Philadelphia University	PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE	**Approval date:**
Faculty of Science		**Issue:**
Department of Math		**Credit hours: 3**
Academic year 2021/2022	**Course Syllabus**	**Bachelor**

Course information

Course#	Course title	Prerequisite
250333	**Applied Probability**	**Prob. Theory 250232**

Course type	Class time	Room #
☐ University Requirement ☐ Faculty Requirement ☒ Major Requirement ☒ Elective ☐ Compulsory	MW 14:15-15:45	21009

Instructor Information

Name	Office No.	Phone No.	Office Hours	E-mail
Feras Awad	822	2132	ST 11:15–12:30 MW 09:45–11:00	fawad@philadelphia.edu.jo

Course Delivery Method

Course Delivery Method			
☒ **Physical**	☐ **Online**	☐ **Blended**	
Learning Model			
Precentage	**Synchronous**	**Asynchronous**	**Physical**
	0%	**0%**	**100%**

Course Description

Markov Chains: What Is a Stochastic Process? What Is a Markov Chain? *n*-Step Transition Probabilities, Classification of States in a Markov Chain, Steady-State Probabilities and Mean First Passage Times, Absorbing Chains. **Queuing Theory:** Some Queuing Terminology, Modeling Arrival and Service Processes, Birth–Death Processes, The M/M/1/GD/∞/∞ Queuing System, and the Queuing Formula L=λW, The M/M/1/GD/c/∞ Queuing System, The M/M/s/GD/∞/∞ Queuing System, The M/G/∞/GD/∞/∞ and GI/G/∞/GD/∞/∞ Models, The M/G/1/GD/∞/∞ Queuing System, Finite Source Models: The Machine Repair Model, Exponential Queues in Series and Open Queuing Networks. The M/G/s/GD/s/∞ System (Blocked Customers Cleared). **Simulation:** Basic Terminology. An Example of a Discrete-Event Simulation, Random Numbers and Monte Carlo Simulation, An Example of Monte Carlo Simulation, Simulations with Continuous Random Variables, An Example of a Stochastic Simulation, Statistical Analysis in Simulations.

Course Learning Outcomes

Number	Outcomes	Corresponding Program outcomes
Knowledge		
K1	Distinguish the Markov chain processes and their properties.	**K_p1, K_p3**
K2	Realize the steady-state behavior of Markov chains.	**K_p1**
K3	Modeling queuing systems and analyze their steady state behavior.	**K_p1**
K4	Understand the basic concepts and main steps in the simulation process.	**K_p1, K_p3**
Skills		
S1	Use computer software like GeoGebra and Google Sheets to do calculations.	**S_p4**
S2	Conduct probabilistic simulation models.	**S_p2, S_p3**
Competencies		
C1	Thinking reasonably and the ability to make decisions.	**C_p1**
C2	Work in a team to implement one of the tasks of the course.	**C_p2**

Learning Resources

Course textbook	Winston, W. L. (2004) Introduction to Probability Models: Operations Research, Volume II (4th ed.). Cengage Learning.
Supporting References	Taha, H. (2017) Operations Research: An Introduction (10th ed.). Pearson.
Supporting websites	✓ GeoGebra: https://www.geogebra.org/ ✓ Google Sheets: http://sheets.new/
Teaching Environment	☒**Classroom** ☐ **laboratory** ☐**Learning platform** ☐**Other**

Meetings and Subjects Timetable

Week	Topic	Learning Methods	Tasks	Learning Material
1	Explanation of the study plan for the course, and what is expected to be accomplished by the students. **Review of Some Probability Concepts:** Laws of Probability. Random Variables. Probability Distribution.	Lecture		Course Syllabus Additional Sheet
2	**Markov Chains:** What Is a Stochastic Process? What Is a Markov Chain?	Lecture		Chapter 17
3	*n*-Step Transition Probabilities. Classification of States in a Markov Chain	Lecture		Chapter 17
4	Steady-State Probabilities and Mean First Passage Times	Lecture	Quiz	Chapter 17
5	Absorbing Chains.	Lecture	Computer Task	Chapter 17
6	**Queuing Theory:** Some Queuing Terminology. Modeling Arrival and Service Processes	Lecture		Chapter 20

7	Birth–Death Processes	Lecture	Computer Task	Chapter 20
8	The M/M/1/GD/∞/∞ Queuing System and the Queuing Formula L=λW	Lecture		Chapter 20
9	The M/M/1/GD/c/∞ Queuing System. The M/M/s/GD/∞/∞ Queuing System	Lecture		Chapter 20
10	The M/G/∞/GD/∞/∞ and GI/G/∞/GD/∞/∞ Models. The M/G/1/GD/∞/∞ Queuing System.	Lecture	Quiz	Chapter 20
11	Finite Source Models: The Machine Repair Model. Exponential Queues in Series and Open Queuing Networks. The M/G/s/GD/s/∞ System (Blocked Customers Cleared)	Lecture	Midterm Exam	Chapter 20
12	**Simulation:** Basic Terminology. An Example of a Discrete-Event Simulation	Lecture		Chapter 21
13	Random Numbers and Monte Carlo Simulation. An Example of Monte Carlo Simulation	Lecture	Quiz	Chapter 21
14	Simulations with Continuous Random Variables.	Lecture	Computer Task	Chapter 21
15	An Example of a Stochastic Simulation. Statistical Analysis in Simulations	Lecture		Chapter 21
16	Final Exam			

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

Course Contributing to Learner Skill Development

Using Technology
• Use GeoGebra to solve an experimental probabilistic problem. • Use Google Sheets to do the calculations in Markov Process and Queuing Systems.
Communication Skills
• Design a program to solve an interactive probabilistic problem and present it to the students and explaining its mechanism.
Application of Concepts Learnt
• Making a simulation of one of the queuing models learned in the course.

Assessment Methods and Grade Distribution

Assessment Methods	Grade Weight	Assessment Time (Week No.)	Link to Course Outcomes
Mid Term Exam	**30%**	**11**	**K1, K2**
Various Assessments *	**30%**	**Continuous**	**S1, S2, C1, C2**
Final Exam	**40%**	**16**	**K1, K2, K3, K4**
Total	**100%**		

* Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Alignment of Course Outcomes with Learning and Assessment Methods

Number	Learning Outcomes	Learning Method*	Assessment Method**
Knowledge			
K1	Distinguish the Markov chain processes and their properties.	Lecture	**Exam**
K2	Realize the steady-state behavior of Markov chains.	Lecture	**Exam**
K3	Modeling queuing systems and analyze their steady state behavior.	Lecture	**Exam**
K4	Understand the basic concepts and main steps in the simulation process.	Lecture	**Exam**
Skills			
S1	Use computer software like GeoGebra and Google Sheets to do calculations.	Case Study	**Computer Project**
S2	Conduct probabilistic simulation models.	Case Study	**Computer Project**
Competencies			
C1	Thinking reasonably and the ability to make decisions.	Discussion	**Quiz**
C2	Work in a team to implement one of the tasks of the course.	Case Study	**Group Project**

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

** Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Course Polices

Policy	Policy Requirements
Passing Grade	The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%).
Missing Exams	• Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment. • A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from an exam or assessment due date. • A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date.
Attendance	The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and seven lectures (S, T, T). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive excuse accepted by the dean of the college, then withdrawal grade will be recorded.
Academic Honesty	Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights.

Program Learning Outcomes to be Assessed in this Course

Number	Learning Outcome	Course Title	Assessment Method	Target Performance level
S_P4	Use technology and computer software in various fields of mathematics.	Applied Probability	Computer Task	100% of the students get 60% or more on the rubric

Description of Program Learning Outcome Assessment Method

Number	Detailed Description of Assessment
S_P4	The student chooses a probability model to solve using Monte Carlo method and implement it using GeoGebra in the 14th week.

Assessment Rubric of the Program Learning Outcome

	Poor (1 pt.**)** Student is very confused and does not understand the topic, nor is able to clearly grasp how to apply it or when to use it.	**Fair (**2 pts**)** Student has a decent grasp of the process but makes some major mistakes.	**Good (**3 pts**)** Student is almost perfect in their understanding of the topic, with some minor confusion or mistakes.	**Excellent (**4 pts**)** Student understands the concept perfectly.
Problem Analysis How much did the student understand the problem and develop a plan for the solution?	Student does not understand the problem and cannot identify the necessary data and create a plan to solve.	Student understands the problem, but cannot identify the data or create a plan to solve	Student understands the problem but can only identify some of the necessary data or creates a slightly inaccurate plan to solve.	Student understands problem, identifies necessary data to solve and creates an accurate plan to solve it.
Computations Accuracy How much the results are correct?	The program is producing incorrect results.	The program produces correct results but does not display them correctly.	The program produces correct results but does not display all of it correctly.	The program works and meets all the specifications.
Trials and Efficiency How many trials can the program do at each run, and how long it takes to execute?	Program takes long time to execute 1 trial at each run.	Program takes long time to execute but the user can implement 1 or 10 trials each time.	Program takes small execution time to implement 10 to 1000 trials at each run.	Program is fast in execution more than 1000 trials at each run.
Output Formatting, Graphics, Animation How much the student represents the simulation using animations?	Results are displayed without animations.	Results are displayed with limited animations and less formatting.	Results are displayed with well animations but less formatting.	Results are perfectly formatted and visualized.