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	23/01/2023
	Number of Pages	08

1.	**Course Title**	**Probability Theory**
2.	**Course Number**	0301732
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	None
5.	**Program Title**	Master Degree in Mathematics
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Mathematics
9.	**Course Level**	Master Level
10.	**Year of Study and Semester (s)**	First Semester 2024
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**	05/11/2024
16.	**Revision Date**	

17. Course Coordinator:

Name: Ahmad Zghoul Contact hours: 11:30-12:30 Su Tue

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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:

Sigma fields, Sequences of events, Kolmogorov's axioms, random variables, distributions, expected values, conditional probability, independence, Borel-Cantelli lemma, characteristic functions and inversion formula, convergence concepts, laws of large numbers, central limit theorems.

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. Read, analyze and write logical arguments to prove mathematical and statistical concepts and theorems.
2. Communicate with mathematical and statistical ideas clearly and consistently, in writing and verbally.
3. Formulate mathematical and statistical problems by modeling real-life problems, and solve them theoretically and/or numerically using technological tools.
4. Apply knowledge and mathematical tools and think creatively to solve real life problems and then verify and interpret the results correctly.

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. Demonstrate a comprehensive understanding of advanced probability concepts, including measure-theoretic foundations, sigma-algebras, and probability spaces, and apply these concepts to theoretical and applied problems.
2. Characterize and utilize properties of discrete and continuous probability distributions including their moments, and effectively apply moment generating functions and characteristic functions to solve advanced problems.
3. Prove and apply major limit theorems, such as the Law of Large Numbers and the Central Limit Theorem, and differentiate between types of convergence (in probability, almost surely, in distribution) with appropriate mathematical rigor.
4. Acquire knowledge of and proficiency in proving key inequalities related to moments and probabilities**,** such as Markov's inequality, Chebyshev's inequality, Jensen's inequality, Hölder's inequality, and Minkowski's inequality.

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
1	•	•	•	•	•	
2	•	•	•	•	•	
3	•	•	•	•	•	•
4	•	•	•	•	•	•

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)	•	•	•	•				

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	**Sets and Classes of Events** Random experiments and events	1	FF	Classroom & Teams		Test	Textbook
	1.2	Sequences of events limsup and liminf	1	FF	Classroom & Teams		Test	Textbook
	1.3	Sigma fields, Borel Fields	1	FF	Classroom & Teams		Test	Textbook
2	2.1	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	2.2	Random Variables Inverse Images	1	FF	Classroom & Teams		Test	Textbook
	2.3	Limits of random Variables	1	FF	Classroom & Teams		Test	Textbook
3	3.1	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	3.2	Probability Space Definition of Probability Some Simple Properties	1, 2	FF	Classroom & Teams		Test	Textbook
	3.3	Discrete Probability Space	2	FF	Classroom & Teams		Test	Textbook
4	4.1	General Probability Space Induced Probability Space	2	FF	Classroom & Teams		Test	Textbook
	4.2	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	4.3	Distribution Function of a Random Variable Properties of D.F.'s	2	FF	Classroom & Teams		Test	Textbook
5	5.1	Distribution Functions of	2	FF	Classroom & Teams		Test	Textbook

		Vector Random Variables						
	5.2	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	5.3	Expectation and Moments Definition of Expectation	2	FF	Classroom & Teams		Test	Textbook
6	6.1	Properties of Expectation	2	FF	Classroom & Teams		Test	Textbook
	6.2	Moments, Inequalities	2,4	FF	Classroom & Teams		Test	Textbook
	6.3	Moments, Inequalities	2,4	FF	Classroom & Teams		Test	Textbook
7	7.1	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	7.2	First Test		FF	Classroom		Test	Textbook
	7.3	Convergence of Random Variables Convergence in Probability	3	FF	Classroom & Teams		Test	Textbook
8	8.1	Convergence Almost Surely	3,4	FF	Classroom & Teams		Test	Textbook
	8.2	Convergence Almost Surely	3,4	FF	Classroom & Teams		Test	Textbook
	8.3	Convergence in Distribution	3,4	FF	Classroom & Teams		Test	Textbook
9	9.1	Convergence in Distribution	3,4	FF	Classroom & Teams		Test	Textbook
	9.2	Convergence in rth Mean	3,4	FF	Classroom & Teams		Test	Textbook
	9.3	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
10	10.1	Midterm Exam		FF	Classroom			Textbook
	10.2	Convergence Theorems for expectations	3,4	FF	Classroom & Teams		Test	Textbook
	10.3	Fubini's Theorem	3,4	FF	Classroom & Teams		Test	Textbook
11	11.1	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	11.2	Characteristic Functions Definition and Simple Properties Inversion Formula	2,4	FF	Classroom & Teams		Test	Textbook
	11.3	Inversion Formula	2,4	FF	Classroom & Teams		Test	Textbook
12	12.1	Characteristic Functions and Moments	2,4	FF	Classroom & Teams		Test	Textbook

	12.2	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	12.3	Central Limit Theorem I.I.D. Case	3,4	FF	Classroom & Teams		Test	Textbook
13	13.1	Variable Distributions	3,4	FF	Classroom & Teams		Test	Textbook
	13.2	Multivariate Central Limit Theorem	3,4	FF	Classroom & Teams		Test	Textbook
	13.3	Multivariate Central Limit Theorem	3,4	FF	Classroom & Teams		Test	Textbook
14	14.1	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	14.2	Conditional Expectation	2,4	FF	Classroom & Teams		Test	Textbook
	14.3	Conditional Expectation	2,4	FF	Classroom & Teams		Test	Textbook
15	15.1	Properties of Conditional Expectation	2,4	FF	Classroom & Teams		Test	Textbook
	15.2	Discussion and Solving Problems		FF	Classroom & Teams		Test	Textbook
	15.3	Review		FF	Classroom & Teams			Textbook

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 Test	20%	Classes of sets, Probability Space, Random variables, Distribution Functions	1, 2, 4	7^{th} week	Class Room
Midterm	30%	Moments, inequalities, modes of convergence	3,4		Class Room
Quizzes	10%	Vary	1,2,3,4	Every 3 wks	Class Room
Final	40%	All topics	1,2,3,4	16^{th}	Class Room

25. Course Requirements:

Students should have a computer and internet connection to be able to access the Teams platform.

26. Course Policies:

A- ***Attendance policies:***

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).

B- ***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.

C- ***Honesty policy regarding cheating, plagiarism, misbehavior***:

All students in this course are expected to adhere to university standards of academic integrity. 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.

Available university services that support achievement in the course:

The library, computer lab, and wi-fi.

27. References:

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

Bhat, B.R., Modern Prob. Theory, 1981, Wiley.

B- Recommended books, materials, and media:

1. Ash, R.B., Real analysis and Prob., 1972, Academic press.
2. Breiman, L., Probability, 1968, Addison Wesley.
3. Chung, B.L., A course in Prob. Theory, 1968, Harcourt.

28. Additional information:

Name of the Instructor or the Course Coordinator: **Prof. Ahmad Zghoul**	Signature: ……	Date: 5/11/2024
Name of the Head of Quality Assurance Committee/ Department: **Prof. 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: ……