Identification	**Subject**	ME 420 Theory of Machines, 6 ECTS
	Department	Mechanical Engineering
	Program	Undergraduate
	Term	Fall 2024
	Instructor	Dr. Mehdi Kiyasatfar
	E-mail:	mkiyasatfar@khazar.org
	Phone:	
	Classroom/hours	
	Office hours	
Prerequisites	Dynamics	
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	**Textbook:** Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007. **Suggested Course Materials:** 1- F.P. Beer, E.R. Johnston Jr., and W.E. Clausen. Vector Mechanics for Engineers - Dynamics, 7th edition, McGraw-Hill Inc. 2- H.H. Mabie and C.F. Reinholz. Mechanisms and Dynamics of Machinery, 4th edition, Wiley. 3- G.H. Martin. Kinematics and Dynamics of Machines, 2nd edition, McGraw-Hill. 4- Theory of Machines, R. S. Khurmi, J. K. Gupta, S. Chand Publications, New Delhi 2015.	
Course outline	Having a comprehensive understanding of various mechanisms and machines is a fundamental requirement for mechanical engineers to excel in the industry. The Theory of Machines serves as a cornerstone course for mechanical engineers, providing essential insights into the operational principles of any machine. Kinematic and dynamic analysis play pivotal roles in the design of mechanisms and machines. Kinematics of machines entails the examination of the relative motion of different components within a machine, often representing one of the initial considerations for a machine's designer. Meanwhile, the dynamics of machines deals with the forces exerted on these components and the resulting motions induced by these forces. Conducting a dynamic analysis becomes imperative to ensure that rotating and reciprocating parts are appropriately balanced and that all components meet the required strength criteria. Machines are inherently characterized by their need for mobility to fulfill their intended functions. Consequently, this course is indispensable for mechanical engineering students, enabling them to comprehend motion, the transmission of motion, and the forces responsible for instigating and maintaining motion within machines. Theory of Machines is designed to introduce the preliminary concepts of mechanisms and to present methods of analysis for the motion and force transmission in mechanisms, to introduce the approaches and mathematical models used in kinematic and dynamic analysis of machinery, to give basic knowledge on kinematic and dynamic design of machinery, and to give basic knowledge on mechanical vibrations.	
Course objective	• Study the basic components of mechanisms, analyze the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions. • Study the basic concepts of toothed gearing and kinematics of gear trains. • Analyzing the effects of friction in machine elements. • Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms. • Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.	
Learning outcomes	Upon successful completion of this course, the student will be able to:	

<table>
<tr><td></td><td colspan="3">Discuss the basics of mechanism.
Solve problems on gears and gear trains.
Examine friction in machine elements.
Calculate static and dynamic forces of mechanisms.
Calculate the balancing masses and their locations of reciprocating and rotating masses.
Computing the frequency of free vibration, forced vibration and damping coefficient.</td></tr>
<tr><td rowspan="2">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Case analysis and assignments</td><td>x</td></tr>
<tr><td rowspan="7">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>25</td></tr>
<tr><td>Class Participation</td><td>At each lesson</td><td>5</td></tr>
<tr><td>Assignment</td><td>During the semester</td><td>20</td></tr>
<tr><td>Quiz</td><td>During the semester</td><td>10</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">Ethics
Copy of other students' work is highly discouraged. All assignments must be handled by the student himself. This is a university policy and violators will be reprimanded accordingly.
Preparation for class
The structure of this course demands your individual effort outside the classroom for extra practice of many problems within the textbook. After each session, every student needs to put sufficient time to practice and finish the assignments by the predetermined date.
Withdrawal (pass/fail)
This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.
Cheating/plagiarism
Cheating or other plagiarism in handling the assignments, Mid-term and Final Examinations will lead to course failure. In this case, the student will automatically get zero (0), without any considerations.
Professional behavior guidelines
The students shall behave in a way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly discouraged.
Attendance
Students who attend the whole classes will get 5 marks. for three absence student loses 1 mark.
Quiz
There will be quizzes for checking understanding of content during class. We are not going to give make-up for a missing quiz due to any reason other than medical report.
Assignment
There will be a homework assignment for every chapter composed of exercises and problems.</td></tr>
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Tentative Schedule		
Week	**Topics**	**Textbook/Assignments**
1	Fundamental concepts, Definitions; geometrical categorization of mechanisms; mobility; kinematic inversion; Grashof's law.	Chapter 1
2	Intro. Graphical solution of vector equations.	Chapter 2
3	Definitions; velocity polygons; apparent linear velocity of a point; apparent angular velocity; instant centers of velocity.	Chapter 3
4	Linear acceleration; angular acceleration; acceleration difference vector;	Chapter 4
5	Acceleration polygons; apparent acceleration; instant centers.	Chapter 4
6	Acceleration polygons; apparent acceleration; instant centers.	Chapter 4
7	Preliminaries; forces acting on links; graphical analysis and superposition; analytical force balance and matrix solution.	Chapter 5
8	Review **Midterm Exams**	
9	Introduction; balancing of machinery; balancing of rotating shafts. analysis of rotor balancing.	Chapter 6
10	Kinematics of cams, definition and classification; displacement diagrams, cam profile design,	Chapter 7
11	Dynamics of cams, rigid cam systems.	Chapter 7
12	Fundamental law of gearing.	Chapter 8
13	Automotive transmission, Planetary Gears	Chapter 9
14	Mechanical Vibrations	Chapter 10
15	Conclusion – Solve problems	
16	**Final Exam**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.