هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Classical Mechanics (2)**
Course Code:	**PHY 1203**
Program:	**Bachelor of Science in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	4
Last Revision Date:	***26/09/2024***

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 3/ Year2)					
4. Course General Description:					
This course deals with fundamental concepts and principles in classical mechanics, applied to particles, systems of particles and rigid bodies. Vector calculus is used extensively to explore topics. The Lagrangian formulation of mechanics is introduced to show its powerful problemsolving ability. Modern notation and terminology are used throughout in support of the course objectives: to facilitate students' transition to advanced physics and the mathematical formalism needed for the quantum theory of physics.					
5. Pre-requirements for this course (if any)**:**					
Classical Mechanics (1), PHY 1105 and Calculus (3), MAT 1203					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Understand the notions of configuration space, generalized coordinates space in mechanics.**
- **Explain various aspects of classical dynamics.**
- **Obtain the Euler-Lagrange equations from the variational principle.**
- **Understand the relation between Lagrange's equations and Newton's laws.**
- **Use Lagrange's equations to solve complex mechanical problems.**
- **Obtain the Hamiltonian formulation of a mechanical system.**
- **Develop problem solving and critical thinking skills.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	
Total		60

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**			
1.1	**Demonstrate and describe the behavior of principle's variations.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the central-force motion and the motion in a non-inertial reference frame.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**State the basic knowledge of Lagrangian and Hamiltonian dynamics.**	**K1, K2**	• Lectures. • Class discussions. Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**Outline the basic knowledge of dynamics of rigid bodies.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and**	**S2, S3**	▪ Problem classes and group tutorial.	▪ Exams. ▪ Discussions. ▪ Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	analyze problems in physics related the topics covered by the course.		Homework assignments as well as problems solutions.	
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Coordinate Systems and Transformation:**Cartesian coordinates; circular cylindrical coordinates; spherical coordinates.	10
2.	**Some Methods in the Calculus of Variations:**Euler's equation, functions with several dependent variables, Euler's equation when auxiliary conditions are imposed.	8
3.	**Lagrangian and Hamiltonian Mechanics:** Hamiltonian's principle, generalized coordinates, Lagrange's equations of motion in generalized coordinates, Lagrange's equations with undetermined multipliers, equivalence of Lagrange's and Newton's equations, a theorem concerning the kinetic energy, conservation theorems, canonical equations of motion–Hamiltonian mechanics.	15
4.	**Central Force Motion:**Reduced mass, conservation theorems-first integrals of the motion, planetary motion-Kepler's problem.	10
5.	**Motion in a non-inertial reference frame:** Rotating coordinate systems, centrifugal and Coriolis forces, motion relative to the earth.	9
6.	**Mechanics of rigid Bodies:**Inertia tensor, angular momentum, principal axes of inertia, moments of inertia for different body coordinate systems, Eulerian angles, Euler's equations for a rigid body.	8
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Class Activities (class quizzes, homework, solving problems, etc.....)	weekly	10 %
2.	Midterm Exam 1	6thweek	25 %
3.	Midterm Exam 2	12thweek	25 %
4.	Final Exam	16thweek	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	- Fowles G.R. and Cassiday G., ***Analytical Mechanics, 7th Edition,*** Brooks Cole Publishing (2004). - Goldstein H., Poole C., and Safko J., ***Classical Mechanics,***3rd Edition, Addison-Wesley (2000).
Supportive References	- Thornton S.T. and Marion J.B., **Classical Dynamics of Particles and Systems,** 5th Edition, Thomas Learning Inc. (2004).
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- **Classrooms.** **-Labs.**
Technology equipment (projector, smart board, software)	- **Classroom equipped with a whiteboard and a projector.**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	- **Students** - **Second examiner**	- **Indirect (The students complete the evaluation forms at the end of term.**

Assessment Areas/Issues	Assessor	Assessment Methods
		- Final exam is evaluated by the second examiner)
Effectiveness of Students assessment	- Instructors	- Direct (exams, HW, project, …)
Quality of learning resources	- Faculty - Students	- Indirect (surveys)
The extent to which CLOs have been achieved	- Instructors - Program Leaders	- Direct (excel sheet)
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Quality Unit-Physics Department
REFERENCE NO.	Department council No. 06
DATE	26/09/2024