هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	Classical Mechanics II
Course Code:	PHYS 0312
Program:	Bachelor of Science in Physics (B.S)
Department:	Department of Physics
College:	College of Science
Institution:	Majmaah University
Version:	I
Last Revision Date:	29/ 12/ 2024

Table of Contents

A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods 4

C. Course Content 5

D. Students Assessment Activities 6

E. Learning Resources and Facilities 6

F. Assessment of Course Quality 7

G. Specification Approval 7

A. General information about the course:

1. Course Identification

1. Credit hours: 3(3, 0, 0)					
2. Course type					
A.	☒ University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (5th Level/ 3rd Year)					
4. Course General Description:					
In this course the students will study: Systems of particles, Applications to vibrating systems, rockets and collisions, Plane motion and space motion of rigid bodies, Lagrange's equations, and Hamiltonian theory.					
5. Pre-requirements for this course (if any)**:**					
PHYS 0111					
6. Co-requisites for this course (if any)**:**					
NA					
7. Course Main Objective(s):					
The students will learn the Fourier series to solve boundary problems, D'Alembert's principle, rockets, and applications, Lagrange's equations, and Hamiltonian theory.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3 h / week	100
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand D'Alembert's principle and Hamiltonian theory.	**PLO 1.1**	Lecture Exercises Quizzes Problem-solving	Exams Quizzes Homework Assignments Presentation
1.2	Describe and understand the application of systems, rockets, and collisions.			
...				
2.0	**Skills**			
2.1	Solve the Lagrange's equations.	**PLO 2.2 & 2.3**	Lecture Exercises Quizzes Problem-solving	Exams Quizzes Homework Assignments
2.2	Apply Lagrangian & Hamiltonian methods to complex motion problems.			
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively in groups as well as individuals.	PLO 3.2	Lecture Exercises Quizzes Problem-solving	Exams Quizzes Homework Assignments Presentation
3.2	Present a short report in written form and orally using appropriate scientific language.			

C. Course Content

No	List of Topics	Contact Hours
1.	**Chapter 1: Systems of Particles** Discrete and continuous; rigid and elastic bodies; degree of freedom; center of mass; center of gravity; momentum of a system of particles; motion of the center of mass; conservation of momentum; angular momentum of a system of particles; total external torque acting on a system; relation between angular momentum and total external torque; conservation of angular momentum; kinetic energy of a system if particles; work; potential energy; conservation of energy; motion relative to the center of mass; impulse; constraints; holonomic and non-holonomic constraints; virtual displacements; statics of a system of particles; principle of virtual work; equilibrium in conservative fields; stability of equilibrium; D'Alembert's principle.	**12**
2.	**Chapter 2: Applications to vibrating systems, rockets and collisions** Newton's Vibrating system of particles; problems involving changing mass; rockets; collisions of particles; continuous system of particles, the vibrating string; boundary value problems; Fourier series; odd and even functions; convergence of Fourier series.	**6**
3	**Chapter 3: Plane motion of rigid bodies** Rigid bodies; Euler's theorem; Chasle's theorem; plane motion of a rigid body; moment of inertia; radius of gyration; theorems on moments of inertia; couples; kinetic energy and angular momentum about a fixed axis; motion of a rigid body about a fixed axis; work and power; impulse; the compound pendulum; general plane motion of a rigid body; instantaneous center; space and body centrodes; statics of a rigid body; principle of virtual work and D'Alembert's principle; stability.	**7**
4	**Chapter 4: Space motion of rigid bodies** General motion of rigid bodies in space; pure rotation of rigid bodies; velocity and angular velocity of a rigid body with one point fixed; angular momentum; products of inertia; moment of inertia matrix or tensor; kinetic energy of rotation; principal axes of inertia; angular momentum and kinetic energy about the principal axes; Euler's equations of motion; force free motion; Poinsot's construction; symmetric rigid bodies; the Euler angles; angular velocity and kinetic energy in terms of Euler angles; motion of a spinning top; Gyroscopes.	**8**
5	**Chapter 5: Lagrange's equations** Generalized coordinates; transformation equations; classification of mechanical systems; kinetic energy; generalized forces; Lagrange's equations; generalized momenta; Lagrange's equations for non-holonomic systems; Lagrange's equations with impulsive forces.	**6**

6	**Chapter 6: Hamiltonian theory** The Hamiltonian; Hamilton's equation; the Hamiltonian for conservative systems; ignorable or cyclic coordinates; phase space; Liouville's theorem; the calculus of variations; Hamilton's principle; canonical or contact transformations; generating functions; the Hamilton-Jacobi equation and its solution; phase integrals.	**6**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1*	6	15
2.	H. W	Every week	10
3.	Mid-term 2*	11	15
4.	Presentation	12	10
5.	Electronic exam	13	10
6.	Final exam *	16	40
	Total		100

*Assessment Activities (i.e., **Written test**, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Classical Mechanics (3rd ed.), Goldstein, H.; Poole, C. P.; Safko, J. L. (2001), Addison-Wesley. ISBN 978-0-201-65702-9. • Theory, and problems of Theoretical Mechanics with an introduction to Lagrange's equations and Hamiltonian theory, Schaum's outline series, Murray R. Spiegel, McGraw Hill Book Company, NY, 1967.
Supportive References	• Thornton and Jerry B. Marion. Analytical Mechanics 7th Edition by Grant R. Fowles and George L. Cassiday. • Analytical Mechanics, Hand L.N., Finch J.D., Cambridge University Press, 1998. • Classical Mechanics, Taylor, J.R., University Science Books, 2005.
Electronic Materials	• Saudi Digital Library (SDL) • https://www.wikipedia.org/ • Web of Knowledge • Physics Today (web version)

	• MIT Courseware • www.eagle.co.uk/news/ppnews.html • http://vlib.org/physics.html • http://dir.yahoo.com/science/physics • http://demonstrations.wolfram.com • http://askthephysicist.com • http:// cyberphysics.co.uk
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with at least 25 seats. Auditorium of a capacity of not less than 100 seats for large lecture format classes.
Technology equipment (Projector, smart board, software)	A smart board to write on a computer.
Other equipment (Depending on the nature of the specialty)	Library, Seminar Room, and Wi-Fi internet connections, White board.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	*Internal Reviewer committee*	*Direct*
Effectiveness of Students' assessment	*Students*	*Indirect*
Quality of learning resources	*Peer Reviewer*	*Direct*
The extent to which CLOs have been achieved	*Internal Reviewer committee*	*Direct*
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**1**
DATE	**29/12/2024**