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	07

1.	**Course Title**	Computational Physics
2.	**Course Number**	0352752
3.	**Credit Hours (Theory, Practical)**	(3, 0)
	Contact Hours (Theory, Practical)	(3, 0)
4.	**Prerequisites/ Corequisites**	None
5.	**Program Title**	MSc. In Physics
6.	**Program Code**	
7.	**School/ Center**	School of Science
8.	**Department**	Physics
9.	**Course Level**	Master
10.	**Year of Study and Semester (s)**	2024/2025, 1st semester
11.	**Other Department(s) Involved in Teaching the Course**	-
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**	24/10/2024
16.	**Revision Date**	14/11/2024

17. Course Coordinator:

Name: Prof. Dr. Hanan Sa'adeh

Contact hours: announced on the website: https://eacademic.ju.edu.jo/hanan.saadeh/Pages/OfficeHours.aspx

Office number: 220 Phone number: 22029

Email: Hanan.Saadeh@ju.edu.jo

18. Other Instructors:

None

19. Course Description:

This course gives a modern introduction to the basic methods in computational physics. Computational physics is a rapidly growing subfield of physics and computational science in large part because computers can solve previously intractable problems or simulate natural processes that do not have analytic solutions. The broad categories of computational physics are Simulation, Visualization and Modeling. This course is basically intended to provide students with the ability of solving difficult problems by using computational methods and to learn and use programming languages.

20. Program Intended Learning Outcomes: (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

1. To be able to 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. To be able to formulate or design a scientific system, process, procedure or program to contribute achieving scientific desired needs.
3. To be able to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
4. To be able to communicate his/her scientific contributions effectively with a range of audiences.
5. To be able to recognize and demonstrate social, ethical and professional responsibilities and the impact of technical and/or scientific solutions in global economic, environmental, and societal contexts.
6. To be able to function effectively independently and on teams for establishing goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

21. Course Intended Learning Outcomes: (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Use computer for modeling, simulation, and visualization of physical problems.

2. Deal with numerical and mathematical tools to enhance problem solving.

3. Translate a physical problem into a form solvable by a computer.

4. Have the practical and theoretical knowledge necessary to use specific computer systems to implement the steps of the solution; and in particular to use the programming language and facilities provided by the Mathematica system to do so.

5. Be acquainted with the general scene of scientific software available and the modern trends in scientific software industry.

Course ILOs	**The learning levels to be achieved**					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
1	√		√	√	√	
2		√	√		√	
3			√	√	√	
4	√	√	√			√
5		√				√

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

Program ILOs / Course ILOs	ILO (1)	ILO (2)	ILO (3)	ILO (4)	ILO (5)	ILO (6)
1	√	√	√			
2	√	√	√			
3	√	√	√			
4	√	√	√			
5	√	√	√			√

23. Topic Outline and Schedule:

Week	Lecture	Topic	ILO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully Online)	Platform Used	Synchronous / Asynchronous	Evaluation Methods	Learning Resources
1	1.1	Overview of the Course	-	Face to Face	Lecture room	Synchronous	Questionnaire	All references
	1.2	Installation of Mathematica 14	-					
2	2.1	Introduction to Computational Physics	1, 3, 5				Discussion	A-2 B-2
	2.2	Computers and Physics	1, 3, 5					
3	3.1	Computer-Aided Problem Solving	1, 3, 5					
	3.2	Computer-Related Errors	1, 3, 5					
4	4.1	Overview of Mathematica 13	2, 3, 4, 5				Discussion Assignments Midterm Exam	A-1 B-1
	4.2	First Encounter with Mathematica	2, 3, 4, 5					
5	5.1	First Encounter with Mathematica	2, 3, 4, 5					
	5.2	First Encounter with Mathematica	2, 3, 4, 5					
6	6.1	Interactive Use of Mathematica	2, 3, 4, 5					
	6.2	Interactive Use of Mathematica	2, 3, 4, 5					
7	7.1	Interactive Use of Mathematica	2, 3, 4, 5					
	7.2	Interactive Use of Mathematica	2, 3, 4, 5					
8	8.1	Programming in Mathematica	3, 4					
	8.2	Programming in Mathematica	3, 4					
9	9.1	Programming in Mathematica	3, 4					
	9.2	Programming in Mathematica	3, 4					
10	10.1	Physics with Mathematica	3, 4					
	10.2	Physics with Mathematica	3, 4					
11	11.1	Numerical Analysis	2, 3, 4				Discussion	A-2 B-2
	11.2	Numerical Analysis	2, 3, 4					
12	12.1	Interpolation and Extrapolation	2, 3, 4				Discussion Assignments	A-2 A-1
	12.2	Interpolation and Extrapolation	2, 3, 4					
13	13.1	Optimization	2, 3, 4					
	13.2	Optimization	2, 3, 4					
14	14.1	Least-Squares Curve-Fitting	2, 3, 4					
	14.2	Students Presentations	5				Presentation	-
15	15.1	Students Presentations	5					
	15.2	Students Presentations	5					

24. Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	ILO/s Linked to the Evaluation activity	Period (Week)	Platform
Assignments	15	All Material	1-5	Weeks 2-13	On campus
Midterm Exam	30	Ch 1 & Ch 2	1-4	December 2024	On campus
Project & Presentation	15	Selected Topics in Computational Physics & Getting Started into a New Software	5	Week 14 & 15	
Final Exam (written & practical)	40	All Material	1-4	January 2025	On campus

25. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform…etc.):

Students and Instructor should have a laptop with Mathematica 14 software installed, and good internet connection.

Instructor should have an account on Wolfram Cloud (recommended).

26. Course Policies:

A- Attendance policies:

Class attendance is expected. Past experience has shown that students who do not attend the lectures invariably receive poor grades. A student whose absence exceeds 15% of lectures will be dismissed.

B- Absences from exams and submitting assignments on time:

Absence from exams without an acceptable excuse means ZERO. No late submission of homework assignments is allowed.

C- Health and safety procedures:

No special precautions.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

All these issues will be considered according to the regulations and laws adopted at the University of Jordan.

E- Grading policy:

Homework: 15%

Midterm Exam: 30%

Project: 15%

Final Exam: 40%

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

Class Room, E-Library, E-Learning Platform

27. References:

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

1- A Physicist's Guide to Mathematica, 2nd Edition (2008), by Patrick T. Tam.

2- Numerical Recipes: The Art of Scientific Computing, 3rd Edition (2007), by W. H. Press, S. A. Teukolsky, W. T. Vetterling, & B. P. Flannery.

B- Recommended books, materials, and media:

1- Wolfram Research Inc. (The makers of Mathematica). This is a huge site, with many useful sub-sites, such as:

- Mathematica Information Center
- MathWorld
- ScienceWorld
- Wolfram Functions Site
- Wolfram Integrator
- The Mathematica Journal
- Stephen Wolfram

2- NAG Library: The world's largest collection of robust, documented, tested and maintained numerical algorithms.

3- 3D Physics Simulations http://www.euclideanspace.com/physics/index.htm

28. Additional information:

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Name of the Instructor or the Course Coordinator: …… **Prof. Dr. Hanan Sa'adeh** ……	Signature: ……...……	Date: October 2024
Name of the Head of Quality Assurance Committee/ Department …….	Signature: ……...……	Date: ……..……
Name of the Head of Department …….	Signature: ……...……	Date: ……..……
Name of the Head of Quality Assurance Committee/ School or Center …….	Signature: ……...……	Date: ……..……
Name of the Dean or the Director …….	Signature: ……...……	Date: ……..……