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
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	Number of Pages	06

1.	**Course Title**	Advanced Classical Mechanics
2.	**Course Number**	0342751
3.	**Credit Hours (Theory, Practical)**	3,0
	Contact Hours (Theory, Practical)	3,0
4.	**Prerequisites/ Corequisites**	
5.	**Program Title**	M.Sc. in Physics
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Physics
9.	**Course Level**	Master degree
10.	**Year of Study and Semester (s)**	2023, Spring
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**	13/11/2024
16.	**Revision Date**	

17. Course Coordinator:

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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:

This course is intended for the first year graduate students who have studied classical mechanics at the undergraduate senior level. In this course we build on the thorough acquaintance the students have with Newtonian mechanics to develop two alternative formulations of mechanics, namely the Lagrangian and Hamiltonian mechanics. The focus in the lectures is on the formalism (chapters 1, 2, 8 of the required text, and the supplemental materials) and little emphasis is left on applications (chapters 3-6). The latter is addressed briefly through the assignments, and will be addressed in detail in the second part of the course; Advanced Classical Mechanics II (951).

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. Analyze the mechanics of a particle
2. Analyze the mechanics of a system of particles
3. Derive Lagrange's equations using D'Alembert's principle
4. Use Lagranian mechanics to tackle velocity-dependent potentials
5. Review some techniques of the calculus of variations
6. Derive Lagrange's equations from Hamilton's Principle
7. Derive the Hamilton equations of motion
8. Apply both Lagranian and Hamiltonian methods for the central force problem
9. Apply both Lagranian and Hamiltonian methods for the rigid body problem
10. Apply both Lagranian and Hamiltonian methods for the small oscillations problem

Course ILOs	**The learning levels to be achieved**					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
1		✓	✓	✓		
2		✓	✓	✓		
3		✓	✓	✓		
4		✓	✓	✓		
5		✓	✓	✓		
6		✓	✓	✓		
7		✓	✓	✓		
8		✓	✓	✓		
9		✓	✓	✓		
10		✓	✓	✓		

٢٢. 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	✓	✓		✓		
6	✓	✓		✓		
7	✓	✓		✓		
8	✓	✓		✓		
9	✓	✓		✓		
10	✓	✓		✓		

٢٣. Topic Outline and Schedule:

Week	Lecture	Topic	ILO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully	Platform Used	Synchronous / Asynchronous	Evaluation Methods	Learning Resources
1	1.1	Analyze the mechanics of a particle	1					
	1.2							
	1.3							
2	2.1	Analyze the mechanics of a system of particles	2					
	2.2							
	2.3							

3	3.1	Derive Lagrange's equations using D'Alembert's principle	3					
	3.2							
	3.3							
4	4.1	Derive Lagrange's equations using D'Alembert's principle	3					
	4.2							
	4.3							
5	5.1	Use Lagranian mechanics to tackle velocity-dependent potentials	4					
	5.2							
	5.3							
6	6.1	Review some techniques of the calculus of variations	5					
	6.2							
	6.3							
7	7.1	Derive Lagrange's equations from Hamilton's Principle	6					
	7.2							
	7.3							
8	8.1	Derive the Hamilton equations of motion	7					
	8.2							
	8.3							
9	9.1	Derive the Hamilton equations of motion	7					
	9.2							
	9.3							
10	10.1	Apply both Lagranian and Hamiltonian methods for the central force problem	8					
	10.2							
	10.3							
11	11.1	Apply both Lagranian and Hamiltonian methods for the central force problem	8					
	11.2							
	11.3							
12	12.1	Apply both Lagranian and Hamiltonian methods for the rigid body problem	9					
	12.2							
	12.3							

13	13.1	Apply both Lagranian and Hamiltonian methods for the rigid body problem	9					
	13.2							
	13.3							
14	14.1	Apply both Lagranian and Hamiltonian methods for the small oscillations problem	10					
	14.2							
	14.3							
15	15.1	Apply both Lagranian and Hamiltonian methods for the small oscillations problem	10					
	15.2							
	15.3							

٢٤. 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
First Exam	30		1,2,3,4	6	On campus
Second Exam	30		5,6,7	11	On campus
Final Exam	40	All	1,2,3,4,5,6,7,8,9,10	15	On campus

٢٥. Course Requirements:

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

N/A

٢٦. Course Policies:

A- Attendance policies: According to JU by-laws. B- Absences from exams and submitting assignments on time: According to JU by-laws. C- Health and safety procedures: N/A D- Honesty policy regarding cheating, plagiarism, misbehavior: According to JU by-laws. E- Grading policy: According to JU by-laws. F- Available university services that support achievement in the course: N/A

٢٧. References:

A- Required book(s), assigned reading and audio-visuals: Classical Mechanics, by H. Goldstein, C. Poole and J. Safko. 3rd edition, Addison Wesley 2002, ISBN 0-201-65702-3. B- Recommended books, materials, and media: Mechanics by Landau and Lifschitz: very concise book, extremely elegant, but it is most useful and best appreciated after you already know the material. Analytical mechanics by Hand and Finch: very readable book, covers all the themes of our text with clearer explanations, but at the expense of less content. Classical Dynamics- A Contemporary Approach by José and Saletan. Classical Dynamics of Particles and Systems by Marion and Thornton.

٢٨. Additional information:

N/A

Name of the Instructor or the Course Coordinator:	Signature:	Date:
Mohammad Hussein		13/11/2024

Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
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Name of the Head of Department	Signature:	Date:
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Name of the Head of Quality Assurance Committee/ School or Center	Signature:	Date:
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Name of the Dean or the Director	Signature:	Date:
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