MA4546: INTRODUCTION TO STOCHASTIC PROCESSES

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Stochastic Processes

Subject Code
MA - Mathematics
Course Number
4546

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2506 Probability and Statistics, or
MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
SDSC4019 Stochastic Processes and Applications

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is an introduction to the probability models and stochastic processes (without measure theory). It aims to develop and analyse stochastic models with applications. It also provides elementary numerical methods for solving real stochastic problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain concepts of stochastic processes, Markovian property, transition probability and master equation	30	x		
2	describe the theory of discrete time and continuous time Markov process, explain the definitions and properties of Poisson process and Brownian motion.	30	x		
3	perform basic numerical methods to compute limiting distributions and mean first passage time	20		x	
4	apply basic knowledge of Markov processes to analyze stochastic problems in practice.	10			x
5	the combination of CILOs 1-4.	10		x	

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 real-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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total
2	Take-home assignmens	Learning through take-home assignments helps students understand basic concepts and theories of curves and surfaces.	1, 2, 3, 4	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 2, 4	15	Questions are designed for the first part of the course to see how well students have learned the concepts and theories of stochastic processes.
2	Quiz	1, 2, 4, 5	15	These are skills based assessment to help students understand concepts and basic methods in stochastic models.
3	Formative take-home assignments	1, 2, 3, 4	10	The assignments provide students chances to demonstrate their understanding of properties of stochastic process and their achievements on stochastic modelling learned in this course.

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

40% Coursework
60% Examination (Duration: 2 hours, at the end of the semester)
For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Test

Criterion

Correct application of methods and correct calculations

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Quiz

Criterion
Skills of solving problems

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Formative take-home assignments

Criterion
Submission on time and independent work

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task

4. Examination

Criterion

Overall performance of understanding key concepts, applying right methods and performing correct computation

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Random walk, Poisson process, Brownian motion, discrete-time and continuous-time Markov process, stationary distribution, occupancy measure, Chapman-Kolmogorov equation, master equation, first passage time, Markov Chain Monte Carlo.

Reading List

Compulsory Readings

	Title
1	Introduction to Modeling and Analysis of Stochastic Systems, Second Edition, by V.G. Kulkarni, Springer, 2011

Additional Readings

	Title
1	Understanding Markov Chains: Examples and Applications, by Nicolas Privault, Springer Undergraduate Mathematics Series, 2013.
2	Introduction to Probability Models, Tenth Edition, by Sheldon M. Ross, Academic Press, 2009
3	An Introduction to Stochastic Modeling, Third Edition, by Howard Taylor and Samuel Karlin, Academic Press, 1998