ENGINEERING MECHANICS II

ENME 153

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:
To provide students with a comprehensive understanding of the principles and applications of engineering mechanics (Dynamics), enabling them to analyze and solve complex problems related to motion, forces, and energy within mechanical systems.

1 Introduction to Dynamics (1 hours)

1.1 Definition, classification
1.2 Applications of dynamics

2 Kinematics of Particles: Rectilinear Motion of Particles (5 hours)

2.1 Derivative of vector function
2.2 Velocity and acceleration
2.3 Determination of motion of particles
2.4 Uniform rectangular motion
2.5 Uniformly accelerated rectilinear motion
2.6 Motion relative to a frame in translation
2.7 Constrained motion of several particles
2.8 Graphical interpretations of rectilinear motion

3 Kinematics of Particles: Curvilinear Motion of Particles (4 hours)

3.1 Rectangular components of velocity and acceleration
3.2 Projectile motion
3.3 Tangential and normal components of velocity and acceleration
3.4 Radial and transverse components of velocity and acceleration

4 Kinetics of Particles: Newton's Second Law (6 hours)

4.1 Newton's second law of motion
4.2 Equations of motion and dynamic equilibrium
4.3 Equations of motion: Radial and transverse components
4.4 Newton's law of gravitation
4.5 Motion due to a central force: Conservation of momentum
4.6 Applications to space mechanics

5 Kinetics of Particles: Work-Energy and Impulse- Momentum Principles

(7 hours)

5.1 Conservative and non-conservative forces
5.2 Work done by a force
5.3 Principle of work and kinetic energy
5.4 Principle of conservation of energy
5.5 Linear impulse and momentum principle
5.6 Power and efficiency
5.7 Impulsive motion and impact
5.8 Central impact: Direct and oblique

6 Kinetics of a System of Particles (6 hours)

6.1 Generalized Newton's second law
6.2 Linear and angular moment for systems of particles
6.3 Motion of the mass center
6.4 Kinetic energy of a system of particles
6.5 Work energy principle for a system of particles
6.6 Conservation of energy for a system of particles
6.7 Principle of impulse and momentum for a system of particles
6.8 Equation of motion for system of steady mass flow
6.9 Equation of motion for system with variable mass

7 Plane Kinematics of Rigid Bodies (5 hours)

7.1 Translation, rotation, and general plane motion
7.2 Absolute and relative velocity in plane motion
7.3 Absolute and relative acceleration in plane motion
7.4 Instantaneous center of rotation
7.5 Plane motion relative to a rotating frame: Coriolis acceleration

8 Plane Kinetics of Rigid Bodies: Force, Mass and Acceleration (4 hours)

8.1 Plane motion equation for a rigid body
8.2 Plane motion of a rigid body; D. Alembert's principle
8.3 Application of rigid body motion in the plane
8.4 Constrained plane motion

9 Plane Kinetics of Rigid Bodies: Work-Energy and Impulse- Momentum Principles (7 hours)

9.1 Work of forces and couples
9.2 Kinetic energy for plane motion of rigid body
9.3 Principle of work and energy for a rigid body
9.4 Principle of conservation of energy for a rigid body
9.5 Impulse and momentum for systems of rigid bodies

9.6 Conservation of angular and linear momentum
9.7 Impulsive motion and eccentric impact

Tutorial **(15 hours)**

1. Sample problems related to kinematics of rectilinear motion of particles; Uniformly accelerated motion, dependent motion of several bodies, and relative motion
2. Sample problems related to kinematics of curvilinear motion of particles; Projectile motion, motion analysis based on rectangular components method, normal and tangential components method, and radial and transverse components method
3. Sample problems related to kinetics of particles; Motion under central force, equation of motion defined in terms of rectangular components, normal and tangential components, and radial and transverse components
4. Sample problems related to work, work-energy method, conservation of energy, impulse-momentum method, and central direct and oblique impacts
5. Sample problems related to kinetic of system of particles, system of steady mass flow, and system with variable mass
6. Sample problems related to plane kinematics of rigid body, determination of motion using instantaneous center and relative methods, determination of coriolis component of acceleration
7. Sample problems related to kinetics of rigid body, plane motion equation for constrained motion of body, centroidal and non-centroidal rotation
8. Sample problems related to work, work-energy principle, impulse-momentum principle, conservation of momentum, conservation of energy, and eccentric impact for plane motion of rigid bodies

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution*
1 and 2	6	8
3	4	5
4	6	8
5	7	10
6	6	8
7	5	6
8	4	5
9	7	10
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Bedford, A., Fowler, W. (1995). Engineering Mechanics Dynamics (Latest Edition). Addison-Wesley.
2. Beer, F.P., Johnston, E.R. (2018). Vector Mechanics for Engineers: Dynamics. McGraw-Hill.
3. Hibbeler, R.C. (2004). Engineering Mechanics – Dynamics. Prentice Hall.
4. Meriam, J.L., Kraige, L.G. (2016). Engineering Mechanics: Dynamics. John Wiley & Sons.
5. Shames, I.H. (2005). Engineering Mechanics: Statics and Dynamics. Prentice Hall.