and moments → transformation of random variables → multiple random variables and joint probability density function → correlation function → random processes → autocorrelation and cross-correlation → stationarity → power spectral density function → response of linear system to random signal → modeling of random processes

### < Class Schedule >

\* language : K-korean, E-English

Weeks	Topics	language	Instructor	Teaching Method	Evaluation Method	Matter to be prepared
1	basic theory of probability	E	Sangsin Na			
2	Bayes' Theorem, independent events	E	Sangsin Na			
3	random variables, probability density functions	E	Sangsin Na			
4	moments, expected values	E	Sangsin Na			

## < Class Schedule >

\* language : K-korean, E-English

Weeks	Topics	language	Instructor	Teaching Method	Evaluation Method	Matter to be prepared
5	conditional probability functions	E	Sangsin Na			
6	special probability distribution functions	E	Sangsin Na			
7	multiple random variables	E	Sangsin Na			
8	midterm week	E	Sangsin Na			
9	correlation functions	E	Sangsin Na			
10	transformation of probability density functions	E	Sangsin Na			
11	functions of random variables	E	Sangsin Na			
12	random processes	E	Sangsin Na			
13	power density functions	E	Sangsin Na			
14	modeling of random processes	E	Sangsin Na			
15	system responses to random signals	E	Sangsin Na			
16	final exam week	E	Sangsin Na			

### 11. Other items of notification

Students are asked to understand thoroughly concepts presented in the course and advised to memorize them.