Form: Course Syllabus	**Form Number**	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	11/12/2024
	Number of Pages	07

1.	**Course Title**	**Stochastic Processes**
2.	**Course Number**	0331334
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	0301333
5.	**Program Title**	B.Sc. Mathematics
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Mathematics
9.	**Course Level**	Elective Specialization Requirements
10.	**Year of Study and Semester (s)**	3rd or 4th year, 1st and 2nd or summer semester
11.	**Other Department(s) Involved in Teaching the Course**	None
12.	**Main Learning Language**	English
13.	**Learning Types**	■ Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	■ Moodle ■ Microsoft Teams
15.	**Issuing Date**	11/12/2024
16.	**Revision Date**	

17. Course Coordinator:

Name: Dr. Maalee Almheidat Contact hours:

Office number: Math. Dpt. 328 Phone number:

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18. Other Instructors:

Name:
Office number:
Phone number:
Email:
Contact hours:
Name:
Office number:
Phone number:
Email:
Contact hours:

19. Course Description:

As stated in the approved study plan. Markov chains, transition probability, classification of states, branching and queueing chains, stationary distributions of Markov chain, Poisson counting processes, continuous-time Markov processes.

20. Program Student Outcomes (SO's):

(To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

1. Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline.
2. Formulate or design a system, process, procedure or program to meet desired needs.
3. Develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
8. Utilize techniques, skills, and modern scientific tools such as mathematical packages, statistical software, graphing calculators, and online resources necessary for professional practice.

21. Course Intended Learning Outcomes (CLO's):

(Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Compute conditional probabilities for discrete and continuous distributions and conditional expectation and conditional variance for compound distributions.
2. Classify Markov chains in discrete and continuous time as recurrent and transient states, periodicity and irreducibility and compute limiting probabilities together with absorption probabilities and the expected time to absorption for Markov chains. Compute probability of extinction in branching processes and Chapman-Kolmogorov equations.

3. Define Poisson and counting processes and be able to find inter-arrival and waiting time distributions. Compute waiting time probability and waiting time mean then apply them for compound Poisson process.
4. Define continuous-time Markov chains and be able to Compute Birth and Death rates and transition probabilities and transition probability function. Compute limiting probabilities of continuous-time Markov chains.
5. Study renewal Theory and Its Applications.

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
CLO (1)	●	●				
CLO (2)	●	●	●	●	●	●
CLO (3)	●	●	●	●	●	
CLO (4)	●	●	●		●	
CLO (5)	●		●		●	

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SO's / Course CLO's	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)	SO (6)	SO (7)	SO (8)
CLO (1)	●							
CLO (2)	●	●	●					●
CLO (3)	●	●	●					●
CLO (4)	●	●	●					●
CLO (5)	●	●	●					●

23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully Online)	Platform Used	Synchronous / Asynchronous Lecturing	Evaluation Methods	Learning Resources
1	1.1	Welcoming students. Discussing the Syllabus. Review of the main ideas of the prerequisite course.	1	F	Teams	S	Exam	Text Book
	1.2	Review of the main ideas of the prerequisite course	1	F	Teams	S	Exam	Text Book
2	2.1	**3. Conditional Probability and Conditional Expectation** 3.2 The Discrete Case 3.3 The Continuous Case	1	F	Teams	S	Exam	Text Book
	2.2	3.4 Computing Expectations by Conditioning 3.5 Computing Probabilities by Conditioning	1	F	Teams	S	Exam	Text Book
3	3.1	3.6 Some Applications	1	F	Teams	S	Exam	Text Book
	3.2	3.7 An Identity for Compound Random Variables	1	F	Teams	S	Exam	Text Book
4	4.1	**4. Markov Chains** 4.2 Chapman–Kolmogorov Equations	2	F	Teams	S	Exam	Text Book
	4.2	4.3 Classification of States	2	F	Teams	S	Exam	Text Book
5	5.1	4.4 Limiting Probabilities	2	F	Teams	S	Exam	Text Book
	5.2	4.5 Some Applications 4.6 Mean Time Spent in Transient States	2	F	Teams	S	Exam	Text Book
6	6.1	4.7 Branching Processes 4.8 Time Reversible Markov Chains	2	F	Teams	S	Exam	Text Book
	6.2	4.9 Markov Chain Monte Carlo Methods 4.10 Markov Decision Processes	2	F	Teams	S	Exam	Text Book
7	7.1	**First Exam**		F				

	7.2	**5 The Exponential Distribution and the Poisson Process** 5.2 The Exponential Distribution	3	F	Teams	S	Exam	Text Book
8	8.1	5.3 The Poisson Process	3	F	Teams	S	Exam	Text Book
	8.2	5.3 The Poisson Process	3	F	Teams	S	Exam	Text Book
9	9.1	5.4 Generalizations of the Poisson Process	3	F	Teams	S	Exam	Text Book
	9.2	5.4 Generalizations of the Poisson Process	3	F	Teams	S	Exam	Text Book
10	10.1	**6. Continuous-Time Markov Chains** 6.2 Continuous-Time Markov Chains	4	F	Teams	S	Exam	Text Book
	10.2	6.3 Birth and Death Processes 374 6.4 The Transition Probability Function *Pij(t)*	4	F	Teams	S	Exam	Text Book
11	11.1	6.5 Limiting Probabilities	4	F	Teams	S	Exam	Text Book
	11.2	6.6 Time Reversibility	4	F	Teams	S	Exam	Text Book
12	12.1	6.7 Uniformization 6.8 Computing the Transition Probabilities	4	F	Teams	S	Exam	Text Book
	12.2	**Second Exam**		F				
13	13.1	**7. Renewal Theory and Its Applications** 7.2 Distribution of *N(t)*	5	F	Teams	S	Exam	Text Book
	13.2	7.3 Limit Theorems and Their Applications 7.4 Renewal Reward Processes	5	F	Teams	S	Exam	Text Book
14	14.1	7.5 Regenerative Processes	5	F	Teams	S	Exam	Text Book
	14.2	7.6 Semi-Markov Processes	5	F	Teams	S	Exam	Text Book
15	15.1	7.7 The Inspection Paradox 7.8 Computing the Renewal Function	5	F	Teams	S	Exam	Text Book
	15.2	7.9 Applications to Patterns 7.10 The Insurance Ruin Problem	5	F	Teams	S	Exam	Text Book

24. Evaluation Methods:

Opportunities to demonstrate achievement of the CLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLO/s Linked to the Evaluation activity	Period (Week)	Platform
First Exam	20%		1, 2	6-8	On Campus
Second Exam	30%		3, 4	11	On Campus
Final Exam	50%		all	Final Exam period	On Campus

25. Course Requirements:

Each student must have:

- Mathematica software
- Account on Microsoft Teams
- Access to E-learning

26. Course Policies:

General Course Policies:

Attendance Policy: Attendance is expected. Arrival on time is expected. Students who miss more than three class sessions with or without excuse will be dismissed from the course automatically. (See the university policies regarding absence).

Cell Phone Policy: Cell phones should be turned off during class time. Disruption of class by ringing cell phones and cell phone conversations is inconsiderate of fellow students and faculty.

Examination Policy: Students unable to take a scheduled exam are expected to inform the instructor within 3 days and make arrangements for a make-up one. Make ups will be given only to students who have notified the instructor and set up an alternate time. Any missed exam will result in a grade of zero for that particular examination type.

Academic Integrity: Work submitted to the course instructor is assumed to be an expression of original ideas by the student. All students in this course are expected to adhere to university standards of academic integrity. Appropriate citation of the intellectual property of other authors is expected. Cheating, plagiarism, and other forms of academic dishonesty will neither be accepted nor tolerated. This includes, but is not limited to, consulting with another person during an exam, turning in written work that was prepared by someone other than you, and making minor modifications to the work of someone else and

turning it in as your own. Ignorance will not be permitted as an excuse. If you are not sure whether something you plan to submit would be considered either cheating or plagiarism, it is your responsibility to ask for clarification.

Communications: Contact by an email is highly encouraged and preferred. Other than contacts by an email, contacts should take place during announced office hours and/or ONLY by appointment. Contact on phones, preferably office number, also is welcomed during working hours.

27. References:

A - Required book (s), assigned reading and audio-visuals:

Ross, S. M. Introduction to Probability Models, tenth edition, Elsevier, 2010.

B - Recommended books, materials, and media:

1. Taylor, H. M., Karlin, S. An Introduction to Stochastic Modeling, third edition, 1998.
2. Hoel, Port, and Stone. Introduction to stochastic Processes, Houghton Mifflin, 1972.

28. Additional information:

Name of the Instructor or the Course Coordinator: **Dr. Maalee Almheidat**	Signature: ……	Date: ……
Name of the Head of Quality Assurance Committee/ Department: **Dr. Manal Ghanem**	Signature: ……	Date: ……
Name of the Head of Department: **Prof. Baha Alzalg**	Signature: ……	Date: ……
Name of the Head of Quality Assurance Committee/ School of Science: **Prof. Emad A. Abuosba**	Signature: ……	Date: ……
Name of the Dean or the Director: **Prof. Mahmoud I. Jaghoub**	Signature: ……	Date: ……