Mechanics (BMETE11AP59)

Red denotes material beyond textbook, covered by supplementary notes

Week	**Lecture**	**Topic**	**Serway-Jewett 10th ed.**
Week 1	Feb. 11	Introduction: new SI units, magnitudes, significant digits.	Chapter 1 pp. 2-17
	Feb. 12	Particle kinematics in one dimension: trajectory, derivative, velocity, acceleration, integration. Motion under constant acceleration, free fall.	Chapter 2 pp. 20-44
Week 2	Feb. 18	Two-dimensional motion: vectors. Projectiles. Uniform circular motion. Tangential and radial acceleration. Relative velocity, relative acceleration. Inertial frames, Galilei's relativity principle, Galilei transformation.	Chapter 4 pp. 68-88
	Feb. 19	Laws of motion, dynamics. Concept of force and mass, Newton's laws. Forces of friction.	Chapter 5 pp. 95-119
Week 3	Feb. 25	Forces of friction. Non-uniform circular motion. Motion in the presence of resistive forces. Motion in accelerated frames.	Chapter 6 pp. 127-143
	Feb. 26	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
Week 4	Mar. 4	Conservation of energy. Isolated and non-isolated systems. Kinetic friction. Changes in mechanical energy for non-conservative systems. Power.	Chapter 8 pp. 181-203
	Mar. 5	Linear momentum. Isolated and non-isolated systems. Collisions in one and two dimensions. Center of mass.	Sections 9.1-9.6 pp. 210-234
Week 5	Mar. 11	Systems of many particles, momentum, and energy conservation. Deformable systems. Rocket propulsion.	Sections 9.7-9.9 pp. 234-241
	Mar. 12	Rotation of a rigid object about a fixed axis. Angular position, velocity, and acceleration. Angular and translation quantities. Torque. Moment of inertia, Steiner theorem.	Sections 10.1-10.6 pp. 249-267
Week 6	Mar. 18	Rotational kinetic energy. Energy considerations in rotational motion. Rolling motion. Angular momentum conservation, system of many particles. Kinematics of a rigid object. Torque on rigid object, equilibrium. Motion of gyroscopes and tops.	Sections 10.7-10.9 pp. 267-277 Chapter 11 pp. 285-302
	Mar. 19	Change of vector in rotating frames. Inertial forces in rotating frames. Centrifugal and Coriolis forces on Earth.	Supplementary lecture notes
Week 7	Mar. 25	Oscillatory motion. Object attached to spring. Simple harmonic motion, energy. Comparison to uniform circular motion.	Sections 15.1-15.4 pp. 386-400
	Mar. 26	Pendulum: mathematical, physical, and torsional. Complex formalism. Superposition of harmonic oscillations. Oscillations with the same direction and frequency. Beats. Combining perpendicular oscillations. Decomposition of oscillations.	Sections 15.5-15.7 pp. 400-407 + supplementary lecture notes

Week 8	Apr. 1	Damped and forced oscillations. Q factor (laboratory class!).	Supplementary lecture notes
	Apr. 2	Resonance. Driven RLC circuit. Molecular oscillations. Coupled oscillations. Matrix formalism, normal modes.	Supplementary lecture notes
Week 9	Apr. 8	Static equilibrium and elasticity. Elastic coefficients, energy. Bending and twisting.	Chapter 12 pp. 310-324
	Apr. 9	Newton's law of universal gravitation. Free fall. Kepler's laws and planetary motion. Gravitation potential energy. Energy considerations in planetary and satellite motion. Equivalence of inertial and gravitational mass.	Chapter 13 pp. 332-352
Week 10	Apr. 15	Static fluids and gases. Pascal's law. Hydrostatic pressure. Buoyant forces and Archimedes principle.	Sections 14.1-14.4 pp. 358-368
	Apr 16.	**Exercise class**	
		Spring break	
Week 11	Apr. 29	Surface tension, Laplace pressure, Young-Laplace equation. Contact angles, capillary phenomena.	Supplementary lecture notes
	Apr. 30	Fluid dynamics. Continuity equation. Bernoulli's equation and its applications (wings!).	Sections 14.5-14.6 pp. 368-375
Week 12	May 6	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
	May 7	Wave motion. Propagation of a disturbance, travelling wave. Harmonic waves in one dimension. Plane waves in three dimensions. Rate of energy transfer by wave on a string.	Sections 16.1-16.4 pp. 415-428
Week 13	May 13	Linear wave equation, on a string and for sound (rod for exercise class). Transversal and longitudinal waves. Doppler effect. Polarisation.	Section 16.5-16.9 pp. 428-443 + supplementary lecture notes
	May 14	Interference with two point sources, coherence. Standing waves, strings, and pipes. Boundary effects: reflection and transmission. Resonance. Standing waves in air columns.	Supplementary lecture notes Sections 17.1-17.6 pp. 451-469
Week 14	May 20	Reflection and refraction. Huygens principle. Diffraction, Huygens-Fresnel principle. Non-sinusoidal waveforms, group velocity.	Supplementary lecture notes Section 17.8 pp. 472-474
	May 21	**Experiments with waves**	