هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

# Course Specification
(Bachelor)

| | |
|---|---|
| Course Title: | **Classical Mechanics (2)** |
| Course Code: | **2033103-2** |
| Program: | **Bachelor in Physics** |
| Department: | **Department of Physics** |
| College: | **College of Science** |
| Institution: | **Taif University** |
| Version: | **2023** |
| Last Revision Date: | *Pick Revision Date.* |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

**1. Credit hours: ( 2 )**

**2. Course type**

| | | | | | |
|---|---|---|---|---|---|
| A. | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| B. | ☒ Required | | ☐Elective | | |

**3. Level/year at which this course is offered: (5th Level / 1nd Year)**

**4. Course general Description:**

**This course covers important parts in advanced classical mechanics. Students will study two and many Bodies Problem. Lagrange's Equations and their applications will be studied. Finally, Hamiltonian's Equations and their applications are also included.**

**5. Pre-requirements for this course** (if any)**:**

**Classical Mechanics 1 / 2032202-3**

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

None

**7. Course Main Objective(s):**

**Manipulate the physical quantities and the laws of classical mechanics for a discrete or continuous system of material point, within the reference frame of the mass center. Apply the laws of conservation for a two material points system. Extend the idea of coordinates system to the generalized coordinates. Construct the Lagrangian and Hamiltonian for simple mechanical systems, rigid bodies and coupled oscillations , as well as, apply Lagrange and Hamilton equations to determine its motion's differential equations.**

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

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 2 | 100% |
| 2 | E-learning | 0 | 0% |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | 0 | 0% |
| 4 | Distance learning | 0 | 0% |

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

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

## 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 | Define the different physical quantities and write clearly mechanics laws and the expression of Hamiltonian and Lagrangian describing the system motion. | K2 | Lecture<br>Discussion | Written exam |
| 1.2 | Distinguish between coordinates and generalized coordinates. | K2 | Lecture<br>Discussion | Written exam |
| ... | | | | |
| **2.0** | **Skills** | | | |
| 2.1 | Apply classical laws of mechanics and deduce the motion equations of some system. | S1 | Problem solving | Written exam<br>Activities |
| 2.2 | Apply Lagrangian and Hamiltonian equations to some systems and explain the difference by comparison with Newtonian mechanics. | S1 | Problem solving | Written exam<br>Activities |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Show responsibility for | V1 | Groups discussion | Homework |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | working independently and for continuous improvement of personal capacities. | | | |
| 3.2 | Work effectively in groups and exercise leadership when needed. | V2 | Groups discussion | Homework reports And research activities |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Unit 1: Two and many Bodies Problem (method and applications):**<br>• Motion of a system of two bodies<br>• Center of Mass for Particles<br>• Kinetic energy of many particle systems in Laboratory & Centercoordinates<br>• Linear momentum of many particle systems in Laboratory & Centercoordinates<br>• Angular momentum of many particle systems in Laboratory & Centercoordinates<br>Collisions of many particle systems in Laboratory & Centercoordinates | **11** |
| 2. | **Unit 2: Lagrange's Equations:**<br>• Motion of many particle systems<br>• Constrained systems & free systems<br>**First Periodic Exam**<br>• Constrained equations<br>• Generalized coordinates<br>• Generalized forces<br>• Conservative and constrained systems<br>• Lagrange's equation<br>• Lagrange's equations for constrained systems<br>Applications | **2**<br><br><br>**1**<br><br><br>**8** |
| 3. | **Unit 3: Hamiltonian's Equations:**<br>• Generalized momenta and cyclic coordinates<br>**Second Periodic Exam**<br>• conservative laws<br>• Hamiltonian equations of motion<br>• Electromagnetic forces and velocity dependent potential<br>Applications | **1**<br>**1**<br><br>**6** |
| | **Total** | **30** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Activities | Periodically | 20% |
| 2. | Midterm exam | 8th | 15% |
| 3. | Short exam | 13th | 15% |
| 4. | Final exam | 16th | 50% |

*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 | Introduction to Classical Mechanics: With Problems and Solutions by David Morin. Cambridge University Press; 1st edition (2008). |
| Supportive References | • Classical Mechanics by Tom Kibble and Frank Berkshire, Fifth Edition, Imperial College Press, 2004.<br>• H. Goldstein, Classical Mechanics, AdisonWeley Pub. Company (1981). |
| Electronic Materials | • https://sites.google.com/site/aljalaliscientificsite/home/2<br>• http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html<br>• wikipedia.org/wiki/ physics subjects |
| Other Learning Materials | • CD associated with the text books (when available).<br>• Lecture notes and Power Points presentations prepared by the lecturer. |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | • Classrooms |
| **Technology equipment**<br>(projector, smart board, software) | • Data show<br>• Laptop<br>• Smart board |
| **Other equipment**<br>(depending on the nature of the specialty) | • None |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | • Instructor | Indirect |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| | • Program coordinator<br>Departmental council | |
| Effectiveness of Students assessment | • Students | Indirect |
| Quality of learning resources | • Students<br>Instructor Faculty | Indircct |
| The extent to which CLOs have been achieved | • Program leaders<br>Instructor | Direct |
| Other | | |

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

Assessment Methods (Direct, Indirect)

## G. Specification Approval

| | |
|---|---|
| COUNCIL /COMMITTEE | PHYSICS DEPARTMENT COUNCIL |
| REFERENCE NO. | NO. 4-45 |
| DATE | 27/09/2023 (12/03/1445) |

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