

Engineering Mechanics

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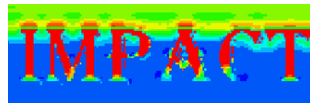
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Integrated Multiscale Predictive & Advanced Characterization Techniques

ME 1020 : Section - I

Location LHC4

Monday 10:00 am – 10:55 am

Wednesday 09:00 am – 09:55 am

Thursday 11:00 am – 11:55 am

Office Hours:

Thursday, 2:30 pm – 3:30 pm

Location: C-505

ME 1020 : Section - I

There are no homework assignments for the course.

Percentage Distribution

- Quiz-I 20%
- Quiz-II 20%
- Quiz-III 20%
- Final Exam 40%

Attendance Policy

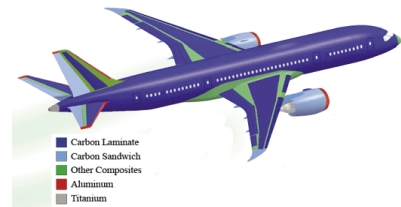
- No penalty for above 80% attendance.
- 2% for 60-80%;
- 4% for 40 - 60%;
- 5% for below 40%.

Why EM?

Prediction

- Will a wheel slip?
- What is the biggest truck that can cross a given bridge?
- What is the relation between gas-ejection rate and thrust in a rocket?
- Which buildings are more likely to fall in what kinds of earthquakes?





Design
Problem?

Governing Laws for systems used in many fields (e.g., thermal protection systems, **aero engines**, **brake systems**, and **nuclear fuel cladding**, etc.).

Defence



Protective Armors Armored Vehicle

Aerospace



Aircraft Engines

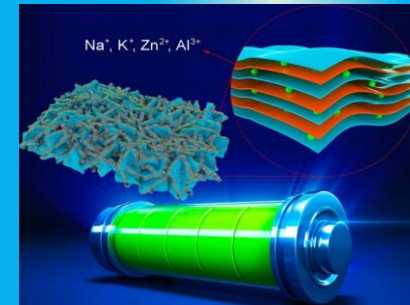
Heat Shield

Biomedical



Medical Implants Artificial Hip Joint

Energy



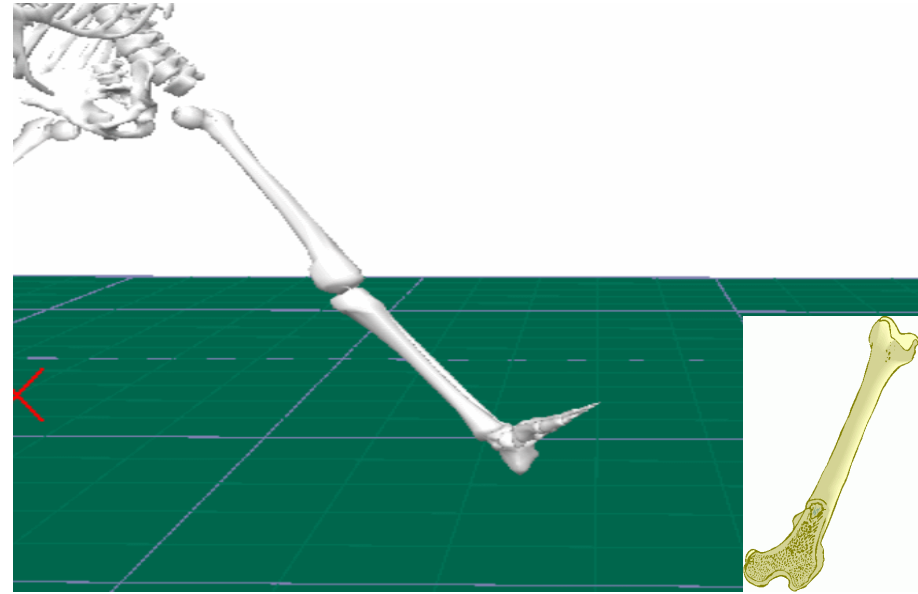
Renewable Energy

Energy Storage

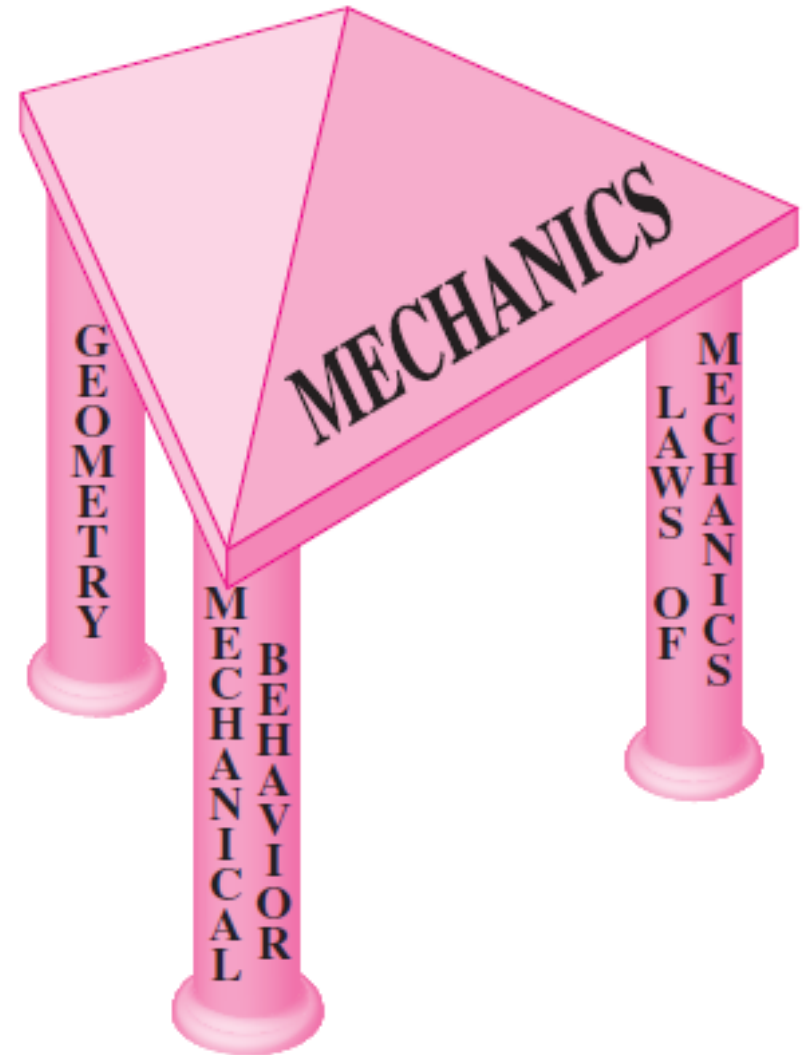








Mechanics?



Engineering Mechanics

Mechanics

Rigid body

Deformable body

Fluid

Statics

Deals with equilibrium of bodies that are either at rest or move with a const velocity

Dynamics

Kinematics

Motion
Displacement
Acceleration
Velocity

Kinetics

Predict motion caused by force

Determine the forces required to produce a given motion

Engineering Mechanics

What is Mechanics?

- ❑ Mechanics is the science that describes and predicts the conditions of rest or motion of bodies under the action of forces.
- ❑ It consists of the mechanics of rigid bodies, mechanics of deformable bodies, and mechanics of fluids.
- ❑ The purpose of mechanics is to explain and predict physical phenomena and to lay the foundations for engineering applications.

Learning Objectives

- Understand the science of mechanics and examine its fundamental principles.
- Develop basic steps for the solution to mechanics problems

ME 1020 : Content

Statics:

Chapter 01: Introduction

Definition of rigid body, statics, dynamics (kinematics and kinetics); Idealizations in mechanics; Vector operations; Resultant of system of coplanar forces (parallelogram law and triangular construction); Free body diagram; Resolution of forces in 3-D; Equilibrium equation

Chapter 02: Shear force and Beam bending

Introduction; Axial force; Free-body diagrams; Equilibrium under the action of a system of forces; Sign convention for shear force, axial force, bending moment and torsional moment; SFD and BMD's for: a) a concentrated load acting on a simply-supported beam b) U.D.L acting on a simply-supported beam c) a concentrated load acting on cantilever d) U.D.L acting on a cantilever beam e) triangular-load distribution acting on a cantilever beam f) a concentrated load applied on a combined beam (two beams hinged in the middle); Relationship between applied load, shear force and bending moment; Method of superposition to obtain SFD and BMD

ME 1020 : Content

Chapter 03: Analysis of trusses

Introduction; Analysis: a) Method of joints b) Method of sections; Special conditions in truss members (zero-force members); Stability of trusses; Space trusses

Chapter 04: Mass and Geometric Properties of Members

Introduction; center of gravity and moment of inertia for simple geometries; Parallel-axis theorem; Perpendicular-axis theorem; Polar moment of area; Second moment of area; Radius of gyration; Product of inertia; Rotation of axes

ME 1020 : Content

Dynamics:

Chapter 05: Kinematics of Rigid Bodies

Kinematics of Particles, Rectilinear motion of particles, curvilinear motion of particles,
Kinematics of rigid bodies

Chapter 06: Kinetics of Rigid Bodies

Kinetics of particles, system of particles, plan motion of rigid bodies, energy and momentum methods, kinetics of rigid bodies in three dimensions

Chapter 07: Vibrations in Simple Mechanical Systems

Introduction; Simple mechanical systems; Features of mechanical systems; Simple harmonic motion; Free and forced vibrations

Energy Methods:

Chapter 08: Energy methods for particles

Introduction; Analysis for a single particle; Analysis for systems of particles

ME 1020 : Section - I

- **Meriam J.L and Kraige L.G.**, Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, New York.
- **Beer F.P. and Johnston E.R.**, Vector Mechanics for Engineers - Volume I - Statics, Volume II - Dynamics, McGraw Hill, New York.
- **Shames L.H.**, **Engineering Mechanics**, Prentice Hall, New Delhi
- **R. C. Hibbler**, Engineering Mechanics, Vols. I and II, Pearson Press.



2023

HAPPY
NEW YEAR