Mechanics exam topics (BMETE11AP59)

Number	Topic	Serway-Jewett 10th ed.
1	Introduction: new SI units, magnitudes, significant digits.	Chapter 1 pp. 2-17
2	Particle kinematics in one dimension: trajectory, derivative, velocity, acceleration, integration. Motion under constant acceleration, free fall.	Chapter 2 pp. 20-44
3	Two-dimensional motion: vectors. Projectiles. Uniform circular motion. Tangential and radial acceleration. Relative velocity and acceleration. Galilei's relativity principle, Galilei transformation.	Chapter 4 pp. 68-88
4	Laws of motion, dynamics. Concept of force and mass, inertial frames, Newton's laws. Forces of friction.	Chapter 5 pp. 95-119
5	Non-uniform circular motion. Motion in accelerated frames with examples. Motion in the presence of resistive forces with examples, terminal velocity.	Chapter 6 pp. 127-143
6	Work, kinetic energy, work theorem. Conservative and non-conservative forces. Potential energy, energy conservation for particles. Energy diagram and equilibrium of a system.	Chapter 7 pp. 150-174
7	Conservation of energy. Isolated and non-isolated systems. Kinetic friction. Changes in mechanical energy for non-conservative systems. Power.	Chapter 8 pp. 181-203
8	Linear momentum. Conservation in isolated and non-isolated systems. Collisions in one and two dimensions. Center of mass.	Sections 9.1-9.6 pp. 210-234
9	Systems of many particles: momentum conservation, energy conservation. Rocket propulsion.	Sections 9.7-9.9 pp. 234-241
10	Rotation of a rigid object about a fixed axis. Angular position, velocity, and acceleration. Angular and translation quantities. Torque. Moment of inertia, Steiner theorem. Rotational kinetic energy. Rolling motion.	Chapter 10 pp. 249-277
11	Vectorial form of angular momentum and torque. Conservation of angular momentum in a system of many particles. Motion of gyroscopes and tops.	Chapter 11 pp. 285-302
12	Change of vector in rotating frames. Inertial forces in rotating frames. Centrifugal and Coriolis forces on Earth.	Supplementary lecture notes
13	Oscillatory motion. Object attached to spring. Simple harmonic motion, energy. Comparison to uniform circular motion.	Sections 15.1-15.4 pp. 386-400
14	Pendulum: mathematical, physical, and torsional. Complex formalism. Superposition of harmonic oscillations, beats. Combining perpendicular oscillations.	Sections 15.5-15.7 pp. 400-407 + supplementary lecture notes

15	Damped and forced oscillations. Q factor. Resonance. Driven RLC circuit.	Supplementary lecture notes
16	Molecular oscillations. Coupled oscillations. Matrix formalism, normal modes.	Supplementary lecture notes
17	Static equilibrium and elasticity. Conditions for static equilibrium. Elastic coefficients, energy. Bending and twisting.	Chapter 12 pp. 310-324
18	Newton's law of universal gravitation. Free fall. Kepler's laws and planetary motion. Gravitational potential energy. Energy considerations in planetary and satellite motion. Equivalence of inertial and gravitational mass.	Chapter 13 pp. 332-352
19	Static fluids and gases. Pascal's law, hydraulic devices. Hydrostatic pressure. Buoyant forces and Archimedes principle.	Sections 14.1-14.4 pp. 358-368
20	Surface tension, Laplace pressure, Young-Laplace equation. Contact angles, capillary phenomena.	Supplementary lecture notes
21	Fluid dynamics. Continuity equation. Bernoulli's equation and its applications.	Sections 14.5-14.6 pp. 368-375
22	Viscous flow, Newton's law. Flow of viscous fluids in pipes, Hagen-Poiseuille equation. Turbulent flows. Forces on bodies moving in fluids and gases.	Sections 14.7-14.8 pp. 375-378 + supplementary lecture notes
23	Wave motion. Propagation of a disturbance, travelling wave. Harmonic waves in one dimension. Rate of energy transfer by wave on a string. Plane waves in three dimensions.	Sections 16.1-16.4 pp. 415-428
24	Linear wave equation, derivation for a string and for sound. Transversal and longitudinal waves. Polarisation. Doppler effect.	Section 16.5-16.9 pp. 428-443 + supplementary lecture notes
25	Boundary effects: reflection and transmission. Interference for one-dimensional waves. Standing waves, strings, and pipes.	Sections 17.1-17.8 pp. 451-474
26	Interference with two point sources, coherence. Two-slit experiment. Huygens principle, reflection and refraction, Snell's law.	Supplementary lecture notes