Physics

The Spring/ Summer semester

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

Lecturer: Prof. Zbigniew J. Grzywna PhD, DSc

Contents

UNIT 1,2,3 Quantum Mechanics of Atoms

Discovery and Properties of the Electron. Planck's Quantum Hypothesis. Photon Theory of Light and the Photoelectric Effect. Photon Interactions. Compton Effect and Pair Production. Wave-Particle Duality; the Principle of Complementarity. Wave Nature of Matter. Electron Microscopes. Early Models of the Atom. Atomic Spectra: Key to the Structure of the Atom. The Bohr Model. De Broglie's Hypothesis applied to Atoms. Quantum Mechanics – a New Theory. The Wave function and its Interpretation; the Double-slit Experiment. The Heisenberg Uncertainty Principle. Philosophic Implications; Probability versus Determinism. Quantum Mechanical View of Atoms. Quantum Mechanics of the Hydrogen Atom; Quantum Numbers. Complex Atoms; the Exclusion Principle. The Periodic Table of Elements. X-ray Spectra and Atomic Number. Fluorescence and Phosphorescence. Lasers. Holography.

UNIT 4, 5 Elements of the Field Theory

Vector differentiation, Scalar Fields; Isotomic Surfaces; Gradient, Vector Fields and Flow Lines, Divergence, Curl, Del Notation, The Laplacian, Vector Identities.

UNIT 6, 7, 8 Elements of Electromagnetic Field

Insulators and conductors, Coulomb's Law, Electric Fields, Electric Flux, Gauss Law, Potential Difference and Electric Potential, Potential Differences in a Uniform Potential Field, Electric Potential Energy, Obtaining E from the Electric Potential, Electric Potential due to Continuous and Point Charge Distributions, Capacitance, Electric Current, Ohm's Law, Resistors in Series and in Paralell, Kirchhoff's Rules, Magnetic Force on Current-Carrying Conductor, The Biot-Savart Law, Magnetic Force Between Two Parallel Conductors, Ampere's Law, Magnetic Field of Solenoid.

UNIT 9,10 Special Theory of Relativity

The Michelson-Morley experiment, Postulates of special theory of relativity, Simultaneity, Time dilation and Twin Paradox, Length contraction, Four dimensional space-time, Galilean and Lorentz Transformations, Relativistic momentum and mass, The Ultimate Speed, Energy and mass ($E=mc^2$), Doppler Shift for Light.

UNIT 11,12 General Theory of Relativity

Principle of Equivalence. Bending of Light by Gravity. Gravity and Time: Gravitational Red-shift. Gravity and Space: Motion of Mercury. Gravity, Space, and new Geometry. Gravitational Waves. Newtonian and Einsteinian Gravitation.

UNIT 13,14 Elementary Particles

High–energy Particles. Particle Accelerators. Beginnings of Elementary Particle Physics; the Yukawa Particle. Particles and Antiparticles. Particle Interactions and Conservation Laws. Particle Classification. Particle Stability and Resonances. Strange Particles. Quarks. The "Standard Model": Quantum Chromodynamics (QCD) and the Electroweak Theory. Grand Unified Theory.

UNIT 15 Astrophysics and Cosmology

Stars and Galaxies. Stellar Evolution: the Birth and Death of Stars. General Relativity: Gravity and the Curvature of Space. The Expanding Universe. The Big Bang and the Cosmic Microwave Background. The Standard Cosmological Model: the Early History of the Universe. The Future of the Universe?

References

1. H.D. Young, R.A. Freedman "University Physics with Modern Physics", Addison-Wesley Publishing Company, 2000
2. Douglas C. Giancoli „Physics principles with applications", Prentice Hall 1998
3. H. F. Davis, A. D. Snider, „Introduction to vector analysis", Allyn and Bacon Inc. 1979
4. R. Resnick, D. Halliday, Fizyka tom 1 i 2, PWN, Warszawa, 1966
5. R. P. Feynman, „Wykłady z Fizyki", PWN, Warszawa, 2003