



**The University of Jordan**

**Accreditation & Quality Assurance Center**

## **COURSE Syllabus**

**Simulation in Business (1904442)**

**Fall 2022-2023**



1	Course title	Simulation in Business
2	Course number	1904442
3	Credit hours (theory, practical)	3 theory
	Contact hours (theory, practical)	3 theory
4	Prerequisites/co requisites	<b>1901233 (Data Structures - 1)</b>
5	Program title	Information Technology
6	Program code	4
7	Awarding institution	The University of Jordan
8	Faculty	King Abdullah II School for Information Technology
9	Department	Department of Information Technology
10	Level of course	4 <sup>th</sup> year
11	Year of study and semester (s)	Any
12	Final Qualification	Bachelor (B.Sc.)
13	Other department (s) involved in teaching the course	none
14	Language of Instruction	English
15	Date of production/revision	10-9-2022
16	Required/ Elective	Required

**17. Course Coordinator: Prof. Rizik Al-Sayyed**

Office numbers:  
Office Hours: 10-11 Everyday  
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**18. Other instructors:**

None

**19. Course Description:**

*The purpose of the course is to have students understand the general principles of simulation model design and concepts of computer simulation. The course introduces students to simulation types, mathematical model types and simulation software and languages. The course covers in details simulation of discrete system (Discrete Event Simulation and simulation by different equations) and simulation of continuous system using differential equations with practical examples in management, banking, manufacturing and computer networks. Both Arena and MS Excel software are intended to be used throughout the course.*



## 20. Course Objectives:

At the end of this course, students should ...

1. Have an understanding of differences between different types of simulations such as discrete event and continuous simulation models.
2. Have knowledge of the important random numbers and frequency distributions in simulation model
3. List applications of simulation.
4. Be able to formulate a simulation study and develop a simulation model within the simulation language such as Arena.
5. Be capable of analyzing the result from simulation models.
6. B4: Design a model for a system.
7. Implement a simulation for a real system.
8. Solve some problems using simulation.
9. Analyze output results of simulation experiments.

Successful completion of this course should lead to the following learning outcomes:

### Intended Learning Outcomes (Mapped directly to KPI → ILO≡KPI):

On successfully completing the module, the students are expected to have gained good knowledge of:

#### A- Knowledge and understanding: Students should ...

A1: Be able to apply basic math and statistics including the differences between discrete event and continuous simulation models, important random numbers generators and frequency distributions. [SO 1]

A2: List applications of simulation. [SO 1]

#### B- Intellectual and specific skills: with ability to ...

B1: Formulating, designing, and implementing a simulation solution for real problems or modelled ones in business areas such as scheduling and warehouse systems using simulation techniques with or without a simulation tool such as Arena. [SO 1]

B2: Analyzing the results from simulation models. [SO 3]

#### C- Transferable skills – with ability to

C1: Work in a group in order to implement a simulation project. [SO 3]

C2: Present the final work (project) and make a demo. [SO 3]

### Teaching and Learning Methodology:

Method	Lecture	Demo	Laboratory	Case study
Learning outcomes	A1+A2+B1+B2	A1+ B1+B2	C1+C2	B1+B2+C2
Assessment	Exams + Assignment	Exams + Assignments	Project + Presentation	Exams + presentation



## 21. Topic Outline and Schedule:

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
Chapter 1: What is Simulation? <ul style="list-style-type: none"> <li>• Modelling</li> <li>• Applications, advantages and limitations</li> <li>• Computer Simulation</li> <li>• How Simulations get Done</li> <li>• When Simulations are used</li> </ul>	1-2	Rizik	A1 A2	<b>T:</b> Lecture <b>L:</b> Reading lecture notes and Chap 1 <b>A:</b> in Class questions	Reading from (Text book) <b>SIM_Ch01</b>
Chapter 2: Fundamental Simulation Concepts <ul style="list-style-type: none"> <li>• An Example and Analysis Options</li> <li>• Pieces of a Simulation Model: Entities, Attributes, (Global) Variables, Resources, Queues, ... etc</li> <li>• Even-Driven Hand Simulation</li> <li>• Even- and Process-Oriented Simulation</li> <li>• Randomness in Simulation</li> <li>• Simulation with Spreadsheets</li> </ul>	3	Rizik	A1 A2 B1 B2	<b>T:</b> Lecture and presentation <b>L:</b> Reading lecture notes and Chap 2 <b>A:</b> in Class cases	Reading From (Text book) <b>SIM_Ch02</b>



<p>Appendix B: A Refresher on Probability and Statistics (Appendix C in 4th Edition)</p> <p>Chapter 3: A Guided Tour Through Arena</p> <ul style="list-style-type: none"> <li>Starting Up</li> <li>Exploring the Arena Window</li> <li>Browsing Through an Existing Model</li> <li>Building a Model Yourself</li> </ul>	4	Rizik	A1 B1 B2	<p><b>T:</b> Lecture and presentation</p> <p><b>L:</b> Reading lecture notes and Chap 2</p> <p><b>A:</b> in Class questions</p>	<b>Sim_Appendix</b>
<p>Chapter 4: Modelling Basic Operations and Inputs</p>	5	Rizik	A1 B1 B2 C1	<p><b>T:</b> Lecture and presentation</p> <p><b>L:</b> Reading lecture notes and Chap 2</p> <p><b>A:</b> in Class questions</p>	<b>Sim_Ch04</b>
<p>Chapter 5-1: Modelling Detailed Operations 1</p>	6	Rizik	A1 B1 B2 C1	<p><b>T:</b> Lecture and presentation</p> <p><b>L:</b> Reading lecture notes and Chap 2</p> <p><b>A:</b> in Class questions</p>	<b>Sim_Ch05_1</b>
<p>Chapter 5-2: Modelling Detailed Operations 2</p>	7	Rizik	A1 B1 B2 C1	<p><b>T:</b> Lecture and presentation</p> <p><b>L:</b> Reading lecture notes and Chap 2</p> <p><b>A:</b> in Class questions</p>	<b>Sim_Ch05_2</b>
<p>Chapter 6: Statistical Analysis of Output from Terminating Simulations</p>	8	Rizik	A1 B1 B2 C1	<p><b>T:</b> Lecture and presentation</p> <p><b>L:</b> Reading lecture notes and Chap 2</p> <p><b>A:</b> in Class questions</p>	<b>Sim_Ch06</b>
<p>Chapter 7: Intermediate Modelling and</p>	9	Rizik	A1 B1 B2	<p><b>T:</b> Lecture and presentation</p>	<b>Sim_Ch07</b>



Steady-State Statistical Analysis			C1	L: Reading lecture notes and Chap 2 A: in Class questions	
Chapter 8: Entity Transfer	10	Rizik	A1 B1 B2 C1	T: Lecture and presentation L: Reading lecture notes and Chap 2 A: in Class questions	<b>Sim_Ch08</b>
Extra Material that Revisits the whole material Practically: <ul style="list-style-type: none"> <li>• Simulating: Monte-Carlo and System simulation in Excel</li> <li>• Monte-Carlo Simulation Example: Valentine Day Gifts Salesman <u>CN1</u></li> <li>• System Simulation Example: Mantel Manufacturing Company <u>CN2</u></li> <li>• Simulation of a pure pursuit problem <u>CN2</u></li> <li>• Random Variables (Variates) generation: Mid- square Method and Congruence Modulo-m Method, Testing of RN Generator <u>CN3</u></li> </ul>	11-14	Rizik	A1 B1 B2 C1	T: Lecture and presentation L: Reading lecture notes and Chap 3 A: Home work assignments	Reading from (Text book)  <b>SIM_CN1</b> <b>SIM_CN2</b> <b>SIM_CN3</b> <b>SIM_CN4</b> <b>SIM_CN5</b> <b>SIM_CN6</b> <b>SIM_CN7</b> <b>SIM_CN8</b>



<ul style="list-style-type: none"><li>• Continuous Distribution, Discrete Distribution and Computing of Variates using the Inverse and the empirical methods, Central limit theorem. <u>CN4</u></li><li>• More Applications on Empirical method: Estimating profit, Random Walk Process (stage 1) <u>CN5</u></li><li>• Random Walk Process (stage 2), Facility Utilization <u>CN6</u></li><li>• Queuing System Model and Parameters, Event List Diagram (ELD) <u>CN6</u></li><li>• Queuing System Theory: Elements of queuing system, Equilibrium of System <u>CN7</u></li><li>• Simulation Modelling Approaches: Fixed time-step vs. event-to-event, Activity scanning approach, Process-driven</li></ul>					
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simulation, Event-driven simulation approach and examples <u>CN7</u> & <u>CN8</u> <b>Other queuing system formats <u>CN8</u></b>					
Catching up and review	15-16	Rizik	A1 A2 B1 B2 <b>C1</b> <b>C2</b>	<b>T:</b> Present examples <b>L:</b> Reading lecture notes and Chap 5 A: Quiz	Reading From (Text book) All Material
Final Exam		All			

## 22. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

Lecture, lab and presentation

## 23. Evaluation Methods and Course Requirements:

### Teaching (T) Strategies

Class Contact is 3 Hours per week. The Course will be delivered using different means like lecture, presentations, seminars, discussion and case studies.

### Learning (L) Methods

Students attend classes, ask questions and participate in discussions, do the home works, present the assignments and demo their works. A student will use the lab and select a programming language to implement the assignments. Students will access the e-learning platform for more instruction and supported learning materials

### Assessment (A) Methods

There will be several assessment methods of evaluation the performance of the students such as attending and class participation, grading the homework, quizzes and assignments; conducting the Midterm and the Final Exams. Every student is expected to completely adhere to the assignments and project strict deadlines, absolutely no exceptions will be given.



## 24. Course Policies:

### A- Attendance policies:

Maximum allowable absence 15% of number of Lectures/Semester

### B- Absences from exams and handing in assignments on time:

It is the student's responsibility to ensure that he/she is aware of all assignments, announcements and contents of missed sessions

### C- Health and safety procedures:

Practical sessions need labs which are suitable adjustable chairs, safe computers and wires should be well organized.

### D- Honesty policy regarding cheating, plagiarism, misbehavior:

It is the student's responsibility to ensure that he/she is adhere with cheating, plagiarism, misbehavior

### E- Grading policy:

#### Intended (Tentative) Grading Scale:

Range	LG	الحرف	Range	LG	الحرف	Range	LG	الحرف
91 - 100	A	أ	74 - 77	B-	-ب	56 - 60	D+	+د
86 - 89	A-	-أ	70 - 73	C+	+ج	50 - 55	D	د
82 - 85	B+	+ب	66 - 69	C	ج	45 - 49	D-	-د
78 - 81	B	ب	61 - 65	C-	-ج	0 - 44	F	هـ

#### Grading and Evaluation Criteria: 100 points distributed as follows:

Weight	Criteria	Comments
30%	Midterm Exam (Automated)	TBA (in due course)
30%	Quizzes and Assignments	TBA (in due course)
40%	Final Exam	TBA (in due course)

### F- Available university services that support achievement in the course:

Computer Labs.

## 25. Required equipment:

1- Personal computers in a lab.

2- Data show

3- Access 2007

## 26. References:

1. Manuel D. Rossetti, Simulation Modeling and Arena, 2nd Edition, Wiley, 2015, ISBN: 978-1-118-60791-6



2. Averill Law, Simulation Modeling and Analysis, 4th Ed., McGraw Hill, 2007.
3. Manuel D. Rossetti., Simulation modeling and Arena, John Wiley & Sons, Inc., 2010.
4. Jerry Banks, John S. Carson, II, Barry L. Nelson, David M. Nicol, Discrete-Event System Simulation, 5/E, Prentice Hall, ©2010
5. Presentation from the site: <http://www.arenasimulation.com/academicprograms>
6. The CD: Arena Academic version 10 for simulation with Arena. 4th Ed.
7. Computer studies: student Handbook.
- 8.

## 27. Additional information:

- Tardiness and/or absenteeism will have a negative impact on the course grade.
- الامتناع المدير عن حضور المحاضرات أو الدروس أو عن الأعمال الأخرى التي تقضي الأنظمة بالمواطبة عليها ، وكل تحريض على هذا الامتناع سوف يؤدي الى حرمان الطالب من المادة المعنية.
- في حالة التغيب عن الامتحانين الأول و الثاني لن يكون هناك امتحان تعويضي الا في حالة وجود عذر وحالة طارئة من المستشفى. على الطالب براز العذر لمدرس المادة في فتره لا تتجاوز الثلاثة ايام من تاريخ الامتحان, وللمدرس الحق في قبول او رفض العذر , وحسب التعليمات.
- Concerns or complaints should be expressed in the first instance to the module lecturer; if no resolution is forthcoming then the issue should be brought to the attention of the module coordinator (for multiple sections) who will take the concerns to the module representative meeting. Thereafter problems are dealt with by the Department Chair and if still unresolved the Dean and then ultimately the Vice President. For the final complaints, there will be a committee to review grading the final exam.
- For more details on University regulations please visit <http://www.ju.edu.jo/rules/index.htm>

Name of Course Coordinator: Prof. Rizik Al-Sayyed Signature: R.A. Date: -----

Head of curriculum committee/Department: Prof. Rizik Al-Sayyed Signature: -----

Head of Department: Prof. Rizik Al-Sayyed Signature: -----

Head of curriculum committee/Faculty: Prof. Rizik Al-Sayyed Signature: -----

Dean: Prof. Bassam Hammo -Signature: -----

Copy to:

Head of Department

Assistant Dean for Quality Assurance