Ahmedabad University

Course	ENR209 Mechanics of Rigid Bodies	Semester	Monsoon Semester 2024
Faculty Name(s)	Bimal Das, Sham Gurav	Contact	bimal.das@ahduni.edu.in, sham.gurav@ahduni.edu.in
School	SEAS	Credits	2
GER Category:	Humanities and Languages	Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP

Schedule

Section 1	08:00 am to 09:00 am	Mon	30-09-24 to 26-11-24
	08:00 am to 09:00 am	Wed	30-09-24 to 26-11-24
	08:00 am to 09:00 am	Fri	30-09-24 to 26-11-24
	09:00 am to 10:00 am	Fri	30-09-24 to 26-11-24
Section 2	08:00 am to 09:00 am	Wed	30-09-24 to 26-11-24
	08:00 am to 09:00 am	Fri	30-09-24 to 26-11-24
	09:00 am to 10:00 am	Fri	30-09-24 to 26-11-24
	08:00 am to 09:00 am	Mon	30-09-24 to 26-11-24

Prerequisite

Not Applicable
OR
The student must be familiar with high school mathematics

Antirequisite	Not Applicable
Corequisite	Not Applicable
Course Description	This course introduces the fundamental principles of statics and dynamics. Statics covers analysis of forces and moments on structures at rest, ensuring equilibrium. In dynamics, the motion and the forces affecting bodies in motion, covering kinematics and kinetics is discussed. The course emphasizes problem-solving, structural analysis, and the practical application of mechanics principles to engineering systems. Students develop critical thinking skills and proficiency in computational tools, preparing them to address real-world engineering challenges in mechanical systems and structures. Key topics include force systems, equilibrium, internal forces, motion analysis, and energy methods.
Course Objectives	The objectives of the course are to CEO1 Learn the fundamental principles of statics and dynamics in a rigorous manner; CEO2 Comprehend key concepts such as force, moment, equilibrium, kinematics, and kinetics; CEO3 Be able to apply these principles to the design and analysis of structures and mechanical systems; CEO4 Utilize appropriate mathematical methods and tools for problem-solving; and CEO5 Understand the practical implications of theoretical concepts in engineering practice.
Learning Outcomes	After completing this course, a student should be able to, • Understand and apply fundamental principles of statics and dynamics, including forces, moments, equilibrium, motion, and energy; • Determine equilibrium states for various mechanical systems through the application of Newton's laws and equilibrium equations; • Analyze and solve for internal forces in simple structures, utilizing methods, such as, the method of joints and method of sections; • Evaluate the motion of mechanical systems using principles of kinematics and kinetics; • Solve problems involving work, energy, impulse, and momentum in mechanical systems; and • Solve problems involving work, energy, impulse, and momentum in mechanical systems; and

Pedagogy	The course will be lecture based. Concepts will be illustrated with simulations, animations, and videos and photographs from a variety of structural and machine components applications. Some of the problems in the assignments shall be small-project type that will require students to perform a simple experiment and/or observe a real phenomenon. Active learning techniques like group problem-solving and case studies are employed to connect theory with real-world applications. Continuous feedback through quizzes, peer reviews, and reflection activities ensures adaptive learning, promoting a deep and applied understanding of mechanics principles. Some exercises will involve model making using LEGO, Meccano, etc.
Expectation From Students	Students must be interactive in the classroom. • Students should submit the home assignments on time. • Students should be ready to work in groups.

Assessment/Evaluation	• End Semester Examination:
	  ◦ Written - 50%
	• Other Components:
	  ◦ Assignment - 25%
	  ◦ Quiz - 25%

Attendance Policy	As per Ahmedabad University Policy.
Project / Assignment Details	Assignment- 25%- This will be evaluated based on their submission of assignments Quiz- 25% - to assess the students' understanding, application, and integration of the material covered during the course of the lecture
Course Material	Text Book(s) • Vector Mechanics for Engineers – Statics and Dynamics, Beer, F. P. and E. R. Johnston,, 8th edition (2007) Edition, Tata-McGraw-Hill, Reference Book • Engineering Mechanics-Statics and Dynamics, Shames, I. H.,, 4th edition (1996). Edition, , Prentice Hall India Ltd, • Engineering Mechanics Vol-1 & 2, Merriam, J. L. and L. G. Kraige, 5th edition (2007). Edition, Wiley India Ltd.,,
Additional Information	None

Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
0					
1	Introduction,	Tacoma Narrows Bridge Collapse, Visualisation of structures, Rigid bodies and deformable bodies, Degree of freedom.	Beer and Johnston , Chapter 1	Lecture	
2	How does a force arise? Point mass, Consistency of units and dimensions	Resolution of forces, Equilibrium of rigid Body-Free body of Diagram, Supports of joints,	Beer and Johnston , section 2.1,2.2,2.3	Lecture	
3	Force systems,	moment of force, Varignon's theorem.	Beer and Johnston , section,2.3	Lecture	
4	Equilibrium of a particle	Conditions of equilibrium for particle,	Beer and Johnston ,section 2.9, 2.10,2.11	Assignment-1 Numerical problem on equilibrium of body and particle on engineering structures.	
5	Trusses	Method of joints,	Beer and Johnston , Chapter 6	Lecture	
6	Trusses	method of sections, , Idealization of Joints,	Beer and Johnston , Chapter 6	Quiz-1	
7	Trusses	Statically determinate and indeterminate trusses	Beer and Johnston , Chapter 6	Lecture	
8	Friction,	The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Problems Involving Dry Friction, Wedges,	Beer and Johnston , Chapter 8	Lecture	
9	Center of gravity	Determination of centers of gravity and centroids for bodies and areas,	Beer and Johnston , Chapter 5	Assignment-2 Numerical problem on analysis of structures, frictions	

10	Moment of inertia	Calculation of moments of inertia for different shapes	Beer and Johnston , Chapter 9	Lecture	
11	Virtual Work and Potential Energy	Work of a Force, Principle of Virtual Work, Applications of the Principle of virtual Work, Potential energy and Equilibrium, Stability of Equilibrium	Beer and Johnston , Chapter 10	Lecture	
12	Introduction to Dynamics, Kinematics of a Particle: Rectilinear Motion	Overview of dynamics and types of motion. Motion along a straight line, velocity and acceleration relations.	Beer and Johnston , section 11.1	Lecture	
13	Kinematics of a Particle: Curvilinear Motion	Motion along a curved path, normal and tangential components	Beer and Johnston , section 11.9	Lecture	
14	Kinetics of a Particle: Force and Acceleration	Linear Momentum of a Particle.Angular Momentum of a Particle.	Beer and Johnston , Chapter 12	Quiz-2	
15	Kinetics of a Particle: Work and Energy, Impulse and Momentum	Kinetic Energy of a Particle.Principle of Impulse and Momentum	Beer and Johnston , Chapter 13	Lecture	
16	D’ Alembert’s Principle, Work energy method	Principle of Work and Energy, D' Alemberts principle	Beer and Johnston , Chapter 13	Assignment-3 Numerical problem on kinematics and kinetics of particle	
17	Introduction to deformable body	average normal and shear stress, allowable stress, factor of safety		Lecture	
18	Stress-strain relation	The tension test, Hooke's law, and Poisson's ratio, thermal stress., stress-strain curve of engineering materials		Lecture	

19	Doubts clearing session and revision of important Concepts				