



**Ahmedabad  
University**

Course	MEC301 Dynamics of Machines and Vibrations	Semester	Monsoon Semester 2024							
Faculty Name(s)	Akhand Rai	Contact	akhand.raai@ahduni.edu.in							
School	SEAS	Credits	3							
GER Category:		Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP							
Schedule	<table> <tr> <td rowspan="2">Section 1</td><td>08:00 am to 09:30 am</td><td>Mon</td><td>01-08-24 to 26-11-24</td></tr> <tr> <td>08:00 am to 09:30 am</td><td>Wed</td><td>01-08-24 to 26-11-24</td></tr> </table>			Section 1	08:00 am to 09:30 am	Mon	01-08-24 to 26-11-24	08:00 am to 09:30 am	Wed	01-08-24 to 26-11-24
Section 1	08:00 am to 09:30 am	Mon	01-08-24 to 26-11-24							
	08:00 am to 09:30 am	Wed	01-08-24 to 26-11-24							
Prerequisite	MAT203 Differential Equations and Linear Algebra & MEC000 Kinematics and Structure of Machines/MEC200 Kinematics and Structure of Machines OR # A preliminary knowledge of the vectors, vector diagrams, computation of resultant vectors will be useful.\\r\\n# A preliminary knowledge of the velocity and acceleration principles in mechanisms will be useful.\\r\\nHowever, a recapitulation of the preliminary concepts will be provided at the beginning of course									
Antirequisite	Not Applicable									
Corequisite	Not Applicable									

Course Description	<p>The course will cover the following topics, systematically divided into four modules to provide a better insight and depth to the students in each topic.</p> <p>Module I: Static and Dynamic force analysis</p> <p>Static force analysis - Applied and Constraint forces, Force conventions, Free body diagrams, Superposition principle, Static Force analysis of planar mechanisms</p> <p>Dynamic force analysis – D'Alembert's principle, Dynamic force analysis of planar mechanisms, Inertia forces and torques, Dynamic force analysis in reciprocating engines, Flywheel, Turning moment diagrams, Energy and Speed fluctuations in engine.</p> <p>Module II: Static and Dynamic Balancing</p> <p>Static and dynamic balancing, Balancing of rotating masses, Balancing a single cylinder engine, Balancing of Multi-cylinder engine, Balancing of reciprocating masses, Partial balancing in engines and its effects</p> <p>Module III: Control mechanisms</p> <p>Governors – Types, Gravity controlled governors, spring controlled governors, Properties of Governor – Sensitiveness, Hunting, Isochronism, and Stability.</p> <p>Gyroscopic effects in machines, Gyroscopic effects in Automobiles, ships and airplanes</p> <p>Module IV: Vibrations</p> <p>Free Vibration - Single degree of freedom system, Free vibration, Undamped and damped vibrations, Governing equations of motion, Natural frequency.</p> <p>Forced Vibration – Forced damped vibrations, Magnification factor, Vibration isolation and Transmissibility</p>
Course Objectives	<ul style="list-style-type: none"> <li>• To understand the concepts of static and dynamic force analysis to rigid bodies and mechanisms.</li> <li>• To understand the static and dynamic balancing of forces arising due to rotating and reciprocating masses.</li> <li>• To understand the functioning and principles of control mechanisms such as governors and gyroscopes.</li> <li>• To understand the concepts of free and forced vibration systems.</li> </ul>

Learning Outcomes	<p>At the end of course, the students should be able</p> <ul style="list-style-type: none"> <li>• To compute the static and dynamic forces involved in rigid bodies and mechanisms.</li> <li>• To compute the balancing masses, forces and their locations in case of rotating and reciprocating masses in mechanism.</li> <li>• To calculate the speed and lift of governors and realize the working principles of a gyroscope</li> <li>• To calculate the natural frequency, displacement, damping, magnification factor for free and forced vibration systems</li> </ul>
Pedagogy	<p><u>Teaching Pedagogy.</u></p> <ul style="list-style-type: none"> <li>• Classroom lectures and presentations,</li> <li>• Demonstration Videos and animations</li> <li>• Problem solving and discussion</li> <li>• Software demo (MATLAB/SolidWorks)</li> <li>• Group Activity and Hands-on exercises</li> </ul> <p><u>Assessment Pedagogy.</u></p> <ul style="list-style-type: none"> <li>• Projects</li> <li>• Assignments</li> <li>• Quizzes</li> <li>• Term Examinations</li> </ul>
Expectation From Students	<ul style="list-style-type: none"> <li>• Active Participation in the class</li> <li>• Submit Assignments on time</li> <li>• Taking interest in Project Assignments</li> </ul>
Assessment/Evaluation	<ul style="list-style-type: none"> <li>• Mid-Semester Examination: <ul style="list-style-type: none"> <li>◦ Written - 25%</li> </ul> </li> <li>• End Semester Examination: <ul style="list-style-type: none"> <li>◦ Written - 35%</li> </ul> </li> <li>• Other Components: <ul style="list-style-type: none"> <li>◦ Project - 10%</li> <li>◦ Assignment - 30%</li> </ul> </li> </ul>
Attendance Policy	As per Ahmedabad University Policy.

Project / Assignment Details	<p># The project assignments will be based on topics covered in the course sessions.</p> <p># The project topics will be given to students by the faculty, however, the students are free to choose project topics</p> <p># The students are expected to bring innovation and creativity in the project through brief literature survey of existing technologies, improvements over the existing designs., etc.</p> <p>#The idea is that the students should not just stick to the given project topic in its basic form but look for other innovations, designs, technological changes going around the world and centered around the project topic.</p> <p># The students must correlate the project activities with the concepts taught in the class</p> <p># The projects will be based on design and development of dynamic systems and software (MATLAB/SolidWorks) simulations</p>
Course Material	<p>Reference Book</p> <ul style="list-style-type: none"> <li>• Theory of Mechanisms and Machines, Amitabha Ghosh &amp; Ashok Kumar Mallik, 3rd Edition Edition, East West Press Pvt. Ltd, ISBN: ISBN: 9788185938936., Year: 2008,</li> <li>• Mechanical Vibrations, S S Rao, 6th Edition Edition, Pearson Education, ISBN: ISBN-13: 978-9353062569, Year: 2018,</li> <li>• Theory of Mechanisms and Machines, Amitabha Ghosh &amp; Ashok Kumar Mallik, 3rd Edition Edition, East West Press Pvt. Ltd, ISBN: ISBN: 9788185938936., Year: 2008,</li> <li>• Mechanical Vibrations, S S Rao, 6th Edition Edition, Pearson Education, ISBN: ISBN-13: 978-9353062569, Year: 2018,</li> </ul>
Additional Information	

## Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
1	Course Overview	Course Overview	Course Outline	Course outline description, teaching pedagogy discussion, assessment pedagogy description	
2	Static and Dynamic force analysis	Static force analysis - Applied and Constraint forces, Force conventions, Free body diagrams,	Textbook 1 Chapter 12	Lecture delivery and discussion	
3	Static and Dynamic force analysis	Superposition principle, Static Force analysis of planar mechanisms	Textbook 1 Chapter 12	Lecture delivery and discussion	
4	Static and Dynamic force analysis	D'Alembert's principle, Dynamic force analysis of planar mechanisms, Inertia forces and torques,	Textbook 1 Chapter 13	Lecture delivery and discussion	
5	Static and Dynamic force analysis	Dynamic force analysis in reciprocating engines	Textbook 1 Chapter 13	Lecture delivery, problem solving and discussion,	
6	Static and Dynamic force analysis	Dynamic force analysis in reciprocating engines	Textbook 1 Chapter 13	Lecture delivery, problem solving and discussion	
7	Static and Dynamic force analysis	Flywheel, Turning moment diagrams	Textbook 1 Chapter 13	Lecture delivery and discussion	
8	Static and Dynamic force analysis	Flywheel, Energy and Speed fluctuations in engine.	Textbook 1 Chapter 13	Lecture delivery and discussion	
9	Static and Dynamic Balancing	Static and dynamic balancing, Balancing of rotating masses	Textbook 1 Chapter 14	Lecture delivery and discussion	
10	Static and Dynamic Balancing	Balancing a single cylinder engine	Textbook 1 Chapter 14	Lecture delivery and discussion	

11	Static and Dynamic Balancing	Balancing of Multi-cylinder engine	Textbook 1 Chapter 14	Lecture delivery and discussion	
12	Static and Dynamic Balancing	Balancing of Multi-cylinder engine	Textbook 1 Chapter 14	Lecture delivery, problem solving and discussion	
13	Static and Dynamic Balancing	Balancing of reciprocating masses	Textbook 1 Chapter 14	Lecture delivery, problem solving and discussion,	
14	Static and Dynamic Balancing	Partial balancing in engines and its effects.	Textbook 1 Chapter 14	Lecture delivery, problem solving and discussion,	
15	Mid-Semester Examination	Mid-Semester Examination	Mid-Semester Examination	Mid-Semester Examination	
16	Control mechanisms	Governors basics and types	Textbook 1 Chapter 16	Lecture delivery and discussion	
17	Control mechanisms	Gravity controlled governors	Textbook 1 Chapter 16	Lecture delivery, problem solving and discussion	
18	Control mechanisms	Gravity controlled governors	Textbook 1 Chapter 16	Lecture delivery, problem solving and discussion	
19	Control mechanisms	Spring controlled governors	Textbook 1 Chapter 16	Lecture delivery, problem solving and discussion	
20	Control mechanisms	Spring Controlled Governors .	Textbook 1 Chapter 16	Lecture delivery and discussion	
21	Control mechanisms	Properties of Governor – Sensitiveness, Hunting, Isochronism, and Stability	Textbook 1 Chapter 16	Lecture delivery and discussion	
22	Control mechanisms	Gyroscope effect in machines	Textbook 1 Chapter 17	Lecture delivery and discussion	
23	Control mechanisms	Gyroscopic effects in ships and airplanes	Textbook 1 Chapter 17	Lecture delivery and discussion	

24	Vibrations - Free Vibration	Single degree of freedom system	Textbook 1 Chapter 18	Lecture delivery and discussion	
25	Vibrations - Free Vibration	Undamped, free vibrations, Natural frequency, Governing Equations of motion	Textbook 1 Chapter 18	Lecture delivery, problem solving and discussion	
26	Vibrations - Free Vibration	Damped free vibrations, Damped Natural frequency, Governing Equations of motion	Textbook 1 Chapter 18	Lecture delivery, problem solving and discussion	
27	Vibrations -Forced Vibration	Forced damped vibrations, Governing Equations of motion, Magnification factor, Vibration isolation and Transmissibility	Textbook 1 Chapter 18	Lecture delivery, problem solving and discussion	
28	Reflection and review-1	Revision and preparation	Revision and preparation	Students can approach the faculty anytime if they have subject doubts	
29	Reflection and review-1	Revision and preparation	Revision and preparation	Students can approach the faculty anytime if they have subject doubts	
30	End-Semester Examination	End-Semester Examination	End-Semester Examination	End-Semester Examination	

