Mechanical Engineering

Mechanical engineering combines engineering physics and mathematics principles with materials science to design, analyze, manufacture, and maintain mechanical systems. The mechanical engineering field requires an understanding of core areas including mechanics, dynamics, thermodynamics, materials science, structural analysis, and electricity.

- Structural Mechanics (Wierzbicki)

This text covers the fundamental concepts of structural mechanics with applications to marine, civil, and mechanical structures. Topics include analysis of small deflections of beams, moderately large deflections of beams, columns, cables, and shafts; elastic and plastic buckling of columns, thin walled sections and plates; exact and approximate methods; energy methods; principle of virtual work; introduction to failure analysis of structures.

- Front Matter
- 1: The Concept of Strain
- 2: The Concept of Stress, Generalized Stresses and Equilibrium
- 3: Development of Constitutive Equations of Continuum, Beams and Plates
- 4: Solution Method for Beam Deflections
The Mechanics Map is an open textbook for engineering statics and dynamics containing written explanations, video lectures, worked examples, and homework problems. All content is licensed under a creative commons share-alike license, so feel free to use, share, or remix the content. The table of contents below links to all available topics, while the about, instructor resources, and contributing tabs provide information to those looking to learn more about the project in general.

- Front Matter
  - 1: Basics of Newtonian Mechanics
  - 2: Static Equilibrium in Concurrent Force Systems
  - 3: Static Equilibrium in Rigid Body Systems
  - 4: Statically Equivalent Systems
  - 5: Engineering Structures
  - 6: Friction and Friction Applications
  - 7: Particle Kinematics
  - 8: Newton's Second Law for Particles
  - 9: Work and Energy in Particles
  - 10: Impulse and Momentum in Particles
  - 11: Rigid Body Kinematics
  - 12: Newton's Second Law for Rigid Bodies
  - 13: Work and Energy in Rigid Bodies
  - 14: Impulse and Momentum in Rigid Bodies
Overview of mechanical properties of ceramics, metals, and polymers, emphasizing the role of processing and microstructure in controlling these properties. Basic topics in mechanics of materials including: continuum stress and strain, truss forces, torsion of a circular shaft and beam bending. Design of engineering structures from a materials point of view.

Introduction to Aerospace Structures and Materials (Alderliesten)

This book provides an introduction to the discipline of aerospace structures and materials and includes all relevant aspects of this discipline within a single monograph. These aspects range from materials, manufacturing and processing techniques, to structures, design principles and structural performance, including aspects like durability and safety.
System Design for Uncertainty (Hover and Triantafyllou)

This text covers the design, construction, and testing of field robotic systems, through team projects with each student responsible for a specific subsystem. Projects focus on electronics, instrumentation, and machine elements. Design for operation in uncertain conditions is a focus point, with ocean waves and marine structures as a central theme. Topics include basic statistics, linear systems, Fourier transforms, random processes, spectra, ethics in engineering practice, and extreme events.
This book covers principles of robot motion, forward and inverse kinematics of robotic arms and simple wheeled platforms, perception, error propagation, localization and simultaneous localization and mapping.

- Front Matter
- 1: Introduction
- 2: Locomotion and Manipulation
- 3: Forward and Inverse Kinematics
- 4: Path Planning
- 5: Sensors
- 6: Vision
- 7: Feature Extraction
- 8: Uncertainty and Error Propagation
- 9: Localization
- 10: Grasping
- 11: Simultaneous Localization and Mapping
- 12: RGB-D SLAM
- 13: Trigonometry
- 14: Linear Algebra
- 15: Statistics
- 16: How to Write a Research Paper
- 17: Sample Curricula
- Back Matter

Thumbnail: Archimedes’ screw was operated by hand and could efficiently raise water, as the animated red ball demonstrates. (CC BY-SA 2.5; Silberwolf via Wikipedia)