Mechanics (BMETE11AP59)

Week	Lecture	Topic	Serway-Jewett 10th ed.
Week 1	Feb. 17	Introduction: new SI units, magnitudes, significant digits.	Chapter 1 pp. 2-17
	Feb. 18	Particle kinematics in one dimension: trajectory, derivative, velocity, acceleration, integration. Motion under constant acceleration, free fall.	Chapter 2 pp. 20-44
Week 2	Feb. 24	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. 25	Laws of motion, dynamics. Concept of force and mass, Newton's laws. Forces of friction.	Chapter 5 pp. 95-119
Week 3	Mar. 3	Forces of friction. Non-uniform circular motion. Motion in accelerated frames. Motion in the presence of resistive forces	Chapter 6 pp. 127-143
	Mar. 4	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. 10	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. 11	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. 17	Systems of many particles, momentum, and energy conservation. Deformable systems. Rocket propulsion.	Sections 9.7-9.9 pp. 234-241
	Mar. 18	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. 24	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. 25	Change of vector in rotating frames. Inertial forces in rotating frames. Centrifugal and Coriolis forces on Earth.	Supplementary lecture notes
Week 7	Mar. 31	Oscillatory motion. Object attached to spring. Simple harmonic motion, energy. Comparison to uniform circular motion.	Sections 15.1-15.4 pp. 386-400
	Apr. 1	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
Spring break			

Week 8	Apr. 14	Damped and forced oscillations. Q factor.	Supplementary lecture notes
	Apr. 15	**Dean's break**	
Week 9	Apr. 21	Resonance. Driven RLC circuit. Molecular oscillations. Coupled oscillations. Matrix formalism, normal modes.	Supplementary lecture notes
	Apr. 22	Static equilibrium and elasticity. Elastic coefficients, energy. Bending and twisting.	Chapter 12 pp. 310-324
Week 10	Apr. 28	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
	Apr 29.	Static fluids and gases. Pascal's law. Hydrostatic pressure. Buoyant forces and Archimedes principle.	Sections 14.1-14.4 pp. 358-368
Week 11	May 5	Surface tension, Laplace pressure, Young-Laplace equation. Contact angles, capillary phenomena.	Supplementary lecture notes
	May 6	Fluid dynamics. Continuity equation. Bernoulli's equation and its applications (wings!).	Sections 14.5-14.6 pp. 368-375
Week 12	May 12	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 13	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 19	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 20	Boundary effects: reflection and transmission. Interference for one-dimensional waves. Standing waves, strings, and pipes.	Sections 17.1-17.8 pp. 451-474
Week 14	May 26	Interference with two point sources, coherence. Two-slit experiment. Huygens principle, reflection and refraction, Snell's law.	Supplementary lecture notes
	May 27	Experiments with waves	