



# Course Specification

— (Bachelor)

|  |
|--|
| Course Title: <b>Vibrations and Waves</b>      |
| Course Code: <b>2032201- 4</b>                 |
| Program: <b>Bachelor in Physics</b>            |
| Department: <b>Physics Department</b>          |
| College: <b>College of Science</b>             |
| Institution: <b>Taif University</b>            |
| Version: <b>1</b>                              |
| Last Revision Date: <i>Pick Revision Date.</i> |



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## A. General information about the course:

### 1. Course Identification

1. Credit hours: ( 4 )

#### 2. Course type

A.  University  College  Department  Track  Others

B.  Required  Elective

3. Level/year at which this course is offered: (4<sup>th</sup> Level/ 2<sup>nd</sup> Year)

#### 4. Course general Description:

This course meets 3 times per week 2 for lecture and 1 for Lab. It is an intermediate-level course dealing with vibrations and waves in mechanical, electromagnetic, and quantum contexts. Students will learn almost a broad range of phenomena generated by the presence of vibrations and waves.

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

Calculus (1) 2021204-4

Physics (2) 2032102-4

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

None

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

Establishing a basic knowledge of vibrations and waves. Provide the student with the concepts and mathematical tools necessary to understand and explain a wide range of phenomena related to vibrations and waves.

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

| No | Mode of Instruction  | Contact Hours | Percentage |
|----|--|---------------|------------|
| 1  | Traditional classroom  | 6             | 100%       |
| 2  | E-learning   |               |            |
| 3  | Hybrid <ul style="list-style-type: none"> <li>• Traditional classroom</li> <li>• E-learning</li> </ul> |               |            |
| 4  | Distance learning  |               |            |





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

| No           | Activity          | Contact Hours |
|--------------|-------------------|---------------|
| 1.           | Lectures          | 45            |
| 2.           | Laboratory/Studio | 45            |
| 3.           | Field             |               |
| 4.           | Tutorial          |               |
| 5.           | Others (specify)  |               |
| <b>Total</b> |                   | <b>90</b>     |

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

| Code       | Course Learning Outcomes  | Code of CLOs aligned with program | Teaching Strategies    | Assessment Methods                    |
|------------|---|-----------------------------------|------------------------|---------------------------------------|
| <b>1.0</b> | <b>Knowledge and understanding</b>  |                                   |                        |                                       |
| 1.1        | Identify oscillators in terms of displacement, velocity and energy exchange.                        | K1                                | Lectures<br>Discussion | Written exam                          |
| 1.2        | Name the difference between the types of oscillators using equation of motion                       |                                   | Lectures<br>Discussion | Written exam                          |
| <b>2.0</b> | <b>Skills</b>   |                                   |                        |                                       |
| 2.1        | Classify the waves and oscillators types .  | S1                                | Problem solving        | Written exam<br>Activities            |
| 2.2        | Solve problems involving undamped, damped and forced oscillations and superposition of oscillations | S2                                | Problem solving        | Written exam<br>Activities            |
| <b>3.0</b> | <b>Values, autonomy, and responsibility</b>   |                                   |                        |                                       |
| 3.1        | Work effectively in groups and exercise leadership when needed.                                     | V2                                | Lectures<br>Discussion | Lab reports<br>Lab exam               |
| 3.2        | Act responsibly and be able to prepare a written scientific report                                  | V3                                | Lectures               | Lab reports<br>Lab exam<br>Activities |



### C. Course Content

| No                      | List of Topics   | Contact Hours |
|-------------------------|--|---------------|
| <b>Part1 (Lectures)</b> |  |               |
| 1.                      | <b>Unit1: Simple Harmonic Oscillations.</b> <ul style="list-style-type: none"> <li>Displacement, Amplitude, Frequency, Time Period and Phase.</li> <li>Velocity, Acceleration, Kinetic, Potential and Total Energy</li> <li>Reference Circle. Rotating. Differential Equation of SHM and its Solution</li> </ul>   | 6             |
| 2.                      | <b>Unit2: Free Oscillations of Systems with One Degree of Freedom:</b> <ul style="list-style-type: none"> <li>Mass-Spring system (horizontal and vertical).</li> <li>Simple Pendulum.</li> <li>Torsional Pendulum.</li> <li>Compound pendulum</li> <li>Oscillations in a U-Tube,</li> <li>Oscillations in Electrical Circuits ( LC circuit)</li> </ul>                                   | 6             |
| 3.                      | <b>Unit3: The Damped Harmonic Oscillator:</b> <ul style="list-style-type: none"> <li>The Equation of Motion for a Damped Harmonic Oscillator.</li> <li>Light damping- Heavy damping - Critical damping.</li> <li>Rate of Energy Loss in a Damped Harmonic Oscillator.</li> <li>The quality factor Q of a damped harmonic oscillator.</li> <li>Damped Electrical Oscillations.</li> </ul> | 6             |
| 4.                      | <b>Unit4: Forced Vibrations and Resonance:</b> <ul style="list-style-type: none"> <li>The Equation of Motion of a Forced Harmonic Oscillator</li> <li>Forced oscillations with damping</li> <li>Power Absorbed During Forced Oscillations</li> <li>Resonance in Electrical Circuits</li> <li>Transient Phenomena</li> <li>The Complex numbers and Complex</li> </ul>                     | 6             |
| 5.                      | <b>Unit5: Superposition of Two Collinear Harmonic Oscillations :-</b> <ul style="list-style-type: none"> <li>Linearity and Superposition Principle.</li> <li>Oscillations having Equal Frequencies</li> <li>Oscillations having Different Frequencies (Beats).</li> <li>Superposition of Collinear Harmonic Oscillations with Phase Differences</li> </ul>                               | 3             |
| 6.                      | <b>Unit6: Superposition of Two Perpendicular Harmonic Oscillations :</b> <ul style="list-style-type: none"> <li>Superposition of Two Perpendicular Simple Harmonic Motions</li> <li>Lissajous Figures and their Uses.</li> </ul>   | 3             |
| 7.                      | <b>Unit7: TRAVELLING WAVES</b> <ul style="list-style-type: none"> <li>Physical Characteristics of Waves</li> <li>Travelling Waves</li> <li>Travelling sinusoidal waves</li> <li>The Wave Equation</li> <li>The Equation of a Vibrating String</li> <li>The Energy in a Wave and transport of Energy by a Wave</li> </ul>   | 6             |





|                           |  |           |
|---------------------------|--|-----------|
|                           | <ul style="list-style-type: none"> <li>Waves in Two and Three Dimensions</li> </ul>  |           |
| 8.                        | <b>Unit8: STANDING WAVES</b> <ul style="list-style-type: none"> <li>Standing Waves on a String</li> <li>Standing Waves as the Superposition of Two Travelling Waves</li> <li>The Energy in a Standing Wave</li> <li>Standing Waves as Normal Modes of a Vibrating String</li> <li>The superposition principle</li> </ul> | 3         |
| 9.                        | <b>Unit9: System with Two Degrees of Freedom :</b> <ul style="list-style-type: none"> <li>Coupled Oscillators.</li> <li>Normal Coordinates and Normal Modes.</li> <li>Energy Relation and Energy Transfer.</li> <li>Normal Modes of N Coupled Oscillators</li> </ul>   | 3         |
| 10.                       | <b>Revision</b>  | 3         |
| <b>Part2 (Laboratory)</b> |  |           |
| 1.                        | Introduction   | 3         |
| 2.                        | Experiment 1: Simple Pendulum  | 3         |
| 3.                        | Experiment 2: Compound pendulum  | 3         |
| 4.                        | Experiment 3: Mass-Spring system   | 3         |
| 5.                        | Experiment 4: Oscillations in Electrical Circuits ( LC circuit   | 3         |
| 6.                        | Experiment 5: Damped Oscillations  | 6         |
| 7.                        | Experiment 6: Driven Harmonic Oscillator   | 3         |
| 8.                        | Experiment 7: Resonance in electric circuit  | 3         |
| 9.                        | Experiment 8: Velocity of Sound using Resonance Tube   | 3         |
| 10.                       | Experiment 9: Sonometer  | 3         |
| 11.                       | Revision   | 6         |
| 12.                       | Reports evolution and practical exam   | 6         |
| <b>Total</b>              |  | <b>90</b> |

#### D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|----|-------------------------|--------------------------------|--------------------------------------|
| 1. | Midterm exam 1          | 8th - 9th                      | 20%                                  |
| 2. | Midterm exam 2          | 13th - 14th                    | 10%                                  |
| 3. | Activities              | Periodically                   | 10%                                  |
| 4. | Lab reports             | Weekly/ 13th                   | 15%                                  |
| 5. | Final Lab Exam          | 13th                           | 5%                                   |
| 6. | Final exam              | 15th                           | 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

|                                 |  |
|---------------------------------|--|
| <b>Essential References</b>     | VIBRATIONS AND WAVES, George C. King, A John Wiley and Sons Ltd, Great Britain, Wiltshire (2009)<br>ISBN 978-0-470-01188-1 (HB)<br>ISBN 978-0-470-01189-8 (PB) |
| <b>Supportive References</b>    | Vibrations and Waves, A.P. French , imprint: CRC Press (2017)<br>ISBN: 9781482289350   |
| <b>Electronic Materials</b>     | Interactive simulations for science and math:<br><a href="https://phet.colorado.edu/">https://phet.colorado.edu/</a>   |
| <b>Other Learning Materials</b> | Lecture notes and PowerPoint presentations prepared by the lecturer.   |

### 2. Required Facilities and equipment

| Items   | Resources  |
|---|--|
| <b>Facilities</b><br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | <ul style="list-style-type: none"> <li>Classrooms</li> <li>Vibration and waves physics laboratory</li> </ul> |
| <b>Technology equipment</b><br>(projector, smart board, software)                         | <ul style="list-style-type: none"> <li>Data show</li> <li>Laptop</li> <li>Smart board</li> </ul>             |
| <b>Other equipment</b><br>(depending on the nature of the specialty)                      | None   |

## F. Assessment of Course Quality

| Assessment Areas/Issues                     | Assessor   | Assessment Methods |
|---|--|--------------------|
| Effectiveness of teaching                   | <ul style="list-style-type: none"> <li>Students</li> </ul>   | Indirect           |
| Effectiveness of Students assessment        | <ul style="list-style-type: none"> <li>Program coordinator</li> <li>Advisory council</li> <li>Faculty</li> </ul> | Indirect           |
| Quality of learning resources               | <ul style="list-style-type: none"> <li>Students</li> <li>Faculty</li> </ul>                                      | Indirect           |
| The extent to which CLOs have been achieved | <ul style="list-style-type: none"> <li>Program coordinator</li> <li>Faculty</li> </ul>                           | 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)    |

