

Course-Plan

MEBT202	Engineering Mechanics	L-T-P-Cr-CH: 3-1-0-4-4	Prerequisite: NIL
----------------	------------------------------	-------------------------------	--------------------------

School : **School of Engineering**
 Department : **Mechanical Engineering**

Instructor: Dr. Seikh Mustafa Kamal
 Assistant Professor, Department of Mechanical Engineering
 Tezpur University
 E-mail: smkmech@tezu.ernet.in
 Telephone: 03712-27-5871 (O)

1. Course Objectives

This is a fundamental course that is designed to provide students a sound understanding of the basic principles of mechanics in order to enable them to endeavour a first-hand analysis for static and dynamical systems. The concepts learned in this course will serve as a prerequisite for higher level courses in mechanics such as Solid Mechanics. The primary objectives of this course are as follows:

1. To introduce the basic principles of mechanics, idealizations to solid bodies with emphasis on their analysis and application to practical engineering problems.
2. To understand the concepts of forces and moments and their effects on rigid bodies.
3. To introduce the concept of free body diagrams.
4. To understand the equilibrium conditions of particles and rigid bodies.
5. To understand and apply different techniques for analyzing the forces and reactions in interconnected rigid bodies and mechanical structures such as trusses and frames.
6. To understand friction between two sliding surfaces and analyze systems involving friction.
7. To determine the centroid and moment of inertia of simple and composite areas.
8. To illustrate the laws of motion, kinematics and kinetics of particles/rigid bodies in rectilinear and polar coordinates.

2. Prerequisites of the course: None.

3. Course outline and Time Plan

Course Contents	L+T
General principles: Mechanics and its relevance in engineering, Review of vector algebra; Transformation of vectors under rotation of coordinate system, Newton's laws, Inertial and non-inertial frames of reference, Idealization in engineering mechanics, General procedure for analysis.	2+0
Force and force systems: Concept of force, Concept of rigid body, Transmissibility of force, Classification of force systems with real life example, Composition of forces, Resolution of forces, Surface and body forces, Distributed and concentrated force, Moment of a force about a point, Moment about an axis, Varignon's theorem, Couple, Moment of a couple, Resolution of a force into a force and couple, Resultant of a force system. (5L+2T)	5+2
Equilibrium of particles and rigid bodies: Necessary and sufficient conditions for equilibrium, Equilibrium condition for two-force and three-force members, Equilibrium conditions for coplanar force system, Interconnected rigid bodies, Free body diagram, Different types of constraints/support reactions for two-dimensional structure, Equilibrium analysis of interconnected rigid bodies, Statically determinate and indeterminate system. (4L+2T)	4+2
Friction and its applications: concept of friction, Coulomb's dry friction model, Laws of friction, Angle of friction, Cone of friction, Experimental determination of coefficient of friction, body on inclined plane involving friction, ladder friction, applications of friction to simple machines (wedge, simple screw jack), rolling resistance. (5L+2T)	5+2
Analysis of Planar Structures: <i>Trusses</i> - Concept of truss	6+2

and its common types; Classification of truss, Analysis of statically determinate truss- method of joints, method of sections, Identification of zero force members; <i>Frames</i> - Concept of frame, Analysis of frames. (6L+2T)	
Method of Virtual Work: Degrees of freedom, Virtual displacement and virtual work, principle of virtual work and its application to structures/machines. (3L+1T)	3+1
Centroid and Moment of Inertia: First moment and centroid of area, Centroid of simple and composite areas, Second moment of area, Parallel and perpendicular axes theorems, Radius of Gyration, Moments of inertia of simple and composite bodies. (4L+2T)	4+2
Kinematics of Particles and Rigid Bodies: Rectilinear motion, Curvilinear motion, Velocity and acceleration in cylindrical and path coordinate system, Relative and constrained motion, Rate of change of a vector in a rotating frame, Three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics. (6L+2T)	6+2
Kinetics of Systems particles and Rigid Bodies: Linear and angular momentum of a system of particles and a rigid body, Newton's second law in rectangular and polar coordinates, D'Alemberts Principle, Work, kinetic energy, power, potential energy, conservative force field, work-energy principle, linear and angular momentum principles, linear and angular impulse, impulse-momentum principle, work-energy principle. (6L+2T)	6+2
Total	41+15

4. Textbooks

1. Hibbeler R.C. and Gupta A., Engineering Mechanics: Statics & Dynamics. Pearson Education Prentice Hall India, New Delhi, 11th edition, 2010.
2. Kumar, K.L. Engineering Mechanics. Tata McGraw Hill, New Delhi, 4th edition, 2010.

5. Reference Books

1. Meriam, J. L., and Kraige, L.G. Engineering mechanics: Statics, Vol. 1. John Wiley & Sons, 7th edition, 2012.
2. Shames, I.H. and Krishna Mohana Rao, G. Engineering Mechanics: Statics and Dynamics. Pearson Education Prentice Hall India, 4th edition, 2011.
3. Meriam, James L., and Kraige, L.G. Engineering mechanics: Dynamics. Vol. 2. John Wiley & Sons, 7th edition, 2012.
4. Beer, F.P., Johnston, E.R., Mazurek, D.F., Cornwell, P.J., Eisenberg, and E.R., Sanghi, S. Vector Mechanics for Engineers: Statics and Dynamics. Tata McGraw Hill, 9th edition, 2011.
5. Timoshenko, S., Young, D.H. and Rao J.V., Engineering Mechanics. Tata McGraw Hill, New Delhi, 5th edition, 2010.

6. Online Resources:

<https://nptel.ac.in/courses/112103108>

<https://nptel.ac.in/courses/115104094>

7. Course Outcomes

Upon completion of the course, the students will be able to

CO1: Solve fundamental problems related to forces being applied to a body under static and dynamic conditions.

CO2: Identify various types of loading and support conditions that act on structural systems and solve for unknown reactions.

CO3: Analyze and solve planar structures such as trusses and frames.

CO4: Analyze and solve various engineering systems involving friction.

CO5: Determine the centroid and second moment of area of composite sections.

CO6: Evaluate the motion of particles and rigid bodies in terms of position, velocity and acceleration in different frames of reference and to analyze the forces causing the motion.

8. Mapping of COs with the Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	1	0	0	0	0	1	0	3	3	0	1
2	3	2	2	1	0	1	0	0	0	1	0	3	3	0	1
3	3	3	3	2	1	1	0	0	0	1	0	3	3	1	2
4	3	3	3	2	1	1	0	0	0	1	0	3	3	1	2
5	3	3	3	2	0	0	0	0	0	1	0	3	3	0	1
6	3	3	3	2	1	1	0	0	0	1	0	3	3	2	3

9. Evaluation Plan

Tests/Exams.	Marks	Duration (minutes)
Test I	10	30
Mid Semester	30	90
Test II (Assignment/term paper/group activity)	10	--
End Semester	50	120
Total	100	

All the tests will be held as per the schedule notified by the Controller of Examinations, Tezpur University.

10. Pedagogy:

Lectures (Blackboard and power point presentation), demonstrations, study groups and project work, Assignments