

Physics

The fall/ winter semester

Course	Type of class	
Physics	Lecture	Chalkboard practice
Number of hours per week	2	2

Lecturer: Prof. Zbigniew J. Grzywna PhD, DSc

Teaching Assistant: Krzysztof Malysiak, MSc.

Contents

UNIT 1 Introduction: units, physical quantities and vectors

The Nature of Physics and its relation to other fields. Models, theories and laws. Standards and Units. Unit Consistency and conversions. Uncertainty and Significant Figures. Estimates and Order of Magnitude. Vectors and Vectors' Algebra. Components of Vectors. Dot and cross products of vectors. Mathematics in Physics.

UNIT 2 The elements of Mathematics needed in Physics

Differentiation. Antidifferentiation. Definite Integration. Line Integration.

UNIT 3 Kinematics

Displacement, Time, and Average Velocity. Instantaneous and Average Velocity. Average and Instantaneous Acceleration. Motion with Constant Acceleration. Freely Falling Bodies. Position and Velocity Vectors. The Acceleration Vector. Projectile Motion. Motion in a Circle. Relative Velocity.

UNIT 4 Newton's laws of Motion

Force and Interactions. Newton's First Law. Newton's Second Law. Mass and Weight. Newton's Third Law. Using Newton's Laws. Free-Body Diagrams Visualized. Frictional Forces. Dynamics of Circular Motion. The Fundamental Forces of Nature. Projectile Motion with Air Resistance

UNIT 5 Work and Energy

Work. Work and Kinetic Energy. Work and Energy with Varying Forces. Power. Automotive Power: A Case Study in Energy Relations. Gravitational Potential Energy. Elastic Potential Energy. Conservative and Nonconservative Forces. Force and Potential Energy. Energy Conservation.

UNIT 6 Momentum, Impulse and Collisions

Momentum and Impulse. Conservation of Momentum and energy in collisions. Elastic Collisions. Inelastic Collisions. Center of Mass and translational motion.

UNIT 7 Rotational Motion

Angular Velocity and Acceleration. Rotation with Constant Angular Acceleration. Relating Linear and Angular Kinematics. Energy in Rotational Motion. Parallel-Axis Theorem. Torque. Torque and Angular Acceleration for a Rigid Body. Rigid-Body. Rotation about a Moving Axis. Work and Power in Rotational Motion. Angular Momentum. Conservation of Angular Momentum.

UNIT 8 Gravitation

Newton's Law of Gravitation. Weight. Gravitational Potential Energy. The Motion of Satellites. The Motion of Planets. Spherical Mass Distributions. Apparent Weight and the Earth's Rotation.

UNIT 9 Periodic Motion

The Cases of Oscillation. Simple Harmonic Motion. Energy in Simple Harmonic Motion. Applications of Simple Harmonic Motion. The Simple Pendulum. The Physical Pendulum. Damped Oscillations. Forced Oscillations, Resonance, and Chaos.

UNIT 10 Fluid Mechanics

Density. Pressure in a Fluid. Buoyancy. Surface Tension. Fluid Flow. Bernoulli's Equation. Turbulence. Viscosity.

UNIT 11, 12 Waves

Types of Mechanical Waves. Periodic Waves. Mathematical Description of a Wave. Speed of a Transverse Wave. Speed of a Longitudinal Wave. Sound Waves in Gases. Energy in Wave Motion. Boundary Conditions for a String and the Principle of Superposition. Standing Waves on a String. Normal Modes of a String. Longitudinal Standing Waves and Normal Modes. Interference of Waves. Resonance.

UNIT 13 Optics

The Nature of Light. Fermat's Principle. Reflection and Refraction. Total Internal Reflection. Dispersion. Polarization. Scattering of Light. Huygens' Principle. Reflection and refraction at a Plane Surface. Reflection at a Spherical Surface. Thin lenses. Graphical Methods for Lenses. The Magnifier. The Microscope.

UNIT 14, 15 Diffusion

From the random walk analysis to diffusion equation. Parabolic versus hyperbolic diffusion. The methods of solution of diffusion equations.

References

1. H.D. Young, R.A. Freedman "University Physics with Modern Physics", Addison-Wesley Publishing Company, 2000
2. P.G. Hewitt "Conceptual Physics", Addison Wesley Longman, 1998
3. R.A. Serway, J.W. Jewett Jr. "Principles of Physics", Saunders College Publishing, 1998
4. Paul G. Hewitt, „Fizyka Wokół Nas”, PWN, Warszawa, 2003.
5. R. Resnick, D. Halliday, Fizyka tom 1 i 2, PWN, Warszawa 1966
6. D.G. Giancoli, „Physics”, 5th ed., Prentice Hall, New Jersey, 1998.
7. R. Feynman, “Feynmana wykłady z fizyki”, PWN, Warszawa, 2003