

**Name of Institute: Institute of Technology and Engineering**

**Name of Faculty: Dr. Mitesh J Munгла**

**Course code: ME0705**

**Course name: Mechanical Vibration**

Pre-requisites: Strength of Materials, Dynamics of Machines, Credit points: 4

Offered Semester: 7<sup>th</sup>

**Course coordinator (weeks 12)**

Full name: Dr. M. J. Munгла

Department with sitting location: 1<sup>st</sup> floor staff room, Bhanwar building

Email: [miteshmunгла.me@indusuni.ac.in](mailto:miteshmunгла.me@indusuni.ac.in)

Consultation times: 15:30 to 17:00

(Monday to Friday)

**Course lecturer (weeks 12)**

Full name: Prof Akshay Shah

Department with sitting location: 3<sup>rd</sup> Floor staff room, Bhanwar building

Email: [akshayshah.me@indusuni.ac.in](mailto:akshayshah.me@indusuni.ac.in)

Consultation times: 15:30 to 17:00

(Monday to Friday)

Full name: Prof. Ravi Dabla

Department with sitting location: Dh-01, 3<sup>rd</sup> floor, Bhanwar Building

Email: [ravidabla.me@indusuni.ac.in](mailto:ravidabla.me@indusuni.ac.in)

Consultation times: 15:30 to 17:00

(Monday to Friday)

Students will be contacted throughout the session via mail with important information relating to this course.

**Course Objectives**

By participating in and understanding all facets of this course a student will:

- 1) To study basics of vibration.
- 2) To study of single degree of freedom systems- forced undamped and damped vibrations
- 3) To study of Two degree of freedom systems.
- 4) To study Multi-Degree of freedom systems and Natural Frequency calculations.
- 5) To study about continuous system.

**Course Outcomes (CO)**

- 1) Understanding towards the harmonic and periodic motion of body and vibration in mechanical system.
- 2) Able to solve problems related to single and multi-degree of freedom vibratory system.
- 3) Understand the damping phenomenon and the effect of damping in vibratory system.
- 4) Able to solve the problems related to continuous system like beams and modes shapes.
- 5) Understand the vibration measuring techniques and devices.

## Course Outline

This course contains an introductory part of the vibration field. This course will help the student to understand the harmonic motion in mechanical systems and how to solve the elementary problem related to mechanical vibration.

Student will learn the effect of stiffness and damper on single and multi-degree freedom of system and in a system with continuous distributed mass. Along with that introduction of vibration measurement techniques and device are also included in this course.

## Method of delivery

Face to face lectures

## Study time

- 1) Two lectures each of one hour
- 2) One tutorial of two hours
- 3) One lab of two hours

## CO-PO Mapping (PO: Program Outcomes)

- PO1 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10 Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11 Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12 Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	3	-	-	-	-	-	1	-	2
<b>CO2</b>	3	2	2	2	-	-	-	-	-	1	-	2
<b>CO3</b>	3	2	1	1	-	-	-	-	-	2	-	1
<b>CO4</b>	3	3	2	1	-	-	-	-	-	2	-	1
<b>CO5</b>	3	2	3	2		-	-	-	-	2	-	1

1-LightlyMapped

2-ModeratelyMapped

3- HighlyMapped

### Blooms Taxonomy and Knowledge retention

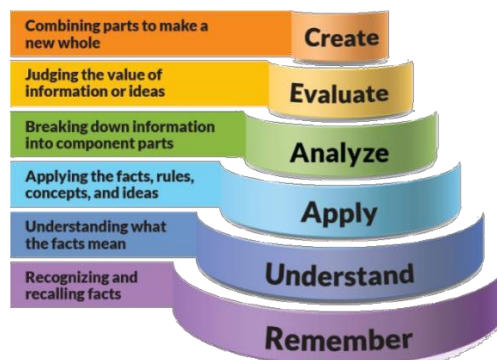


Figure 1: Blooms Taxonomy

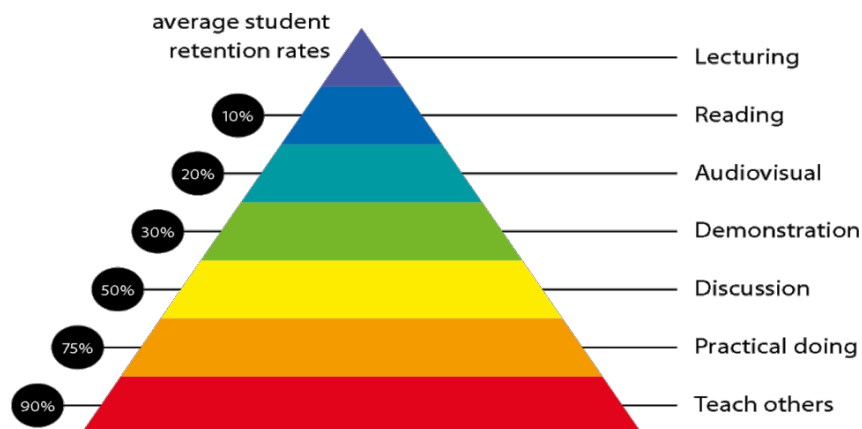


Figure 2: Knowledge retention

## Graduate Qualities and Capabilities covered

General Graduate Qualities	Specific Department of Mechanical Graduate Capabilities
<b>Informed</b> Have a sound knowledge of vibration system study and management, need to study or profession and understand its current issues, locally and internationally. Understand how to apply this knowledge to ground level. Understand how an vibrational system has developed and how it relates to other areas.	<b>1 Professional knowledge, grounding &amp; awareness</b>
<b>Independent learners</b> By case study on vibration lead to develop ideas and ways of thinking and critically analyze issues. By providing expert lecture references help in to get extend subject knowledge. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	<b>2 Information literacy, gathering &amp; processing</b>
<b>Problem solvers</b> Take on challenges and opportunities in industries and organization related to vibration issues by case study. By Demonstration of effect of different type of vibration help in to understand problem faces in industries and try to give solution to resolve problems. Apply creative and logical to respond effectively. Make and implement decisions.	<b>3 Problem solving skills</b>
<b>Effective communicators</b> Report or Assignment writing help in improve written communication. Presentation need to give based on case study or research paper related to course. Work collaboratively and engage with people for innovative ideas related to subject and presentation. Recognize how culture can shape communication.	<b>4 Written communication</b>
	<b>5 Oral communication</b>
	<b>6 Teamwork</b>
<b>Responsible</b> Understand and Implements of science of vibration lead to sustainable design approach. Help in fulfilling in creating a safe structure or machines without harmful environment impact.	<b>7 Sustainability, societal &amp; environmental impact</b>

### Practical work:

1. To study frequency of simple pendulum.
2. To study frequency of compound pendulum.
3. To study frequency of sprig mass system.
4. To study frequency of lateral vibration system.
5. To study frequency of torsion vibration system (single Rotor).
6. To study free damped vibration system.
7. To study whirling speed of shaft.

8. To study forced damped vibration system.
9. To study frequency of simple pendulum with considering mass of the rod.
10. To study frequency of roller rolls without slip inside the cylinder.
11. To study frequency of U tube filled with liquid.

### Lecture/tutorial times

Lecture: 1) As per Time table
2)
Lab: 1)
2)
Tutorial: 1)
2)

### Details of referencing system to be used in written work

Text books, online sources and NPTEL videos.

### Text books

- 1) Mechanical Vibration by Singiresu S. Rao, Pearson Education
- 2) Mechanical Vibrations by G.K. Groover, Nemchand & Bro
- 3) Theory of Vibration With Applications by William Thomson, Marie Dillon Dahleh, Prentice Hall

### Additional Materials

Reference books:

- 1) Theory of Vibration with Application by Willium T Thomson, Pearson Education
- 2) Theory and Problems of Mechanical Vibrations by Graham Kelly, Schaum series
- 3) Fundamental of Mechanical Vibrations by Graham Kelly Mcgrawhill

Online course material:

- 1) <https://nptel.ac.in/courses/112/103/112103111/>
- 2) <https://online.stanford.edu/courses/aa242b-mechanical-vibrations>
- 3) <https://www.coursera.org/learn/fundamentals-waves-vibrations>

## ASSESSMENT GUIDELINES

### 1) Theory Assessment:

a) CIE theory will contain 60 marks and the distribution of marks will be as follows:

Distribution	Marks	Remarks
Mid Semester Examination	40	- Based on your performance in the examination
Assignment	10	- Two Assignments (each of 05 marks) - Assignment 1- Unit 1 & 2 - Assignment 2- Unit 3 & 4
Presentation	05	- Content of presentation will not be from the syllabus topics but must contain the application of subject - Marks will be provided on the basis of content, presentations & communication skills, questionnaires
- Attendance	05	- Bonus for all students having attendance > 80% - On prorata basis having attendance < 80%
<b>Total marks</b>		<b>60</b>

b) ESE theory will contain 40 marks.

### 2) Practical Assessment:

a) CIE practical will contain 60 marks and the distribution of marks will be as follows:

Attendance-10 marks

File Work – 10 marks

Experiment Performance – 20 marks

Question Answer/Viva – 20 marks

b) ESE practical will contain 40 marks.

## SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e. internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

### **Practical Work Report/Laboratory Report:**

A report on the practical work is due the subsequent week after completion of the class by each group.

### **Late Work**

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10% of the maximum mark per calendar day and extra innovative assignments will be provided.

### **Format**

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

*Do not copy the work of other students.*

*Do not share your work with other students (except where required for a group activity or assessment)*

## Course schedule (subject to change)

Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
Weeks 1	Vibration terminology, Harmonic and periodic motions, Beats phenomenon, uses and effects, practical applications and current research trends	1,3	Chalk and talk
Weeks 2	Free undamped vibrations using Newton's second law, D'Alemberts principles, Energy method,	1,3	Chalk and talk
<b>Issue of Assignment 1</b>			
Week 3	Rayleigh's method, free damped vibrations, logarithmic decrement, under damped, over damped and critically damped conditions.	1,3,4	Chalk and talk
Week 4	Forced harmonic undamped vibration, Damped free Magnification factor, Transmissibility,	2	Chalk and talk
Week 5	Vibration Isolation, Equivalent viscous damping, Rotor unbalance, Excitation and Stability analysis	2	Chalk and talk
<b>Submission of Assignment 1 &amp; Issue of Assignment 2 Mid Semester Examination</b>			
Week 6	Generalized and Principal coordinates, derivation of equations of motion,	2,4	Chalk and talk
Week 7	Lagrange's equation, Coordinate coupling, Forced Harmonic vibration	2,4	Chalk and talk
<b>Submission of Assignment 2 &amp; Issue of Assignment 3</b>			
Week 8	Derivation of equations of motion for MDOFs, influence coefficient method,	3,5	Chalk and talk
Week 9	Properties of undamped and damped vibrating systems: flexibility and stiffness matrices, reciprocity theorem, Modal analysis.	2,3	Chalk and talk
<b>Submission of Assignment 3 &amp; Issue of Assignment 4</b>			



Week 10	Rayleigh method, Stodala method, Matrix iteration method , Holzer's method and Dunkerley's method, Whirling Speed of shaft.	3,4	Chalk and talk
Week 11	Introduction to continuous systems, lateral vibration of string, transverse vibrations of the beam, Orthogonality of eigenvectors.	2,3	Chalk and talk
Week 12	Vibration measuring instruments, acceleration and frequency measuring instruments, FFT analyzer.	5	Chalk and talk
<b>Submission of Assignment 4                  &amp;                  Schedule of Extra lectures for any common difficulties/advance learners</b>			

## Program Map

