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|  | **Mutah University**  **Detailed Syllabus Form** | Description: C:\Users\lamasat.lamasat-PC\Pictures\Picture1.png |

**First :** Course Information**:**

|  |  |
| --- | --- |
| * Course Number: 0302202 | * Course Title: Physics of Vibrations and Waves |
| * Credit Hours: 3 | * College: Science |
| * Pre-requisite: General Physics 1 | * Department: Physics |
| * Instructor: Dr. Moayad Al-Sabayleh | * Semester & Academic Year: First Semester 2016/2017 |
| * The time of the lecture: 12 – 1 | * Office Hours: Sunday 10-12 and Tuesday 10-12 |

**Second :** General Course Description

**To give students a basic knowledge to understand the vibrations and waves and to introduce them to its different applications; as well as to teach them the mathematical tools used in their analysis.**

**Third :** Course Objectives

* **Understand and describe simple harmonic motion (SHM), be able to derive the equations of motions for physical systems that undergo SHM and solve;**
* **Be able to use the complex notation for analysing vibrations and waves;**
* **Be able to adapt the general SHM solution for speciﬁc initial conditions;**
* **Understand the general consequences of a non-linear restoring force;**
* **Be able to derive the velocity and acceleration of SHM and the kinetic, potential and total energy of a mechanical system undergoing SHM;**
* **Understand and be able to derive and solve the equations for the damped oscillator in the over damped, critically damped and under damped regimes;**
* **Understand and be able to derive and solve the equations for a forced oscillator;**
* **Understand the concept of resonance and the response of a system (amplitude and phase, power dissipation) as a function of driving frequency and the effects of transients;**
* **Understand and be able to calculate the quality factor Q for damped and driven oscillators;**
* **Understand the principle of linear superposition and the phenomenon of beating;**
* **Understand the concept of coupled oscillators, derive and solve the equations of motion for simple systems and describe motion of coupled oscillators in terms of normal mode solutions;**
* **Understand a wave as a travelling oscillation; understand the concepts of and the differences between transverse and longitudinal waves; know the non-dispersive wave equation and be able to derive it for transverse waves on a string; understand superposition of waves, wave groups and harmonic waves;**
* **Understand and be able to calculate reﬂection, transmission and absorption of travelling waves;**
* **Understand refraction and know Snells law;**
* **Understand the concept and consequences of wave dispersion and be able to identify** **normal and anomalous dispersion;**
* **Understand the concepts of phase and group velocities and be able to calculate these quantities;**
* **Understand standing waves as counter-propagating travelling waves, the concepts of nodes and anti-nodes and how boundary conditions lead to normal modes and harmonics;**
* **Understand and analyses the Doppler effect;**
* **Understand diffraction and interference of waves; understand the importance of relative phase and be able to analyses the summation of waves from two point sources;**

**Fourth:** Expected Learning Outcomes

* **Demonstrate a sound understanding of the behavior of oscillating systems and the associated topic of wave generation and propagation;**
* **Develop the mathematical formalism that describes vibrations, oscillations and waves;**
* **Use that mathematical formulism to become proficient in the solution of analytical and numerical problems in vibratory and wave phenomena;**
* **Recognize a whole host of examples of oscillatory and wave phenomena and devices across a wide and diverse range of domains in physics.**

**Fifth :** Course Plan Distribution & Learning Resources

|  |  |  |
| --- | --- | --- |
| **Learning Resources** | **Topics to be Covered** | **Week**  **No.** |
|  | Simple harmonic vibrations |  |
|  | Superposition of two parallel and perpendicular simple harmonic vibrations |  |
|  | Types of damping and damped harmonic oscillation |  |
|  | Methods of describing the damping of an oscillator |  |
|  | Vector form of Ohm's law and impedance |  |
|  | Forced oscillators and resonance |  |
|  | Behavior of displacement and velocity versus driving frequency |  |
|  | Problem on vibration insulation and power supplied to oscillator by driving force |  |
|  | Q value as amplification factor and Q value in terms of the resonance absorption bandwidth |  |
|  | Coupled oscillations and normal coordinates and modes |  |
|  | Coupled oscillations of a loaded string and the wave equation |  |
|  | Transverse wave and the solution of wave equation |  |
|  | Reflection and transmission of waves and energy on a string at a boundary |  |
|  | Standing waves, wave groups and group velocity |  |
|  | Longitudinal waves, sound waves and energy distribution in sound waves |  |
|  | The wave equation for electromagnetic waves and impedance to electromagnetic waves |  |

**Sixth :** Teaching Strategies and Methods

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| --- | --- |
| **Teaching Strategies and Methods** | No |
| **Demonstrating the basic information and principles through lectures**  **and the achieved applications.** | **1** |
| **Discussing phenomena with illustrating pictures and diagrams Solve some example during the lecture.** | **2** |
| **Lecturing method: Blackboard Power point e-learning.** | **3** |
| **Open discussions, Group work, Homework assignments and Small**  **Projects.** | **4** |
| **Encourage the student to look for the information in different**  **References and interactive learning.** | **5** |

**Seventh :** Methods of Assessment

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| --- | --- | --- | --- |
| **Proportion of Final Evaluation** | **Evaluation Methods of** | **Week & Date** | **No.** |
| **20%** | **First Exam** |  | **1.** |
| **20%** | **Second Exam** |  | **2.** |
| **10%** | **Home Work** |  | **3.** |
| **50%** | **Final Exam** |  | **4.** |
| **(100%)** |  | **Total** | |

**Eighth :** Required Textbooks

**- Primary Textbook:**

* **The physics of vibrations and waves, H. J. Pain, Wiley, 6rd (2005).**

**-** **Secondary References**

* **The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988).**

**Ninth :** General Instructions

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| **Additional Notes, Office hours, Incomplete Exams, Reports, Papers, …etc** | **No** |
|  | **1** |
|  | **2** |
|  | **3** |
|  | **4** |
|  | **5** |