University of Cyprus
Department of Physics

Fall Semester 2019-2020

1) PHY 322 Advanced Physics Laboratory II (7.5 ECTS)(Experiments in Atomic and Nuclear Physics)Introduction. Measurement of the Specific Charge of the Electron. Observation of the Zeeman Effect. Observation ofthe Electron Spin Resonance. The Compton Effect. X-Ray Fluorescence and Moseley's Law. Rutherford Scattering Spectroscopy of α-Particles. Spectroscopy of β-Particles. Spectroscopy of γ-Rays. The Geiger-Mueller Counter.

2) PHY 331 Particle Physics (7.5 ECTS)Brief historical background, Particles of Matter and Funda-mental Interactions, Interactions of Particles and Radiation with Matter, Particle Detectors and Accelerator Systems. Symmetries, Quantum Numbers and Conservation Laws. Symmetry Violations, Local Gauge Transformations, Quan-tum Electrodynamics, Weak Interactions, Spontaneous Symmetry Breaking. Higgs Mechanism, Intermediate Vector Bosons, Electroweak Theory. Quantum Chromo-dynamics, Asymptotic Freedom, Confinement, problems of the Standard Model. Unification Theories, Supersymmetry and Supersymmetric Particles. Applications of Particle Physics in Medicine, Technology and Industry

3) PHY 347 Computational Physics (7.5 ECTS)A) Random-number generators. Evaluation of integrals with the Monte Carlo Method. Metropolis Monte Carlo simulations (applications in random-walk problems, the 2-d Ising model). B) Numerical solution of differential equations. Application to the Diffusion Equation, the Laplace/Poisson Equation and the Schroedinger Equation.C) Molecular Dynamics Simulation Methods – basic notions(equations of motion, numerical algorithms; heating and equilibration; micro canonical and canonical simulations).Application to the Lennard-Jones Fluid. Calculation of pressure, Diffusion Coefficient, Radial Distribution Function.

SPRING SEMESTER 2019-2020

1) PHY 415 Biophysics (7.5 ECTS)The aim of the course is to familiarize students of Physics with concepts from Life Sciences and to present the application of concepts and methods from Classical

Mechanics, Statistical Physics, Electro-statistics and Quantum Mechanics to the study of phenomena taking place in living systems, with emphasis on the behaviour of biomolecules. Brief introduction to the central dogma of Molecular Biology. Structure and properties of bio-molecules: Classes of biomolecules (proteins, nucleic acids, lipids, carbohydrates). Properties of amino acids; hierarchical organization of protein structures into primary, secondary, tertiary and quaternary levels. Protein Thermodynamics: atomic interactions; the helix-coil transition; the Random Energy Model. Statistical mechanics of biomolecular association; Allosteric Mechanisms; Molecular Modelling: Hamiltonians used in the description of atomic interactions in biomolecules; normal modes and applications in biomolecules; molecular dynamics simulations; Implicit-solvent descriptions; Continuum Dielectric Models, Poisson-Boltzmann calculations and the Generalized Born approximation; Free-energy calculations: the Thermodynamic Integration and Thermodynamic Perturbation approaches; Jarzynski Inequality

2) PHY 435 Theoretical Physics (7.5 ECTS)Symmetries: Definition, physical consequences of sym-metries, Symmetries in Classical Mechanics, Symmetries in Quantum Mechanics. The Heisenberg Representation. Classical Fields: Gauge invariance, the action functional ofthe Electromagnetic Field, the energy and momentum tensor. Relativistic Quantum Mechanics: The Klein-Goldon Equation, the Dirac Equation, elements of second quantisation. Scattering Theory: Green's functions, asymptotic states, potential scattering, phase shifts, resonances. Introduction to String Theory.