# Course Specification
## (Bachelor)

| | |
|---|---|
| **Course Title:** | Classical Mechanics I |
| **Course Code:** | PHYS 0111 |
| **Program:** | BSc in Physics and BSc in Physics of Renewable Energy and Environment |
| **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:

### 1. Course Identification

| 1. Credit Hours: 4 (3,2,0) | | | | | |
|---|---|---|---|---|---|
| **2. Course type** | | | | | |
| **A.** | ☒ University | ☐College | ☒ Department | ☐Track | ☐Others |
| **B.** | ☒ Required | | ☐Elective | | |
| **3. Level/year at which this course is offered: (2nd Level/ First Year)** | | | | | |
| **4. Course General Description:** | | | | | |
| In this course, the students will study Vectors, Velocity and Acceleration, Newton's Law of Motion, Work, Energy, and Momentum, Motion in a Uniform Field, Falling Bodies and Projectiles, the simple harmonic oscillator and the simple pendulum, central forces and planetary motion, and Moving coordinate systems. | | | | | |
| **5. Pre-requirements for this course (if any):** | | | | | |
| PHYS 0101, General Physics 1 | | | | | |
| **6. Co-requisites for this course (if any):** | | | | | |
| NA | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| • The students will learn the calculus of variations and how the two-body central force works and solves problems.<br>• To study mechanics in non-inertial frames and the rotational motion of rigid bodies.<br>• Solve linear oscillation problems and Newton's equations. | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 75 | 100 |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

### 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 45 |
| 2. | **Laboratory/Studio** | 30 |
| 3. | **Field** | |
| 4. | **Tutorial** | |
| 5. | **Others (specify)** | |
| **Total** | | 75 |

## 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** | | | |
| CLO1.1 | Understand Newton's laws of motion. | **K1 & K2** | *Lecture*<br>*Exercises*<br>*Quizzes*<br>*Problem-solving* | *Exams*<br>*Quizzes*<br>*Homework*<br>*Assignments* |
| CLO1.2 | Describe and understand the motion of a mechanical system. | | | |
| ... | | | | |
| **2.0** | **Skills** | | | |
| 2.1 | Solve the Newton's equations for simple configurations using various methods. | *S1* | *Lecture*<br>*Exercises*<br>*Quizzes*<br>*Problem-solving* | *Exams*<br>*Quizzes*<br>*Homework*<br>*Assignments* |
| 2.2 | Apply Newton's laws of motion to solve the problems. | | | |
| ... | | | | |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Work effectively in groups as well as individuals. | *V1* | *Lecture*<br>*Exercises*<br>*Quizzes*<br>*Problem-solving* | *Exams*<br>*Quizzes*<br>*Homework*<br>*Assignments* |
| 3.2 | Present a short report in written form and orally using appropriate scientific language. | | | |
| | | | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| | **Theory:** | |
| 1. | **Chapter 1: Vectors, Velocity and Acceleration**<br>Introduction to Mechanics, Mathematical models; Scalars and vectors; vector algebra; unit vectors, rectangular unit vectors, components of a vector; dot or scalar product; cross or vector product; derivatives of vectors; integrals of vectors; velocity; acceleration; tangential and normal acceleration; circular motion; gradient, divergence, and curl; line integrals; free, sliding and bound vectors. | 8 |
| 2. | **Chapter 2: Newton's Law of Motion, Work, Energy, and Momentum**<br>Newton's Laws; inertial frame of references; absolute motion; work; power; kinetic energy; conservative force fields; potential energy; conservation of energy; impulse; torque and angular momentum; conservation of momentum; conservation of angular momentum; non-conservative forces; statics or equilibrium of particle; stability or equilibrium. | 7 |
| 3 | **Chapter 3: Motion in Uniform Field, Falling Bodies and Projectiles**<br>Uniform force fields; uniformly accelerated motion, assumption of flat earth; freely falling bodies; projectiles; potential energy in a uniform force field; motion in a resisting medium; isolating the system; constrained motion; statics in a uniform gravitational field. | 7 |
| 4 | **Chapter 4: The simple harmonic oscillator and the simple pendulum**<br>The simple harmonic oscillator; amplitude; period and frequency of simple harmonic motion; the energy of a simple harmonic oscillator; the damped harmonic oscillator; overdamped, critically damped, and under-damped motion; forced vibrations; the simple pendulum; the two-and three-dimensional harmonic oscillator. | 8 |
| 5 | **Chapter 5: Central forces and planetary motion**<br>Central forces; properties of central force fields; equations of motion for a particle in a central field; potential energy of a particle in a central field; conservation of energy; determination of the orbit from the central force; determination of the central force from the orbit; conic sections; ellipse; parabola and hyperbola; Kepler's laws of planetary motion; Newton's universal law of gravitation; motion in an inverse square field. | 8 |
| 6 | **Chapter 6: Moving coordinate systems**<br>Non-inertial coordinate systems; rotating coordinate systems; derivative operators; velocity in a moving system; acceleration in a moving system; | 7 |

| | | |
|---|---|---|
| | Coriolis and centripetal acceleration; motion of a particle relative to the earth; Coriolis and centripetal force; moving coordinate systems; the Foucault pendulum. | |
| | Experimental | |
| 1. | Introduction and instructions about the laboratory | 2 |
| 2. | Measuring Length: using a Vernier calipers & a micrometer screw | 4 |
| 3. | Free fall | 4 |
| 4. | Simple pendulum | 4 |
| 5. | Projectile motion | 4 |
| 6. | Hooke's law | 4 |
| 7. | Inclined plane | 4 |
| 8. | Friction | 4 |
| | **Total** | **75** |

## 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.<br>• 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** | • Analytical Mechanics 7th Edition by Grant R. Fowles and George L. Cassiday.<br>• Analytical Mechanics, Hand L.N., Finch J.D., Cambridge University Press, 1998.<br>• Classical Mechanics, Taylor, J.R., University Science Books, 2005.<br>• Laboratory Manuals |
| **Electronic Materials** | • Saudi Digital Library (SDL)<br>• https://www.wikipedia.org/<br>• Web of Knowledge<br>• Physics Today (web version)<br>• MIT Courseware<br>• www.eagle.co.uk/news/ppnews.html<br>• http://vlib.org/physics.html<br>• http://dir.yahoo.com/science/physics<br>• http://demonstrations.wolfram.com<br>• http://askthephysicist.com<br>• http:// cyberphysics.co.uk |
| **Other Learning Materials** | |

## 2. Required Facilities and equipment

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

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | *Internal Reviewer committee* | *Direct* |
| Effectiveness of | *Students* | *Indirect* |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Students' assessment | | |
| 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

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