| Mechanical Engineering Department | | Faculty of Engineering & Technology |
|---|---|---|

| Department | Course Name | Course Number | Semester |
|---|---|---|---|
| Mechanical Engineering | Mechanical Vibrations | (0904411) | Fall 2017 |

**2005 Course Catalog Description**

Simple harmonic motion. Elements of vibratory systems. Systems with single degree of freedom and applications; damped free vibration, rotating and reciprocating unbalance, vibration isolation and transmissibility, and period excitation, systems with multiple degrees of freedom and applications, methods of finding natural frequencies.

**Instructors**

| Name | E-mail | Sec | Office Hours Sun/Tus/Thu | Lecture Time Sun/Tus/Thu |
|---|---|---|---|---|
| **Dr. Ali Alhadidi** | ahadidi@ju.edu.jo | 1 | 11:00 – 12:00 | 01:00 – 02:00 |

**Text Books**

| | Text book 1 | Text book 2 |
|---|---|---|
| **Title** | Mechanical Vibrations | |
| **Author(s)** | Singiresu S. RAO | |
| **Publisher, Year, Edition** | Addison-Wesley Publishing Company, 2010, 5th Edition. | |

**References**

| | |
|---|---|
| **Books** | 1. Graham Kelly "Mechanical Vibrations; Theory and Applications", Cengage Learning<br>2. S. Graham Kelly "Fundamentals of Mechanical vibrations", McGraw-Hill Book Company.<br>3. W. T. Thomson and M. D. Dahleh "Theory of Vibration with application"<br>4. Leonard Meirovitch " Elementary of Vibration Analysis", McGraw-Hill Book Company. |
| **Journals** | Sound and Vibration, Shock and Vibration |

**Prerequisites**

| | |
|---|---|
| **Prerequisites by topic** | Dynamics, Strength of materials, Differential Equations (ODEs & PDEs) |
| **Prerequisites by course** | Dynamics 0904222 + Applied Math for Mechanical Engineers *0904305* |
| **Co-requisites by course** | - |
| **Prerequisite for** | System Dynamics and Control 0904418 |

**Topics Covered**

| Week | Topics | Chapter | Sections |
|---|---|---|---|
| 1, 2 | Fundamentals of Vibration | **1** | **1 -11** |
| 3, 4, 5 | Free vibration of Degree of Freedom systems | **2** | **1 – 6, 9 -11** |
| 6, 7,8 | Harmonically Excited Vibration | **3** | **1 - 10** |
| 9, 10, 11 | Vibration Under General Forcing Conditions | **4** | **1 – 5, 8 - 10** |
| 12, 13 | Two Degree of Freedom Systems | **5** | **1 - 8** |

**Measurable Student Outcomes (SOs) and Course Outcomes**

| Course Outcome | ABET a -k |
|---|---|
| 1. Derive the equation of motion of single-degree-of freedom system using Newton's second law and energy method | **a** |
| 2. Solve the damped and un-damped free vibration response of SDOF system | **e** |

| | |
|---|---|
| 3. Find the response of SDOF system subjected to general periodic excitation | **e** |
| 4. Formulate the equations of motion of two-degree-of-freedom systems | **a** |
| 5. Determine the forced vibration under harmonic excitation of two-degree-of-freedom systems | **e** |

## Evaluation

| Assessment Tools | Expected Due Date | Weight |
|---|---|---|
| **First Exam** | **Tuesday -> 02 / 11 / 2017 ( 12 - 1)** | **30%** |
| **Second Exam** | **Thursday -> 7 / 12 / 2017 ( 12 - 1)** | **30%** |
| **Final Exam** | **TBA** | **40 %** |
| | | |

## Contribution of Course to Meet the Professional Components

Simple harmonic motion. Elements of vibratory systems. Systems with single degree of freedom and applications; damped free vibration, rotating and reciprocating unbalance, vibration isolation and transmissibility, and period excitation, systems with multiple degrees of freedom and applications, methods of finding natural frequencies.

## Relationship to Student Outcomes (L= Low, M= Medium, H= High)

| SOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Level | H | | | | H | | | | | |

## Relationship to Mechanical Engineering Program Objectives (MEPOs)

| MEPO1 | MEPO2 | MEPO3 | MEPO4 | MEPO5 |
|---|---|---|---|---|
| √ | √ | | | |

| ABET a-k | Relation | Student Outcomes |
|---|---|---|
| **a** | **H** | Ability to apply knowledge of mathematics, science, and engineering |
| **b** | | Ability to design and conduct experiments, as well as to analyze and interpret data |
| **c** | | Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability |
| **d** | | Ability to function on multidisciplinary teams |
| **e** | **H** | Ability to identify, formulate, and solve engineering problems |
| **f** | | Understanding of professional and ethical responsibility |
| **g** | | Ability to communicate effectively |
| **h** | | The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context |
| **i** | | A recognition of the need for, and an ability to engage in life-long learning |
| **j** | | A knowledge of contemporary issues |
| **k** | | Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

## Prepared by

Dr. Ali Hadidi, 17th , September , 2017

Mechanical Vibrations A mass m is suspended at the end of a spring, its weight stretches the spring by a length L to reach a static state (the equilibrium position of the system). Let u(t) denote the displacement, as a function of time, of the mass relative to its equilibrium position. Recall that the textbookâ€™s convention is that downward is positive Then, u > 0 means the spring is stretched beyond its equilibrium length, while u < 0 means that the spring is compressed. Vibrations are oscillations of a mechanical or structural system about an equilibrium position. Vibrations are initiated when an inertia element is displaced from its equilibrium position due to an energy imparted to the system through an external source. A restoring force, or a conservative force developed in a potential energy element, pulls the element back toward equilibrium.Â  Figure 1.1 Vibrations occur in many mechanical and structural systems. If uncontrolled, vibration can lead to catastrophic situations.