** University of Management and Technology**

**School of Science and Technology**

**Department of Physics**

**Course Code** **PH-103**

**Course Title: WAVES AND OSCILLATIONS**

**Program: BS (PH/MA)**

**Course Outline**

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| --- | --- | --- | --- | --- | --- |
| **Schedule** | Tuesday----Thursday (8:00 a.m – 9:15 a.m) | **Pre-requisite** | | PH-101 Mechanics | |
| **Course Coordinator** | Syed Nasrullah Ali Qazi | **Contact** | | nasrullah.qazi@umt.edu.pk | |
| **Course**  **Description** | Waves and vibrations are present in almost all physical systems, from the vibrations in strings to the waves of the oceans and atmosphere and to propagation of Electromagnetic(light) waves. Waves and patterns are also seen in chemical and living systems. This course is an introduction to the theory of waves; starting from description of the state of mater this course will explain the fluids, elasticity & oscillations in solids, simple harmonic motion, waves and types of waves, sound waves and elementary ideas about sound waves like timber, beats, Doppler effect. In further, we apply the concepts of waves to explore the EM or light wave phenomena. This includes in exploring various phenomena and properties of light such as reflection, refraction, interference, diffraction and polarization  The learning in this course is strengthened by related lab work. | | | | |
| **Expected**  **Outcomes** | The Participants will learn unified mathematical theory of oscillations and waves in physical systems. They will also be ready for advance courses like modern physics.  . | | | | |
| **Text**  **Book** | Physics, Volume I,II 5th Edition: Resnick, Halliday and Krane  University Physics 13th Edition, Young and Freedman, (Reference book) | | | | |
| **Assignment & Projects** | Problems will be assigned at regular intervals as an assignment.  Marks will be deducted for late submission. | | **Quizzes** | | All quizzes will be announced well before time.  No make-ups will be offered for missed quizzes. |
| **Mid Term**  **Examination** | A 60-minutes exam will cover all the material covered during the first 14-16 lectures.  Combined Mid Term exam for all multiple sections. | | **Final**  **Examination** | | A 120-minutes exam will cover all the material covered during the semester.  Combined Final exam for all multiple sections. |
| **Attendance**  **Policy** | Students missing more than 20% of the lectures will receive an “SA” grade in the course and will not be allowed to take final exam. | | | | |
| **Grading**  **Policy** | Assignment + Quizzes: 20%  Mid Term Examination: 20%  Final Examination: 60% | | | | |

Waves and Oscillations

**Lecture Plan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Week** | **Lecture**  **#** | **TOPICS** | **CH** | **SECTIONS** |
| 1 | 1  2 | Fluid Statics, Pressure and Density,  Variation of Pressure, Archimedes Principle, Measurement of Pressure | 15  15 | 1 – 2  3 – 5 |
| 2 | 1  2 | Fluid dynamics, Equation of continuity  Bernoulli’s equation | 16  16 | 1-2  3 |
| 3 | 1  2 | Spring, Simple Harmonic Motion  Energy of SHM, Applications of SHM and circular motion | 17  17 | 1-3  4-6 |
| 4 | 1  2 | The damped, forced oscillations and resonance  Wave motion, types of waves, travelling waves | 17  18 | 7-8  1-3 |
| 5 | 1  2 | Energy in Wave Motion, principle of superposition, Interference of waves, Standing waves, Standing waves and Resonance | 18  18 | 6-7  8– 10 |
| 6 | 1  2 | Properties of sound waves, traveling sound waves and speed of sound  Interference of Sound waves and Standing Longitudinal Waves | 19  19 | 1 – 3  5-6 |
| 7 | 1  2 | Beats and Doppler Effect  Electromagnetic Spectrum, Visible Light, Speed of Light | 19  39 | 8-9  1-3 |
| 8 | 1  2 | Reflection and Refraction, Internal Reflection  Doppler Effect | 39  39 | 4-5  6 |
| 9 | 1  2 | Two source interference, double slit interference  Coherence, intensity in double-slit interference | 41  41 | 1-2  3-4 |
| 10 | 1  2 | Diffraction and wave theory of light, single slit diffraction  Intensity in single slit diffraction, diffraction at circular aperture | 42  42 | 1-2  3-4 |
| 11 | 1  2 | Multiple slits  Diffraction gratings, dispersion and resolving power | 43  43 | 1  2-3 |
| 12 | 1  2 | X-ray diffraction  Polarization of electromagnetic waves, Polarizing sheets | 43  44 | 4  1-2 |
| 13 | 1  2 | Polarization by Reflection, double refraction  Circular Polarization | 44  44 | 3-4  5 |
| 14 | 1  2 | Revision week |  |  |
| 15 | 1  2 | Revision week |  |  |

PH 103 Waves and Oscillations Lab

**Lab Work**

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| --- | --- |
| **Lab Policy** | Students are expected to perform experiments (as per attached list) related to the course work, analyze the data, draw conclusions, and write a report. Grades will be awarded based on student’s lab reports and a final exam in the lab. |
| **Grading**  **Policy for Lab work** | Laboratory Reports 12 Marks  Final Examination 08 Marks |
| **Make-up Labs** | If due to an unavoidable circumstance a student has to miss a Lab, then he/she should obtain an excuse for this from the instructor. The instructor will accept an excuse only if he feels that the student had a genuine reason. In an accepted case the instructor may allow the student to take a make-up session. |
| **Attendance**  **Policy** **for Lab** | Students missing more than 20% of the Labs. (Excused or unexcused) will receive an “SA” grade in the Lab work. |

**OVERALL POLICY:**

* **Student has to pass both Course work and Lab work separately.**
* **Student failing in the Course work but passing in the Lab work, has to repeat both Course work and Lab work.**
* **Student failing in the Lab work but passing in the Course work, has to repeat Lab work alone.**

Department of Physics

Waves and Oscillations Lab

(PH-103)

List of Experiments

|  |  |  |
| --- | --- | --- |
| **Week** | **Exp No.** | **Title of Experiment** |
| 1st |  | **Lab Orientation Week** |
| 2nd | 1 | **Buoyant forces**  To study buoyant forces and use Archimedes’ principle to determine the density of a material. |
| 3rd | 2 | **Compound pendulum and angular motion**  To measure the acceleration due to gravity and the radius of gyration of a bar. |
| 4th | 3 | **Standing waves on a string**  To investigate standing waves in a vibrating string, to measure the frequency of a vibrator. |
| 5th | 4 | **Young’s Modulus**  To study the elasticity of a metal wire and determine the Young’s modulus **“***Y***”** by using Searle’s apparatus. |
| 6th | 5 | **Modulus of rigidity of thin rod**  To determine the modulus of rigidity of thin rod by Maxwell’s needle(Dynamic method). |
| 7th | 6 | **To calibrate a given thermocouple using a potentiometer and a thermometer** |
| 8th | 7 | **To determine the value of “Mechanical Equivalent of heat”** |
| 9th | 8 | **Measurement of the speed of sound in air**  To measure the speed of sound in air using resonance method. |
| 10th | 9 | **Thermal expansion( Analysis of data)**  To learn how the deflection at the centre of the wire varies with the current. |
| 11th | 10 | **Standing waves on a wire ( Analysis of data)**  To analyze the data on the variation of resonant length of a wire with frequency. |
| 12th | 11 | **The Volume of N2 as a function of pressure (Analysis of data)**  To analyze data on the variation of volume of a gas with pressure. |
| 13th | **Revision Week** | |
| 14th | **Lab Final Examination** | |
| 15th | Week for Preparation of Theory Final Examination | |

\* The listed sequence of the experiments may vary from student-to-student. However, each student must perform all the listed experiments.