



Course Specification

(Bachelor)

Course Title: **Analytical Mechanics**

Course Code: **PHYS 0415**

Program: **BSc Physics**

Department: **Physics**

College: **Science**

Institution: **Majmaah University**

Version: **1**

Last Revision Date: **30/12/2024**



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: (3,0,0)

2. Course type

A. University College Department Track Others
 B. Required Elective

3. Level/year at which this course is offered: (.....)

4. Course General Description:

The course covers the topics of the dynamics of systems of particles, the elastic and inelastic collisions in center of mass and laboratory coordinates, the mechanics of rigid bodies, and finally the Lagrangian and Hamiltonian mechanics

PHYS 3123 Classical Mechanics II

Classical Mechanics PHYS 0312

6. Co-requisites for this course (if any):

none

7. Course Main Objective(s):

The students will learn a full description for the dynamics of discrete and continuous systems of particles

The students will learn the concept of generalized coordinates and generalized forces

The students will learn Lagrangian and Hamiltonian Mechanics.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> • 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		100%

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.2	comparison between the Lab and the center of mass coordinates. The generalized coordinates in the Lagrangian mechanics, the EulerLagrange equation of motion and the Hamiltonian equatio	K2	Lectures, discussion	Direct (formative and summative): In class interactive questioning, quizzes, written exams Indirect:
2.0	Skills			
2.2	Skills to analytical methods commonly used to treat rigid bodies of mechanics.	S2	Lectures, Discussion, Tutorial	Direct (formative and summative): In class interactive questioning, quizzes, written exams Indirect:
2.4	Develop communication and critical thinking competencies during interactive discussion, group assignments, essays or web-based activities	S4		
3.0	Values, autonomy, and responsibility			
3.3	Develop skills of working in groups in group assignments and discussion		Discussion, question and answer	Direct In class interactive



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	and bear individual responsibility in the assigned tasks	V3		questioning, quizzes, written exams. Indirect: student survey

C. Course Content

No	List of Topics	Contact Hours
1.	<p>Dynamics of systems of particles</p> <p>Introduction: Center of Mass and Linear Momentum of a System</p> <p>Angular Momentum and Kinetic Energy of a System</p> <p>Motion of Two Interacting Bodies: The Reduced Mass</p> <p>The Restricted Three-Body Problem</p> <p>Collisions</p> <p>Oblique Collisions and Scattering: Comparison of Laboratory and Center of Mass Coordinates</p> <p>Motion of a Body with Variable Mass: Rocket Motion</p>	9
2.	<p>Mechanics of Rigid Bodies: Planar Motion</p> <p>Center of Mass of a Rigid Body</p> <p>Rotation of a Rigid Body about a Fixed Axis: Moment of Inertia</p> <p>Calculation of the Moment of Inertia</p> <p>The Physical Pendulum</p> <p>The Angular Momentum of a Rigid Body in Laminar Motion</p> <p>Examples of the Laminar Motion of a Rigid Body</p> <p>Impulse and Collisions Involving Rigid Bodies</p>	12
3	<p>Lagrangian Mechanics</p> <p>Hamilton's Variational Principle</p> <p>Generalized Coordinates</p> <p>Calculating kinetic and Potential Energies in Terms of Generalized Coordinates</p> <p>Lagrange's Equations of Motion for Conservative Systems</p> <p>Some Applications of Lagrange's Equations</p> <p>Generalized Momenta: Ignorable Coordinates</p> <p>Forces of Constraint: Lagrange Multipliers</p> <p>D'Alembert's Principle: Generalized Forces</p> <p>The Hamiltonian Function: Hamilton's Equations</p>	12
4	<p>Dynamics of Oscillating Systems</p> <p>Potential Energy and Equilibrium: Stability</p>	12





<p>Oscillation of a System with One Degree of Freedom about a Position of Stable Equilibrium Coupled Harmonic Oscillators: Normal Coordinates General Theory of Vibrating Systems Vibration of a Loaded String or Linear Array of Coupled Harmonic Oscillators Vibration of a Continuous System: The Wave Equation Motion of a Body with Variable Mass</p>	
Total	45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz	4-5	10
2.	Mid-Term Exam 1	6-8	15
3.	Homework	continuous	10
4.	Presentation and discussion	9-10	10
5.	Mid-Term Exam 2	9-11	15
6.	Final Exam	end	40

*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	Analytical Mechanics, G. R. Fowls and G. Cassiday Thomson Brooks, Cole 2004
Supportive References	Classical Mechanics, Taylor J.R, University Science Books 2005
Electronic Materials	https://www.coursera.org/courses?query=classical%20mechanics
Other Learning Materials	Analytical Mechanics, NIVALDO A. LEMOS

2. Required Facilities and equipment

Items	Resources
<p>facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)</p>	Classrooms





Items	Resources
Technology equipment (projector, smart board, software)	data show, Smart Board, Internet
Other equipment (depending on the nature of the specialty)	Physics lab

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 review	Direct, Indirect
The extent to which CLOs have been achieved	Peer review	Indirect
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	DEPARTMENT COUNCIL
REFERENCE NO.	16
DATE	30/12/2024

