



Index

Chapter 1 : Introduction to Mechanic's 1-1 to 1-6

1.1	Introduction	1 - 1
1.2	Non-Deformable Bodies.....	1 - 1
1.3	Scalars and Vectors	1 - 1
1.4	Force.....	1 - 1
1.5	Mass	1 - 2
1.6	Newton's Laws of Motion.....	1 - 2
1.7	Principle of Transmissibility of Forces.....	1 - 3
1.8	Moment of a Force	1 - 3
1.9	Resolution of a Force into Components.....	1 - 4
1.10	Some Physical Quantities used in Mechanics.....	1 - 6

Chapter 2 : System of Coplanar Forces 2-1 to 2-37

2.1	Types of Force Systems.....	2 - 1
2.1.1	Concurrent Force System	2 - 1
2.1.2	Parallel Force System	2 - 1
2.1.3	General Force System.....	2 - 2
2.2	Resultant of a Given Force System.....	2 - 2
2.3	Composition of Vectors.....	2 - 2
2.3.1	Parallelogram Law of Vector Addition.....	2 - 2
2.3.2	Triangle Law of Vector Addition	2 - 3
2.3.3	Polygon Law of Vector Addition.....	2 - 3
2.4	Subtraction of a Vector From Another	2 - 3
2.5	Varignon's Principle.....	2 - 3
2.6	Couple	2 - 4
2.6.1	Introduction	2 - 4
2.6.2	Important Characteristics of A Couple	2 - 5
2.7	To Calculate Moment of a Force About A Point	2 - 6
2.8	Equivalent Force Systems.....	2 - 7
2.9	Force Couple Systems	2 - 8
2.10	Types of Loads	2 - 9
2.10.1	Concentrated load (Point load)	2 - 9
2.11	Distributed loads.....	2 - 9
2.12	Problems based on Concurrent Force Systems	2 - 10
2.13	Problems based on parallel force systems.....	2 - 16
2.14	Problems based on general force systems.....	2 - 23
2.15	Problems for Practice.....	2 - 34

Chapter 3 : Equilibrium of System of Coplanar Forces 3-1 to 3-43

3.1	Introduction	3 - 1
3.2	Equations of Equilibrium (for Coplanar Force Systems).....	3 - 1
3.3	Free Body Diagram (FBD)	3 - 1
3.4	Types of Supports and Support Reactions	3 - 2
3.5	Two Force Principle	3 - 3
3.6	Three Force Principle	3 - 4
3.6.1	Condition of Concurrency of the Three Forces	3 - 4
3.6.2	Lami's Theorem	3 - 4
3.7	Type of Force System and Number of Unknowns....	3 - 5
3.8	Condition of Equilibrium for Concurrent Forces.....	3 - 5
3.9	Condition of Equilibrium for Parallel Forces	3 - 18
3.10	Condition of Equilibrium for Non-Concurrent and Non-Parallel General Forces and Couples	3 - 19
3.11	Problems Based on Finding Support Reaction of Beams.....	3 - 32
3.12	Problems for Practice	3 - 42

Chapter 4 : Centroid for Plane Areas 4-1 to 4-16

4.1	Introduction	4 - 1
4.2	Meaning of Terms Used for a Plane Lamina (Sheet)	4 - 1
4.2.1	Centroid (G)	4 - 1
4.2.2	Centre of Gravity (CG).....	4 - 1
4.2.3	Centre of Mass (CM).....	4 - 1
4.3	To Locate the Centroid of a Plane Lamina	4 - 2
4.4	Procedure for Obtaining the Centroid Location for a Composite Area.....	4 - 2
4.5	Centroid of Standard Figures.....	4 - 2
4.6	Problems for Practice	4 - 15

Chapter 5 : Friction 5-1 to 5-27

5.1	Introduction	5 - 1
5.2	Nature of Frictional Force	5 - 1
5.3	Reasons Behind Frictional Force.....	5 - 1
5.4	Magnitude of Frictional Force.....	5 - 2
5.5	Laws of Dry Friction (Coulomb Friction)	5 - 3
5.6	Angle of Friction (ϕ).....	5 - 3



5.7	Angle of Repose (θ).....	5 - 3	8.2.5	Speed : (Denoted by v).....	8 - 2
5.8	Cone of Friction.....	5 - 4	8.2.6	Average Velocity in an Interval : (Denoted by v)....	8 - 2
5.9	Problems on Blocks on Horizontal Planes.....	5 - 4	8.2.7	Acceleration : (Denoted by a).....	8 - 2
5.10	Problems on Blocks on Inclined Planes.....	5 - 9	8.2.8	Average Acceleration in an Interval : (Denoted by a).....	8 - 2
5.11	Problems Based on Cylinders.....	5 - 14	8.3	Rectilinear Motion with Uniform Acceleration.....	8 - 2
5.12	Problems on Ladders or Rods.....	5 - 15	8.3.1	Kinematical Equations of Motion.....	8 - 2
5.13	Problems on Tipping.....	5 - 19	8.3.1.1	To Obtain Velocity as a Function of Time.....	8 - 2
5.14	Problems on Wedge Friction.....	5 - 20	8.3.1.2	To Obtain Displacement as a Function of Time.....	8 - 2
5.15	Problems for Practice.....	5 - 26	8.3.1.3	To Obtain Velocity as a Function of Displacement.....	8 - 2
Chapter 6 : Forces in Space			6-1 to 6-21		
6.1	Introduction to Spatial Force Systems.....	6 - 1	8.3.2	Distance Covered in the n^{th} second of Motion.....	8 - 3
6.2	Types of Spatial Force Systems.....	6 - 1	8.4	Rectilinear Motion with Variable Acceleration.....	8 - 8
6.2.1	Concurrent Spatial Force System.....	6 - 1	8.4.1	Equations for Solving Variable Acceleration Problems.....	8 - 8
6.2.2	Parallel Spatial Force System.....	6 - 1	8.4.2	Condition for Maximum Velocity.....	8 - 9
6.2.3	General Spatial Force System.....	6 - 1	8.4.3	Condition for Maximum Value of x (Position).....	8 - 9
6.3	Revision of Basics of Vectors.....	6 - 1	8.5	Motion Curves.....	8 - 13
6.4	Rectangular Components of Force in Space.....	6 - 2	8.5.1	Position–time ($x - t$) Graph.....	8 - 13
6.5	To Express a Force in Vector Form.....	6 - 3	8.5.2	Velocity–Time ($v-t$) Graph.....	8 - 13
6.6	Component of a Force Along a Given Direction.....	6 - 4	8.5.3	Acceleration–time ($a-t$) Graph.....	8 - 14
6.7	Moment of a Force About a Point.....	6 - 5	8.5.4	Relationship between $a - t$, $v - t$ and $x - t$ Graphs.....	8 - 14
6.8	Moment of a Force about a Line (an Axis).....	6 - 6	8.6	Problems for Practice.....	8 - 27
6.9	Resultant of a System of Concurrent Forces.....	6 - 12	Chapter 9 : Kinematics of Particles (Curvilinear Motion)		
6.10	Resultant of a System of Parallel Forces in Space..	6 - 14	9-1 to 9-31		
6.11	To Convert a General Spatial Force System into an Equivalent Force and Couple.....	6 - 16	9.1	Introduction.....	9-1
6.12	Problems for Practice.....	6 - 19	9.2	General Curvilinear Motion.....	9-1
Chapter 7 : Introduction to Dynamics			7-1 to 7-2		
7.1	What is Dynamics.....	7 - 1	9.2.1	Position Vector of a Particle in Curvilinear Motion...	9-1
7.2	Kinematics.....	7 - 1	9.3	Velocity of a Particle in Curvilinear Motion.....	9-1
7.3	Kinetics.....	7 - 1	9.3.1	Acceleration of a Particle in Curvilinear Motion.....	9-2
7.4	Particle.....	7 - 1	9.4	Using Rectangular Components.....	9-2
7.5	Rigid Body.....	7 - 1	9.5	Using Normal and Tangential Components.....	9-2
Chapter 8 : Kinematics of Particles (Rectilinear Motion)			8-1 to 8-29		
8.1	Introduction.....	8 - 1	9.5.1	Radius of Curvature of Path (ρ).....	9-3
8.2	Terms used in Kinematics.....	8 - 1	9.5.2	Use of Kinematic Equations of Motion in Curvilinear Motion.....	9-3
8.2.1	Position : (Denoted by x or y).....	8 - 1	9.6	Projectile Motion.....	9-11
8.2.2	Displacement: (Denoted by s).....	8 - 1	9.6.1	Velocity and Acceleration Components in Projectile Motion.....	9-11
8.2.3	Distance Travelled : (Denoted by d).....	8 - 1	9.6.2	Equation of Path for a Projectile.....	9-12
8.2.4	Velocity : (Denoted by v).....	8 - 2	9.6.3	Maximum Height (H), Time of Flight (T) and Range (R).....	9-12



9.6.4	Normal and Tangential Components of Acceleration during Projectile Motion	9-13
9.6.5	To Find the Radius of Curvature 'ρ' at any Point during Projectile Motion	9-13
9.7	Relative Velocity	9-27
9.8	Problems for Practice	9-29

Chapter 10 : Kinetics of Particles (D'Alembert's Principle) 10-1 to 10-23

10.1	Introduction	10 - 1
10.2	Newton's Second Law of Motion.....	10 - 1
10.3	D' Alembert's Principle	10 - 1
10.3.1	Steps to use D'Alembert's Principle	10 - 1
10.3.2	D'Alembert's Principle for Rectilinear Motion.....	10 - 2
10.3.3	D'Alembert's Principle for Curvilinear Motion	10 - 2
10.4	Problems on Simple Blocks.....	10 - 2
10.5	Problems on Pulleys with Fixed Centres	10 - 8
10.6	Problems on Pulleys with Movable Centres	10 - 12
10.7	Problem Based on Curvilinear Motion	10 - 19
10.8	Problems for Practice	10 - 21

Chapter 11 : Kinetics of Particles (Work Energy Principle) 11-1 to 11-14

11.1	Work Done by a Force	11-1
11.2	Work Energy Principle	11-1
11.3	Work Done by Weight of the Body.....	11-2
11.4	Work done by a Spring Force.....	11-2
11.5	Law of Conservation of Mechanical Energy	11-2
11.6	Power	11-3
11.7	Problems for Practice	11-13

Chapter 12 : Kinetics of Particles (Impulse and Momentum) 12-1 to 12-14

12.1	Impulse of a Force	12-1
12.2	Momentum	12-1
12.3	Impulse Momentum Principle	12-1
12.4	Law of Conservation of Momentum.....	12-2

12.5	Collisions	12-3
12.5.1	Line of Impact	12-3
12.5.2	Coefficient of Restitution 'e'	12-4
12.5.3	Collision between a Ball and a Stationary Surface (Floor / Wall)	12-8
12.5.4	Ball Dropped from Height h_1 Bouncing to Height h_2	12-12
12.6	Problems for Practice	12-13

Chapter 13 : Kinetics of Particles - Combined Problems 13-1 to 13-05

13.1	Summary of Kinetics of Particles (Revision of Concepts).....	13-1
13.1.1	D'Alembert's Principle	13-1
13.1.2	Work Energy Principle (WEP).....	13-1
13.1.3	Impulse Momentum Principle	13-1
13.2	Combination Problems	13-1
13.3	Problems for Practice	13-4

Chapter 14 : Kinematics of Rigid Bodies 14-1 to 14-24

14.1	Plane Motion	14-1
14.2	Fixed Axis Rotation	14-2
14.2.1	Fixed Axis Rotation with Uniform Angular Acceleration	14-2
14.2.2	Velocity and Acceleration of any Point on a Body Performing F.A.R.....	14-2
14.2.3	Fixed Axis Rotation with Variable Angular Acceleration	14-2
14.2.4	Certain Standard Results	14-2
14.3	General Plane Motion.....	14-4
14.4	Instantaneous Centre of Rotation (ICR)	14-4
14.4.1	Methods to Locate the ICR	14-18
14.5	Relative Velocity Method	14-20
14.6	Problems for Practice	14-22

➤ **Appendix - A : Solved University Question Paper of Dec. 2019** A-1 to A-8

