هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Applied Stochastic Processes**
Course Code:	**2024112-3**
Program:	Bachelor in Mathematics
Department:	Mathematics and Statistics Department
College:	**Faculty of Sciences**
Institution:	**Taif University**
Version:	1
Last Revision Date:	20/05/2023

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A. General information about the course:

1. Course Identification

1. Credit hours: 3(3,0,0)

2. Course type

A.	☐University	☐College	☒ Department	☐ Track	☐Others
B.	☐ Required		☒Elective		

3. Level/year at which this course is offered: Level 7 / Fourth Year

4. Course general Description:

This course introduces random processes and their applications. firstly, consider probability generating functions and the concept of using conditioning for calculating expectation, variance and then probabilities. Then, present stochastic processes and their types. After that, look at both discrete-time Markov chains and continuous ones and the theory of ordinary Monte Carlo, The Markov Chin Monte Carlo (MCMC), and applications. Then, study in some details one of the most common continuous-time process, that is the Poisson process. Also, Hidden Markov models, definitions, conditional independence in hidden Markov models, hierarchical hidden Markov models, and Gaussian Markov random fields. Lastly, apply these stochastic processes to some real-world problems.

5. Pre-requirements for this course (if any)**:**

Probability and Statistics (2022107-4)

6. Co-requirements for this course (if any)**:**

None

7. Course Main Objective(s):

The student will be taught as follows:

1. **Distinguishing between types of stochastic processes**
2. **Applying these stochastic processes to some real-world problems.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**3Hr /Week**	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	NA
3.	**Field**	NA
4.	**Tutorial**	NA
5.	**Others (specify)**	NA
Total		**50**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Recognize a stochastic process	K2	• Lectures • Group discussions	• Quizzes • Assignments
1.2	Identify the states of chains and outline Markov chains	K2	• Lectures • Group discussions	• Exams • Assignments
2.0	**Skills**			
2.1	Apply down transition probability matrix	S2	• Interactive classes • Group discussions	• Quizzes • Assignments
2.2	Explain Markov chain and Poisson and Markov Chain Models.	S2	• Lectures • Group discussions	• Exams • Quizzes
2.3	Apply communication skills and mathematical techniques in solving many	S3	• Group discussions • Self-learning through the website	• Exams • Quizzes • Assignments

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	problems in other disciplines.		Problem based learning	
3.0	**Values, autonomy, and responsibility**			
3.1	Show the responsibility for their own learning and continuing personal and professional development.	V2	• Interactive classes • Give students tasks of duties	• Assessment of design projects that have elements of interpersonal skills

C. Course Content

No	List of Topics	Contact Hours
1.	Vector Algebra (Addition, subtraction and multiplication) (Scalar and vector product double and triple)	3
2.	Introduction to stochastic processes. Types of stochastic processes, Randomness, stochastic processes, purposes of stochastic processes, discrete-time Markov chains and their properties	3
3.	Transition matrix, higher order transition probabilities, the marginal distribution, stationary distribution and long-term behavior	3
4.	Inference for discrete-time Markov chains, likelihood theory for Markov chins, conditional least square estimation,	3
5.	Bayesian inference and non-parametric inference,	3
6.	The theory of ordinary Monte Carlo,	3
7.	**First Midterm exam**	3
8.	The Markov Chin Monte Carlo (MCMC), and applications,	3
9.	Classifying states of chains	3
10.	Counting process. Stationary and independent increments. The Poisson distribution and the Poisson Process. Distributions associated with the Poisson Process,	3
11.	Hidden Markov models, definitions, conditional independence in hidden Markov models, hierarchical hidden Markov models,	3
12	Monte Carlo simulation for hidden Markov models and hidden Markov models as missing data models,	3
13.	**Second Midterm exam**	3
14.	Gaussian Markov random fields (GMRF); definition and properties, simulation algorithms for GMRF, intrinsic GMRF, hierarchical GMRF models,	3
15	Applications and computing,	3
	Total	45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	Continuous Evaluation	10 %
2.	Assignments, report	Continuous Evaluation	10 %
3.	Midterm 1 Exam	8-9	15%
4.	Midterm 2 Exam	12-13	15%
5.	Final Exam	15-16	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	S. Karlin and M.Howard Taylor, "A First Course in Stochastic Processes", 2nd ed, 2012., Academic Press, ISBN 0-12-398552-8.
Supportive References	A. Papoulis and S. U. Pillai, Probability, Random Variables, and Stochastic Processes, 4th ed., McGraw-Hill, 2001.
Electronic Materials	http://www.math.harvard.edu/~knill/books/KnillProbability.pdf
Other Learning Materials	http://www.ma.utexas.edu/users/gordanz/notes/introduction_to_stochastic_processes.pdf

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms, which can accommodate up to 50 students and equipped with e-podiums, and internet access.
Technology equipment (Projector, smart board, software)	Laptop, smart board, and projector.
Other equipment (Depending on the nature of the specialty)	Wi-Fi internet connections

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of students assessment	Faculty, Program Leader	Direct
Quality of learning resources	Peer Reviewer, Students	Direct, Indirect
The extent to which CLOs have been achieved	Peer Reviewer, Students	Direct. Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Department Council
REFERENCE NO.	4
DATE	October 2023

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