SHIV NADAR UNIVERSITY

I. **Course Title:** Engineering Mechanics

II. **Course Code:** CED 101

III. **Course Credits (L:T:P):** (3:1:0)

IV. **Course Type:** Major

V. **Prerequisite/s (If Any):** High School Physics and Mathematics

VI. **Course Coordinators/Instructor(s):** Dr. Pavan G. S. & Dr. Gyan Vikash

VII. **School:** School of Engineering

VIII. **Department:** Civil Engineering

IX. **Objective:** The objective of this Course is to provide an introduction of Engineering Mechanics to the students. This course gives the students an opportunity to learn physical and mathematical principles of mechanics and their application to analyze simple as well as complex real world engineering problems. It also serves the purpose to prepare a good foundation for taking up advanced courses in applied mechanics area in the subsequent semesters.

X. **Learning Outcomes:** Upon successful completion of the course, student should be able to

- Draw Free body diagram for any type of structural system
- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts)
- Understand basic dynamics concepts – force, momentum, work and energy
- Understand and be able to apply the concepts of properties of surfaces and solids
- Understand and be able to apply the concept of virtual work principle to solve statically determinate structures, frame and machine

XI. **Course Content:**

Module 1: 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 Indeterminacy

Module 2: 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

Module 3: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia, 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.

Module 4: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack

Module 5: 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.

Module 6: 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, potential energy, impulse-momentum (linear, angular); Impact (Direct and oblique)

Module 7: 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

Module 8: 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

XII. **Recommended 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

XII. **Assessment Scheme:**

[1] Assignment: 10 %
[2] Quiz: 25 %
[3] Mid Semester Exam: 25 %
[4] Final Exam: 40 %