City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester B, 2020/2021

Part I Course Overview

Course Title:	Probability Models in Information Engineering
Course Code:	EE3331
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	3
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	MA2001 Multi-variable Calculus and Linear Algebra
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

(A 150-word description about the course)

This course introduces probability models and their applications to major areas of information engineering, including digital communications and computer networks. The aims are to elucidate the fundamental concepts of probability theory through examples, to explain the principles of Bayesian decision methods and queueing analysis, and to develop the ability of students in solving problems with randomness and uncertainty. This course is project-based, which provides hands-on experience to students and conveys the relevance and usefulness of probability and stochastic processes to practical engineering problems that undergraduate students can appreciate.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain basic concepts in probability, and apply them to solve real-life problems.		√	√	
2.	Apply Bayesian decision theory to solve engineering problems.		√	√	
3.	Analyze simple Markovian systems.		√	√	
4.	Apply simulation tools to analyse the performance of simple communication networks.		√	√	
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Key concepts are described and illustrated.	√	√	√	√			2 hrs/wk
Tutorial	Key concepts are worked out based on examples or problems.	√	√	√	√			1 hr/wk
Project	Key concepts are worked out by experiments and/or simulations.		√		√			

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4				
Continuous Assessment: 50%								
Tests (min: 2) and quizzes							30 %	
#Assignments and Lab Assignments (min.: 3)							20 %	
Examination: 50% (duration: 2hrs , if applicable)								
Examination							50 %	
** The weightings should add up to 100%.*							100%	

Remark:

To pass the course, students are required to achieve at least 30% in coursework and 30% in the examination.

may include homework, tutorial exercise, project/mini-project, presentation

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal levels

6. Constructive Alignment with Major Outcomes

MILO	How the course contribute to the specific MILO(s)
1	The mathematics areas that are fundamental in information engineering are introduced and their applications are explained.
3	The students will learn how to allocate resources such as transmission power and link capacity to meet specified required quality of service of a communication system.
5	Application examples are used to illustrate how engineering problems can be formulated and solved using probability.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Probability with Real-Life Applications

Sample space and events, independent events, discrete and continuous random variables, jointly distributed random variables, covariance, moment generating functions, limit theorems, conditional probability and expectation, application to real-life problems.

Bayesian Decision for Digital Communications

Bayes' Theorem, prior, posterior, likelihood, real-life examples; Basic concepts of digital communications, representation of binary data by simple waveforms, common noise models in communication systems, detection of signals in channels with additive Gaussian noise, bit error probability; Hands-on project experience of digital communications experiment: random generation of source data based on different probability distributions, design of Bayesian decision rules, and measurement of bit error rates.

Queueing Models in Communication Networks

Markov chains, the Poisson process, circuit-switched and packet-switched networks, statistical multiplexing, network performance measures: delay and losses, queueing models, Little's theorem, Markovian queueing systems, performance analysis of simple communication networks; Hands-on project experience of using simulation to design and evaluate the performance of a simple communication system.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Nil.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Sheldon M. Ross, Introduction to Probability Models, 11th ed., Academic Press, 2014.
2.	Roy D. Yates and D. J. Goodman, Probability and Stochastic Processes: a Friendly Introduction for Electrical and Computer Engineers, 3rd ed., Wiley, 2014.
3.	Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd ed., Prentice Hall, 2001.
4.	Dimitri Bertsekas and Robert Gallager, Data Networks, 2nd ed., Prentice Hall, 1992.