Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Mechanical Engineering

(Applicable from the academic session 2018-2019)

Subject Code : ES-ME301	**Category:** Engineering Science Courses
Subject Name : Engineering Mechanics	**Semester** : Third
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Objectives:

The objective of this Course is to provide an introductory treatment of *Engineering Mechanics* to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	**Module 1***: Introduction to Engineering Mechanics covering,* Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy.	3
2	**Module 2***: Friction covering,* Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.	4
3	**Module 3***: Basic Structural Analysis covering,* Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.	4
4	**Module 4***: Centroid and Centre of Gravity covering,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.	5
5	**Module 5***: Virtual Work and Energy Method*- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	5
6	**Module 6***: Review of particle dynamics*- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power,	5

	potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).	
7	**Module 7:***Introduction to Kinetics of Rigid Bodies covering,* Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.	5
8	**Module 8:***Mechanical Vibrations covering,* Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.	5
9	**Tutorials** *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack.	12

Course Outcomes:

At the end of this course students will be able to

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of maths and physics to solve real-world problems.
4. 4.Understand measurement error, and propagation of error in processed data.
5. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
6. Understand basic dynamics concepts – force, momentum, work and energy.
7. Understand and be able to apply Newton's laws of motion.
8. Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution.
9. Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces).
10. Learn to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy, and
11. Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

Text /Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications