Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	Erbil Technical Engineering	
Department	Technical Mechanical and Energy Eng.	
Module Name	Theory of Vibration	
Module Code	VIB605	
Degree	Technical Diploma ☐ Bachler ■ High Diploma ☐ Master ☐ PhD ☐	
Semester	6	
Qualification	PhD in Mechanical Engineering	
Scientific Title	Lecturer	
ECTS (Credits)	5	
Module type	Prerequisite ☐ Core ■ Assist. ☐	
Weekly hours	4	
Weekly hours (Theory)	(2)hr Class	(24)Total hrs Workload
Weekly hours (Practical)	(2)hr Class	(24)Total hrs Workload
Number of Weeks	12	
Lecturer (Theory)	ABDULRAHMAN BAHADDIN SHAKIR	
E-Mail & Mobile NO.	abdulrahman.shakir@epu.edu.iq, 07504748599	
Lecturer (Practical)	ABDULRAHMAN BAHADDIN SHAKIR	
E-Mail & Mobile NO.	abdulrahman.shakir@epu.edu.iq, 07504748599	
Websites		

Course Book

<table>
<tr><td>Course Description</td><td colspan="5">The study of vibration in mechanical systems which is concerned with the oscillatory motions of bodies and the forces associated with them. This course aims to provide you with an understanding of the nature and behavior of dynamic engineering systems and the capability of applying the knowledge of mathematics, science, and engineering to solve engineering vibration problems</td></tr>
<tr><td>Course objectives</td><td colspan="5">(Vibration course) aims are acquire the ability to
(1) Formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
(2) Determine a complete solution to mechanical vibration problems using mathematical or numerical techniques.
(3) Determine physical and design interpretations from the results.</td></tr>
<tr><td>Student's obligation</td><td colspan="5">Student's obligation In the Mechanical vibration course is:
• Attendance in the all lectures.
• One or more quizzes in each course.
• Attendance in practical hour in Mechanical vibrations lab.
• Exam in end of first course
• Practical exam at end of all courses.</td></tr>
<tr><td>Required Learning Materials</td><td colspan="5">- Data show, and PowerPoint program in teaching in computer hall.
- White board.
- Web site to upload all lecture notes.</td></tr>
<tr><td rowspan="13">Evaluation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td colspan="2">Paper Review</td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Assignments</td><td>Homework</td><td>5</td><td></td><td></td></tr>
<tr><td>Class Activity</td><td>2</td><td></td><td></td></tr>
<tr><td>Report</td><td>5</td><td></td><td></td></tr>
<tr><td>Seminar</td><td>5</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8</td><td></td><td></td></tr>
<tr><td colspan="2">Lab.</td><td>10</td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td>25</td><td></td><td></td></tr>
<tr><td colspan="2">Final Exam</td><td>40</td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td>100</td><td></td><td></td></tr>
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Specific learning outcome:	(Vibration course) the student will be able: 1. To construct the equations of motion from free-body diagrams. 2. To solve for the motion and the natural frequency of (1) a freely vibrating single degree of freedom undamped motion and (2) a freely vibrating single degree of freedom damped motion. 3. To construct the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force. 4. To decompose any periodic function into a series of simple harmonic motions using Fourier series analysis. 5. To solve for the motion and the natural frequency for forced vibration of a single degree of freedom damped or undamped system. 6. To obtain the complete solution for the motion of a single degree of freedom vibratory system (damped or undamped) that is subjected to non-periodic forcing functions. 7. To solve vibration problems that contains multiple degrees of freedom. 8. To obtain design parameters and indicate methods of solution for a complicated vibratory problem.
Course References:	**Key reference:** **1.** Mechanical Vibrations by Sinirseu S. Rao Fifth Edition 2011 **Useful Reference:** **1-** Mechanical Vibrations theory and applications , S Graham Kelly **2-** Theory of Vibration with Application ,W.T. Thomson

Course topics (Theory)	Week	Learning Outcome
Basic concepts of vibration and Introduction to oscillatory motion	1-2	
Free vibration of an undamped single degree of freedom system.	3-4	
Free vibration of a viscously damped single degree of freedom system.	5-6	
Forced vibration of a single degree of freedom system.	7-8	
Two - degree of freedom system.	9-10	

Multi degree of freedom	11-12	
Practical Topics	**Week**	**Learning Outcome**
1. SIMPLE PENDULUM	1-3	
2. LONGITUDINAL VIBRATIONS OF HELICAL SPRING	4-6	
3. SPRING IN SERIES & SPRING IN PARALLEL	7-9	
4. TORSIONAL VIBRATION OF SINGLEROTOR SHAFT SYSTEMS	9-12	
5. TORSIONAL OSCILLATIONS OF A SINGLE ROTOR WITH VISCOUS DAMPING	12-14	

Questions Example Design

EXAMPLE :

A vibrating system consisting of a weight of W = 10 lb and a spring with stiffness k = 20 Ib/in is viscously damped so that the ratio of two consecutive amplitudes is 1.00 to 0.85. Determine:

I. The natural frequency of the undamped system.

2. The logarithmic decrement.
3. The damping ratio.
4. The damping coefficient.
5. The damped natural frequency.

Solution:

1. The undamped natural frequency of the system in radians per second is

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{(20\ \text{lb/in} \times \frac{386\ \text{in/sec}^2}{10\ \text{lb}})} = 27.78\ \ \text{rad/sec}$$

or in cycles per second

$$f = \frac{\omega}{2\pi} = 4.42\ \text{cps}$$

2. The logarithmic decrement is given

$$\delta = \ln\frac{u_1}{u_2} = \ln\frac{1.00}{0.85} = 0.163$$

3. The damping ratio from equation below is approximately equal to

$$\xi = \frac{\delta}{2\pi} = \frac{0.163}{2\pi} = 0.026$$

4. The damping coefficient is obtained from equations

$$c = \xi c_{cr} = 2 \times 0.026\sqrt{(10 \times 20)/386} = 0.037\frac{\text{lb.sec}}{\text{in}}$$

5. The natural frequency of the damped system is given by equation below so that

$$\omega_D = \omega\sqrt{1-\xi^2}$$

$$\omega_D = 27.78\sqrt{1-(0.026)^2} = 27.77\ \text{rad/sec}$$

Extra notes:

External Evaluator

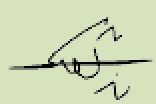
This module catalogue is well organised, covered a wide range of assignment methods which makes it sufficient for students' understanding and knowledge.

1- The course objective is quite clear. It meets the standard requirement for engineering competences by international mechanical engineering organisations; for example, Institute of Mechanical Engineers (IMechE) -the UK.

2- The references are up to dated references.

3- All course topics included in this catalogue is essential for further understanding of Mechanical Engineering and practise them during engineering projects.

Hereby, I confirm that this module catalogue is extremely useful and sufficient in terms of scope and quality for the third-year students in the Department of Mechanical and Energy Engineering at Erbil Polytechnic University.



Dr. Zhwan Dilshad Ibrahim
05/09/2022