ACADEMIC DIDACTIC MEMORANDUM
Constantinos Simserides

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ACADEMIC TEACHING

1. Department of Physics, National and Kapodistrian University of Athens

Undergraduate courses

States and Properties of Matter

States and Properties of Matter [compulsory, 4th semester, Y0347) Acad. Years 2012-2021] and **[free selection, 7th semester, 10ΕΛΕ05, Acad. Years 2021-]**
Chapter 1. Introduction to the states of matter. Chapter 2. Solids. Chapter 3 Chronological survey. Alloys. Synthesis - Structure - Properties - Performance. Chapter 4. Real Gases and Liquids.
For all Academic Years I have taught the course, evaluation by the students has been done.
The results can be found in the relevant National and Kapodistrian University of Athens website.
Video-lectures of this course (my part) exist for Academic Years 2015, 2019, 2020 on the National and Kapodistrian University of Athens website https://delos.uoa.gr/opendelos/
My e-class https://eclass.uoa.gr/courses/PHYS196/ contains the ***e-book*** **States of Matter** written by me and all the past exams problems solved as well as other didactic material.

Contents:

CHAPTER 1. Introduction to the states of matter.
1. "Elementary" particles.
2. States of Matter.
3. State or Phase transitions. Phase diagrams.
4. Bose – Einstein condensate.
5. Atomic structure.
5. Classification of solids: periodic crystals, quasi-crystals, amorphous, fractals.
6. Classification of liquids and gases: ideal and real.
7. Atomic structure.
8. Shape of atomic orbitals. Symmetries.
9. Bonds between atoms. Hybridization.

CHAPTER 2. Solids.
1. Basic notions of crystal lattices and crystals.
2. Symmetry of lattices and molecules.
3. Classification of point groups.
4. Crystal lattices in 1, 2 and 3 dimensions. Crystals.
5. Reciprocal lattice.
6. Lattice lines, lattice planes, Miller indices.
7. Allotropic forms of Carbon.
8. Solids.
9. Classification of Solids by various criteria.

CHAPTER 3 Chronological survey. Alloys. Synthesis - Structure - Properties - Performance.
1. About materials.
2. Chronological survey: Stone Age, Bronze Age, Iron Age.
3. Examples of composite materials (alloys) known from antiquity. Impurities, doping and thermal processing.
4. Processing or synthesis. Structure. Properties. Performance.
5. Examples of relationship between structure and properties.

CHAPTER 4. Real Gases and Liquids.
1. Size of atoms and molecules.
2. Virial expansion or equation of state.
3. Van der Waals equation of state.
4. Van der Waals equation of state in Virial form.
5. Isothermal compressibility. Cubic expansion coefficient.
6. Ideal gases laws. Ideal gas isotherms.
7. Theoretical isotherms of a real gas.
8. Experimental isotherms Gas – Liquid phase transition. Latent heat.
9. Lennard – Jones potential energy.

Quantum Optics & Lasers

Quantum Optics & Lasers [compulsory, solid state physics direction, Y3503, Acad. Years 2012-2021] and **[compulsory, condensed matter physics direction, 10YK501, Acad. Years 2021-]**
EM = electromagnetic 2LS = two-level system, 3LS = three-level system, PLS = poly-level system
Chapter 1. Introduction to the quantum nature of light. Chapter 2. EM radiation - matter (2LS) interaction mechanisms. Chapter 3. Semiclassical approach of the EM radiation – matter (2LS, 3LS, PLS) interaction. EM field: classically. 2LS, 3LS, PLS: quantum mechanically. Chapter 4. Quantum-mechanical approach of the EM radiation – matter (2LS, 3LS, PLS) interaction. EM field quantization. Chapter 5. Lasers. Chapter 6. Density Matrix. Chapter 7. Several additional issues for laser properties and operation
For all Academic Years I have taught the course, evaluation by the students has been done.
The results can be found in the relevant National and Kapodistrian University of Athens website.
Video-lectures of this course exist for Academic Years 2014, 2019, 2020 on the National and Kapodistrian University of Athens website https://delos.uoa.gr/opendelos/ and from 2021 in youtube.
My e-class https://eclass.uoa.gr/courses/PHYS107/ contains the ***e-book*** **Quantum Optics and Lasers** written by me and all the past exams problems solved as well as other didactic material.

Contents:

CHAPTER 1. Introduction to the quantum nature of light.

1. Black body and related notions.
2. EM radiation energy density in infinitesimal frequency range, black body in thermodynamical equilibrium, $\rho(\nu,T)d\nu$: Planck's law and comparison with the classical approaches of Rayleigh-Jeans and Wien. Ultraviolet catastrophe and far infrared problem.
3. Two formulations of the Stefan-Boltzmann law of black body in thermal equilibrium: (1) EM radiation energy density u(T), and (2) radiated power per unit area I.
4. Maxwell equations. Formulation in term of total charge and total current.
5. Boundary conditions at an interface.
6. Existence of EM waves when $\rho = 0$, $J = 0$.
7. Fields inside an ideal conductor.
8. Fields at the boundary of an ideal conductor.
9. Fields in cavities.
10. Normal modes of EM waves in a rectangular cavity.
11. Infinitesimal number of normal modes per infinitesimal frequency range, $g(\nu) = \mathrm{d}N/\mathrm{d}\nu$. 1st case: periodic boundary conditions. 2nd case: in rectangular cavity.
12. Proof of the classical Rayleigh-Jeans law from the equipartition of energy theorem and $g(\nu) = \mathrm{d}N/\mathrm{d}\nu$. Ultraviolet catastrophe.
13. Proof of Planck law.
14. Proof of Wien displacement law.
15. Photoelectric effect.

CHAPTER 2. EM radiation - matter (two-level system) interaction mechanisms.

1. Einstein interaction mechanisms between EM radiation and a two-level system: (Stimulated) absorption. Spontaneous Emission. Stimulated Emission. Einstein coefficients A, B.
2 Derivation of Planck's formula from the above mechanisms and Boltzmann statistics. Relation between Einstein coefficients A and B.
3. Emissions comparison. Stimulated processes comparison.
4. Discrete spectrum: atoms and molecules, color centers, artificial atoms and molecules (quantum dots).

CHAPTER 3. Semiclassical approach of the EM radiation - matter (2LS, 3LS, PLS) interaction. Electromagnetic field: classically. Two-level, Three-Level, Multi-Level system: quantum mechanically.

1. Semiclassical approach: EM field classically. Two-level system quantum mechanically..
2. Unperturbed system, i.e., without EM field.
3. Perturbed system, i.e., subjected to EM field. Time-dependent perturbation theory. Dipole moment. Dipole approximation.
4. Equations describing the temporal evolution of a two-level system. Rabi frequency. Rotating Wave Approximation (RWA).
5. Solution of the differential equations we obtain after RWA with the simplistic Newton recursive method.
6. Einstein coefficients calculation.

7. Einstein coefficients calculation using the solutions we found in section 3.4.
8. Allowed and forbidden optical transitions within dipole approximation.
9. "Eigenenergies"of perturbed two-level system (i.e. subjected to EM field).
10. Hydrogen atom: atomic orbitals shape.
11. Hydrogen atom: Calculation of the dipole moment matrix elements. Allowed and forbidden optical transitions. Selection rules.

CHAPTER 4. Quantum-mechanical approach of the EM field – matter interaction. EM field quantization.

1. Full Quantum Mechanical Approach versus Semiclassical Approach.
2. Relation between wavevectors, cyclic frequencies and phases of the electric and the magnetic field.
3. Standing EM field ina cavity.
4. EM field Hamiltonian with creation and annihilation operators.
5. Two-level system Hamiltonian with spinors.
6. Boson (e.g. photon) commutation relations and fermion (e.g. electron) anticommutation relations.
7. Ladder operators.
8. EM field – two-level system interaction Hamiltonian.
9. Hamiltonians synopsis.
10. Mean values of various quantities for the Jaynes-Cummings Hamiltonian.
11. Photon absorption.
12. Photon Emission.

CHPTER 5. Lasers.

1. Laser He-Ne.
2. Rate equations for the level populations that contribute to the coherent EM radiation emission and for the radiation density.
3. Longitudinal modes within line width.
4. Level populations and EM radiation density in the steady state. Critical pumping. Population inversion.
5. Numerical solution of the rate equations in the general case.
6. Simulation Lab: numerical solution of the rate equations in the general case.
7. Stationary EM waves in 3D cavity: Longitudinal and transverse modes.
8. Shape of TEM00 and higher order TEM$p'q'$ in rectangular and cylindrical cavity.
9. Laser species - some applications.
10. Diode Laser or p-n junction laser.
11. Quantum Dot Laser.

CHAPTER 6. Density Matrix

1. Density matrix.
2. Pure state and mixed state.
3. Density matrix and density operator.
4. Density matrix and density operator in a pure state of a two-level system.
5. The temporal evolution of the density matrix: The von Neumann equation.
6. The temporal evolution of the density matrix with relaxation mechanisms.

CHAPTER 7. Several additional issues for laser properties and operation.

1. Isolation of TEM00 and higher order TEM$p'q'$.
2. Fresnel equations. Brewster angle.
3. Total internal reflection.
4. Polarized beam emission.
5. Poynting vector.

Core Lab Course II

Academic Years 2013-2021, compulsory, 6th semester, Y0367

Lab exercises

Σ1 Ge band gap, and

Σ2 Electron diffraction by graphite dust.

Basic Physics Lab III: Theormodynamics-Waves-Optics

Basic Physics Lab III: Thermodynamics-Waves-Optics [compulsory, 3rd semester, Y0333, Acad. Years 2012-2021] and **[compulsory, 3rd semester, 10YKO07, Acad. Years 2021-].**
Supervisor of this Lab for Academic Year 2018-2019 together with V. Likodimos and E. Syskakis.
Supervisor of this Lab for Academic Year 2019-2020 together with E. Syskakis.
Supervisor of this Lab for Academic Years 2020-2022 together with E. Skordas.

Contents of the whole Lab: 1. Prism and grating spectrometers. 2. Study of the isothermal process of a gas and of the Otto cycle. 3. Measurement of the speed of longitudinal waves and of elastic constants in solids. 4. Measurement of convex lenses focal distance and relevant aberration errors. Dispersion. 5. Study of polarized light. Measurement of rotation capacity by polarimeter. 6. Measurements with Michelson interferometer. 7. Study of wave phenomena with microwaves (reflection, refraction, polarization, interference, diffraction, standing waves). 8. Study of Doppler effect in air. From these I have taught: 1, 2, 3, 4, 7, 8.

Basic Physics Lab I: Introductory - Mechanics

Academic Year 2020-2021, compulsory, 1st semester, Y0314
All these introductory exercises.

Introduction to Solid State Physics Lab

Academic Years 2011-2015, compulsory, 6th semester, Y063, old program of studies
Circle 2:
2α. Linear lattice oscillations
2β. Electron diffraction in graphite crystal lattice
2γ. Temperature dependence of color centers in glass

Basic Physics Lab IV: Waves - Optics

Academic Year 2011-2012, compulsory, 4th semester, Y043, old program of studies
Circle 2:
2.1. Measurement of the speed of sound via the Quincke tube
2.2. Study of Light Diffraction
2.3. Spectrometer calibration and study of Hydrogen spectrum
2.4. Measurements with the Michelson interferometer

Postgraduate courses

Materials Physics MSc Program, Department of Physics, National and Kapodistrian University of Athens. Special Topics in Condensed Matter Physics:

Nanostructures and Biomaterials

Academic Years 2015-2022
Contents:
1. Electronic structure of organic molecules including nucleic acids and DNA.
2. Tight-binding Approach from molecules to polymers and solids. Charge transfer and transport.
3. Electronic states and transport in low-dimensional structures.
4. Quantum transport.

Internships

RISE worldwide, **DAAD** (Deutscher Akademischer Dienst). I supervised the Internship of BSc student **Richard Lopp** (Georg-August-Universität Göttingen, Germany) [2 Jul - 6 Sep 2015]. Project: **Temporal and spatial evolution of electron or hole transfer along DNA**. Now he is a PhD student at University of Waterloo & Institute for Quantum Computing, Canada.

Erasmus. I supervise the Internship of 4th year student **Chloe Olacia**, Materials Engineering, Polytech School of Université de Montpellier, France. From 24/05/2021 to 30/07/2021. Title: Charge transfer in carbynes and carbon-nitrogen polymers (like NCCCCN), via density functional theory and tight-binding.

Previous appointments:

2. Lecturer on contract (ΠΔ 407), University of Peloponnese, Greece. 3/ 2011- 8/2011.
I taught autonomously, Department of Telecommunications Science & Technology, Tripolis.
Physics II (compulsory B΄ semester, Acad. Year 2010-2011). Electromagnetism – Waves

DEPARTMENT OF TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY, TRIPOLIS
UNIVERSITY OF PELOPONNESE
PHYSICS II (COMPULSORY B΄ SEMESTER, 2010-2011):

Electromagnetism – Waves
Gauss laws for electric and magnetic field. Ampère law for constant currents. Lorentz force. Biot-Savart law. Electromagnetic induction, Ampère and Faraday laws for time dependent electric and magnetic fields. Introduction to electromagnetism and Maxwell equations. Wave definition, transverse and longitudinal waves, harmonic waves, energy, intensity and velocity of harmonic waves. Principle of superposition, Reflection and refraction, interference. Standing waves. Wave optics - light. Refraction index of a medium. Reflection, refraction, polarization and interference of monochromatic light.

3. Assistant Professor on contract (ΠΔ 407), University of Patras, Greece. 3/2005 - 2/2008.
I taught in **8 laboratory courses**, at the **Materials Science** Department:
Physics I Labs (compulsory I semester, Acad. Year 2005-2006). Mechanics.
Physics II Labs (compulsory II semester, Acad. Years 2004-2006). Waves. Optics.
Physics III Labs (compulsory III semester, Acad. Years 2005-2007). Electromagnetism.
Materials Science I Labs (compulsory II semester, Acad. Years 2005-2007). Metallography, Crystallography.
Materials Science II Labs (compulsory Γ΄ semester, Acad. Year 2006-2007). Mechanical properties of materials, alloy phase diagrams.
Materials Science III Labs (compulsory IV semester, Acad. Year 2004-2005). Semiconductors.
Materials Science V Labs (compulsory VI semester, Acad. Years 2005-2007). Dielectric, magnetic, superconducting materials.
Materials Science VI Labs (compulsory VII semester, Acad. Years 2005-2008). Dielectric, magnetic, superconducting materials (2005-2006). Optoelectronics (2006-2008).

MATERIAL SCIENCE DEPARTMENT,
UNIVERSITY OF PATRAS
Physics II Lab, B΄ Semester (compulsory)

I have taught all students, three out of seven laboratory exercises, i.e.
4th Lab Exercise.Superposision of oscillations.
5th Lab Exercise.Light Interference and diffraction.
7th Lab Exercise. Reflection and Refraction. Determination of the critical angle of total internal reflection and of the refractive index of a prism.

Material Science Lab III, Δ΄ Semester (compulsory)

I have taught all students, three out of seven laboratory exercises, i.e.
2nd Lab Exercise: Conductivity measurement of a Ge film as a function of temperature, and calculation of its energy gap.
6th Lab Exercise. Semiconductor applications. Simple rectification by a Si p-n junction. Light emitting diode (LED).
7th Lab Exercise. Optical properties. Absorption of a glass film.

Physics I Lab, A΄ Semester (compulsory)

I have taught all students, two out of six laboratory exercises, i.e.
2nd Lab Exercise. Measurement of the density of various materials.
5th Lab Exercise.Measurement of the internal friction coefficient of a liquid, by the falling of small spheres' method.

Physics III Lab, Γ΄ Semester (compulsory)

I have taught half of the students, two out of six laboratory exercises, i.e.
3rd Lab Exercise. RC Circuit.
4th Lab Exercise.RL Circuit.

Materials Science Lab I, Β΄ Semester (compulsory)

I have taught half of the students two out of eight laboratory exercises, i.e.:
2nd Lab exercise: Crystal morphology – symmetry.
5th Lab exercise: Preparation of metallic (alloy) samples for metallographic examination.

Materials Science Lab V, ΣΤ΄ Semester (compulsory) which was Materials Science Lab VI, Ζ΄ Semester (compulasory) 2005-2006

I have taught all students, two out of six laboratory exercises, i.e.
5th Lab Exercise.Magnetic hysteresis measurements of ferromagnetic materials.
6th Lab Exercise.Study of the superconducting behavior of a ceramic superconductor with high transition temperature.

Materials Science Lab VI, Ζ΄ Semester (compulsory)

I have taught all students, two out of six laboratory exercises, i.e.
5th Lab Exercise. Electrooptic effect and photoelastic effect.
6th Lab Exercise. Simulation of optical diffraction grating.

Materials Science Lab II, Γ΄ Semester (compulsory)

I have taught half of the students, two out of six laboratory exercises, i.e.:
2nd Lab exercise. Study of mechanical properties via supersonic vibrations.
3rd Lab exercise. Thermal processing of materials (alloys).

4. Associate Professor on contract (ΠΔ 407), Demokritos University of Thrace, Greece. 2/2000 - 8/2002.

I taught autonomously 5 semester courses and **all the corresponding labs.** Specifically:

Molecular Biology and Genetics Department, Alexandroupolis
Physics (compulsory A΄ semester, Acad. Years 2000-2002). Optics. Lasers. Radioactivity-Dosimetry. Molecular Spectroscopy. Calorimetry. **Physical Chemistry** (compulsory B΄ semester, Acad. Years 2000-2002). Thermodynamics. Photochemistry. Chemical Kinetics. Colloids. **Applied Mathematics** (elective A΄ semester, Acad. Year 2001-2002). Topics of differential and integral calculus of one or more variables, useful in physics and physical chemistry.

Forestry & Management of Environment & Physical Resources Department, **Orestias**
Physics (elective B΄ semester, Acad. Years 1999-2001). Soil physics elements. Optics elements. Hydrostatics. Hydrodynamics. Calorimetry. Radioactivity elements.

Agricultural Development Department**, Orestias**
Physics (compulsory A΄ semester, Acad. Years 2000-2002). Soil physics elements. Optics elements. Hydrostatics. Hydrodynamics. Calorimetry. Mechanics elements.

Molecular Biology and Genetics Department, Demokritos University of Thrace, Alexandroupolis

Physics A΄ Semester (compulsory)

1. OPTICS - LASER
Electromagnetic spectrum and the nature of light.
General geometrical optics (reflection, refraction, optical paths etc).
Hero and Fermat principles.
Huygens Principle. Application of Huygens principle in reflection and refraction.
Optical fibres and their use (especially in near field optics, biology and medicine).
Photometry (luminous flux, sensitivity of the human eye, luminous intensity). Colour of objects.

Optical system, specula, lenses (convergence and divergence of light, magnification, imaginary / real image and focal points etc).
Application to optical instruments (magnifying lens, microscope, eye, photographic camera etc).
Interference of Light Waves. Young experiment. Intensity distribution in interference of light waves from two point sources.
Diffraction of light. Resolution of microscope, eye. Diffraction of X-rays from a crystal.
Polarization of light.
Physical principles and function of laser.
Properties of the laser light (what is it that makes laser light so special).
Application of lasers to medicine and biology.
«Familiarization with reflection, refraction, optical paths» (laboratory exercise)
«Specula: Familiarization with images and focal distance» (laboratory exercise)
«Lenses: Familiarization with images and focal distance» (laboratory exercise)
«Laser light diffraction and interference with slits and obstructions» (laboratory exercise)

2. RADIOACTIVITY - DOSIMETRY
Potential of atomic nucleus. The standard model.
Natural radioactive decay.
α, β and γ decay.
Neutrons. Nuclear Fission and Nuclear Fusion.
Measurement of radioactivity – Dosimetry.
Ionising and non-ionising radiation.
Dose, exposure, activity, absorbed dose, dose equivalent, quality factor.
Physical, biological and effective half-life.
Biological effects of radiation.
Medical use of radiation and of isotopes.
Permeability of radiation and armour from radiation.
«Natural radioactive decay and half-life» (laboratory exercise)
«Geiger counter» (laboratory exercise)

3. MOLECULAR SPECTROSCOPY
Spectral regions (radiowaves, microwaves, infrared, visible, ultraviolet, X-rays, γ-rays).
Spectroscopy and spectra.
Microwave spectroscopy.
Infrared spectroscopy. Raman spectroscopy.
Electronic molecular spectroscopy.
Magnetic resonance spectroscopy.

4. BASIC PRINCIPLES OF HEAT AND CALORIMETRY
Transfer of heat. Temperature measurement – types of thermometers.
Calorimetry and applications.
«Measurement of the specific heat capacity of solid and liquid objects» (laboratory exercise)
«Thermoelectric effect» (laboratory exercise)

APPENDICES
International System of Units (introduction, resumption)
Some useful mathematics (errors, differential and integral calculus subjects).

Physical Chemistry B΄ Semester (compulsory)

0. SOME USEFUL MATHEMATICS
Resumption of integral calculus. Partial derivatives. Exact and inexact differentials.

1. THERMODYNAMICS
Open, insulated, closed system, diathermic or adiabatic walls, phase, homogeneous, heterogeneous system.
State, property, process and equilibrium. Thermodynamic equilibrium.
Extensive and intensive thermodynamic variables.
Zero law of thermodynamics. Temperature.
Reversible and irreversible processes. Quasi static processes.
First law of thermodynamics. Conservation of Energy.

Heat capacities.
Second law of thermodynamics (Kelvin-Planck and Clausius views).
Theorem and corollary Carnot. Clausius theorem and entropy.
Thermodynamic properties: S, H, F, G ; Helmholtz and Gibbs free energy.
Thermochemistry: Reaction heat under constant volume or pressure. Dependence of reaction heat with temperature. Heat capacities of reactions. Thermochemical laws. Calorimetric measurement of reaction heat.
Third law. Nernst theorem.
Entropy from thermal data. Entropy of mix.
Phase equilibrium.
Chemical potentials and reactivity.
Thermodynamics and biology.
Change of state of objects – phase diagram – latent heat.

2. PHOTOCHEMISTRY
Photochemical reactions, chemiluminescence etc. Phosphorescence and fluorescence.
Photochemical laws.
Absorption and Beer-Lambert law.
Spontaneous, non-spontaneous photochemical reactions, quantum yields.
Types of photochemical reactions (disintegration, ionisation, fluorescence etc).
Photosensitivity.
Photochemical equilibrium.
Kinetics of photochemical reactions. Photolysis.
Example of photochemical reactions: Dimerism of anthracene. Disintegration of AgBr in photographical plates. HBr composition. Green plant photosynthesis.

3. CHEMICAL KINETICS
Order and molarity.
Zero, first, second and third order reactions.
The differential and the integration method.
Kinetic equations from the mechanism of the reactions.
Bidirectional, parallel, and consecutive reactions.

4. COLLOIDS
Definition and taxinomisis: Solutions, colloids, suspensions. Sols, emulsions etc. lyophil and lyophobic sols.
Colloid dispersion. Macromolecular solutions.

FORESTRY AND MANAGEMENT OF ENVIRONMENT AND PHYSICAL RESOURCES DEPT
DEMOKRITOS UNIVERSITY OF THRACE, ORESTIAS

Physics B΄ Semester (elective)

DIMENSIONS OF PHYSICAL QUANTITIES – INTERNATIONAL SYSTEM OF UNITS
SUBJECTS FROM SOIL PHYSICS
Relation between mass and volume of the three soil phases. Porosity, densities, moisture etc
Specific surface of soil particles.
Determination of the size of soil particles by sedimentation.

SUBJECTS FROM GEOMETRICAL OPTICS
Electromagnetic spectrum and the nature of light.
General geometrical optics (reflection, refraction, optical paths etc).
Optical system, specula, lenses (convergence and divergence of light, magnification, imaginary / real image and focal points etc).
Application to optical instruments (magnifying lens, microscope, eye, photographic camera etc).
Photometry.
«Familiarization with reflection, refraction, optical paths» (laboratory exercise)
«Specula: Familiarization with images and focal distance» (laboratory exercise)
«Lenses: Familiarization with images and focal distance» (laboratory exercise)

SUBJECTS FROM HYDROSTATICS – HYDRODYNAMICS
Solids- Liquids - Gases.
Hydrostatic Pressure – Pascal Principle – Force exerted to barrier and force to bottom.
Buoyancy and the Principle of Archimedes.
Atmospheric pressure.
Ideal and real fluids. Viscosity.
Flow of ideal fluids. Law of continuity and Bernoulli law.
Viscous flow of real fluids. Laminar and turbulent flow.
Surface tension - osmosis - capillary phenomena.
«Measurement of the density of liquid and solid objects» (laboratory exercise)

BASIC PRINCIPLES OF CALORIMETRY AND HEAT
Transfer of heat. Temperature measurement – types of thermometers.
Calorimetry and applications.
«Measurement of the specific heat capacity of solid and liquid objects» (laboratory exercise)
Environmental Consequences.

BASIC PRICIPLES OF RADIOACTIVITY (free report)

AGRICULTURAL DEVELOPMENT DEPARTMENT
DEMOKRITOS UNIVERSITY OF THRACE, ORESTIAS

Physics A΄ Semester (compulsory)

DIMENSIONS OF PHYSICAL QUANTITIES – INTERNATIONAL SYSTEM OF UNITS
SUBJECTS FROM SOIL PHYSICS
Relation between mass and volume of the three soil phases. Porosity, densities, moisture etc
Specific surface of soil particles.
Determination of the size of soil particles by sedimentation.

SUBJECTS FROM GEOMETRICAL OPTICS
Electromagnetic spectrum and the nature of light.
General geometrical optics (reflection, refraction, optical paths etc).
Optical system, specula, lenses (convergence and divergence of light, magnification, imaginary / real image and focal points etc).
Application to optical instruments (magnifying lens, microscope, eye, photographic camera etc).
Photometry.
«Familiarization with reflection, refraction, optical paths» (laboratory exercise)
«Specula: Familiarization with images and focal distance» (laboratory exercise)
«Lenses: Familiarization with images and focal distance» (laboratory exercise)

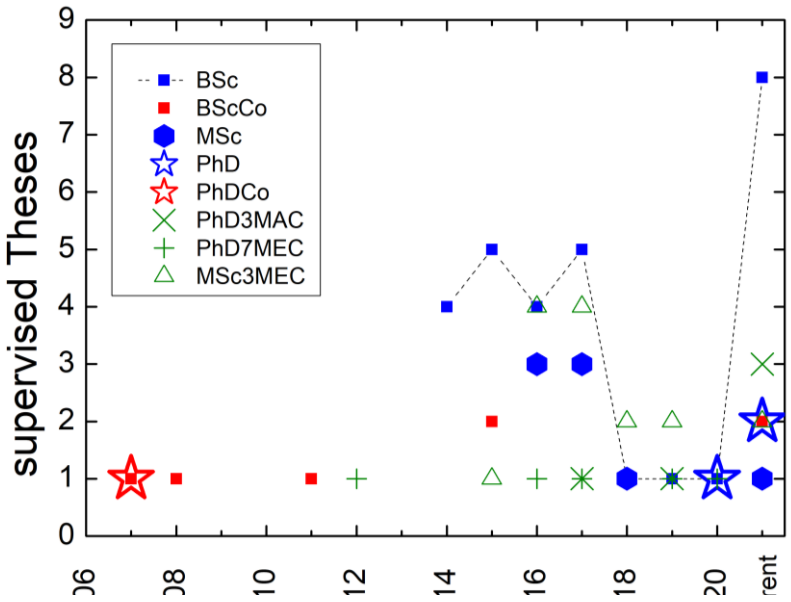
SUBJECTS FROM HYDROSTATICS – HYDRODYNAMICS
Solids- Liquids - Gases.
Hydrostatic Pressure – Pascal Principle – Force exerted to barrier and force to bottom.
Buoyancy and the Principle of Archimedes.
Atmospheric pressure.
Ideal and real fluids. Viscosity.
Flow of ideal fluids. Law of continuity and Bernoulli law.
Viscous flow of real fluids. Laminar and turbulent flow.
Surface tension - osmosis - capillary phenomena.
«Measurement of the density of liquid and solid object» (laboratory exercise)

BASIC PRINCIPLES OF CALORIMETRY AND HEAT
Transfer of heat. Temperature measurement – types of thermometers.
Calorimetry and applications.
«Measurement of the specific heat capacity of solid and liquid objects» (laboratory exercise)
Environmental Consequences.
MECHANICS PROPERTIES

Basic law of mechanics. Tension. Pressure. Strain.
Types of elastic deformation of solids.
Surface tension - osmosis - capillary phenomena.

SUPERVISION of PhD, MSc, BSc THESES

	Accomplished		Current	
	Supervision	Co-supervision	**Supervision**	Co-supervision
BSc	**23**	4 (+2)	**6**	1
MSc	**8**	0	**0**	0
PhD	**1**	1	**2**	KA



Also...	Accomplished	Current
Member of 3-Member Advisory Committee (not supervisor) in PhD Theses	2	3
Member of 7-Member Examination Committee in PhD Theses	5	0
Member of 3-Member Examination Committee in MSc Theses	15	0

1. Supervision of PhD Theses

Current:

3. **I supervise** the PhD of **Marilena Mantela**. From 6/11/2017 member of the 3-Member Advisory Committee: **C. Simserides (supervisor)**, I. Lelidis, S. Gardelis. Subject: **Electronic structure of aperiodic and natural nucleic acid segments and influence of mutations in the charge transport and transfer properties.**

2. **I supervise** the PhD of **Andreas Morphis**. From 18 February 2013 I am member of the 3-Member Advisory Committee: C. Simserides (co-supervisor on behalf of NKUA), K.N. Trohidou (supervisor, NCSR Demokritos), G.P. Triberis, with subject: Structure and magnetic properties of complex nanoparticles with core/shell morphology. 20 Octover 2014: Modification of the 3-Member Advisory Committee to **C. Simserides (supervisor)**, G.P. Triberis, G. Papaioannou and of the Subject to **Electronic structure, magnetic and optical properties of organic molecules and nanomaterials.**

T5. From 04/02/2019, member of the 3-Member Advisory Committee for the supervision of the PhD of **Elli Georgopoulou - Kotsaki**: Em. Syskakis (supervisor), V. Likodimos, **C. Simserides**. Subject: **Study of magnetothermal properties of monocrystallic and polycrystallic samples of the compounds $Mn_{5-x}Fe_xSi_3$ (x=0-4) in connection with modern applications (magnetic cooling, Medicine).**

T4. From 25/06/2018, member of the 3-Member Advisory Committee for the supervision of the PhD of **Christina Zacharaki**: A. Dimoulas (supervisor, NCSR Demokritos, Institute of Nanoscence and Nanotechnology), V. Likodimos, **C. Simserides**. Subject: **Fabrication and study of $Zr_xHf_{1-x}O2$ films with ferroelectric properties.**

T3. From 24/02/2014, member of the 3-Member Advisory Committee for the supervision of the PhD of **Kleopatra Aretouli**: A. Dimoulas (supervisor, NCSR Demikritos, Institute of Nanoscience and Nanotechnology), **C. Simserides** (co-supervisor from NKUA), E. Syskakis. Subject: **Molecular beam epitaxy of the topological insulator Bi_2Se_3 on dielectric substrates and study of their electrical properties**. On 19-10-

2016, modification of subject to **Epitaxial growth and study of two-dimensional layered topological insulators and transition metal dichalcogenides**. On 18-5-2020, modification of the 3-Member Advisory Committee to A. Dimoulas (supervisor), **C. Simserides,** E. Syskakis. On 19-7-2021, modification of the 3-Member Advisory Committee to **C. Simserides** (supervisor), V. Likodimos, D. Stamopoulos.

Accomplished **(1 supervision, 1 co-supervision, 2 in 3-member Advisory Committee):**

1. I supervised the PhD of **Konstantinos Lambropoulos**. From 11/04/2016 member of the 3-Member Advisory Committee: **C. Simserides (supervisor)**, G.P. Triberis, V. Likodimos. Subject: **Energy structure and physical properties of periodic crystalline, quasi crystalline, fractal, amorphous, random and natural DNA segments.** Modified on 23/9/2019 to **Energy structure and charge transport-transfer in molecular wires: carbynes, and periodic, deterministic aperiodic and random DNA**. Successfully examined Exam (excellent) on Wednesday 12-2-2020.

T2. From 11/04/2016, member of the 3-Member Advisory Committee for the supervision of the PhD of **Aristotelis Patsopoulos**: G.P. Triberis (co-supervisor on behalf of NKUA), D. Kechrakos (supervisor, ASPETE), **C. Simserides**. Subject: **Dynamics of magnetization at finite temperature of composite nanostructured materials.** Successful Exam (excellent) on 3 December 2019.

T1. From 25/06/2012, member of the 3-Member Advisory Committee for the supervision of the PhD of **Sigiava Aminalragia Giamini**: I. Grammatikakis (co-supervisor on behalf of NKUA), A. Dimoulas (supervisor, NCSR Demokritos, Institute of Nanoscience and Nanotechnology), **C. Simserides**. Subject **Physical Properties of Graphene and Topological Insulators for Applications in Nanoelectronics.** 30/5/2016: Subject modified to **Graphene and two-dimensional materials for nanoelectronic applications.** Successful Exam (excellent) on 7 December 2017 with **C. Simserides** as a co-supervisor on behalf of NKUA.

C1. Together with G. P. Triberis, **I have co-supervised** the PhD Thesis of **Anna Zora** with subject **Optical properties of quantum dots.** It is about magneto-absorption in the near field and photoluminescence of individual quantum dots. Successful Exam (excellent) on 7 December 2007.

2. Supervision of MSc Theses

Accomplished 8 supervisions, all at Materials Physics MSc, Physics Dept., NKUA. Current 0 supervisions.

#	name	title	finished
8	Panagiota Bilia	Monte Carlo simulations of Heisenberg model with 1, 2, 3 and 4 neighbors for fcc lattice and with many neighbors for (Ga,Mn)N: dilute magnetic doping of fcc and hcp cation lattices.	9 July 2021
7	Marina Theodorakou	Charge transfer in aperiodic B-DNA segments, made of different base pairs: Tight Binding description at the base-pair level.	4 July 2018
6	Konstantinos Kaklamanis	Monte Carlo simulations of the classical Heisenberg ferromagnet in lattices of cubic symmetry.	30 June 2017
5	Marilena Mantela	Charge transfer in aperiodic B-DNA segments: Tight Binding description at the base-pair level.	29 June 2017
4	Christina Zacharaki	Theoretical study of the electronic structure of planar organic molecules (purines, pyrimidines and similar molecules) with linear combination of orbitals.	22 February 2017
3	Georgios Georgiadis	Charge oscillations within one or two DNA base pairs: tight-binding description at the single base level.	27 July 2016
2	Charalambos Maroulis	Charge transfer in one-dimensional periodic DNA segments: tight binding description at the base-pair level.	1 July 2016
1	Konstantinos Lambropoulos	Charge transfer in one-dimensional periodic DNA segments: tight binding description at the base-pair level and at the single-base level.	29 March 2016

3. Supervision of BSc Theses

Accomplished: 22 supervisions, 4 co-supervisions, 2 typical co-supervisions.
Current: 3 supervisions, 1 co-supervision.
All at Physics Dept. NKUA, except for C1-C2 (at Materials Science Dept., University of Patras, Greece).

#	name	title	finished
29	Adrianos Tsaros	Monte Carlo simulations of classical Heisenberg model with many neighbors in orthorhombic lattices.	
28	Ekaterini Orfanaki	Charge transfer in DNA polymers: fishbone wire description at the base-pair level.	
27	Polymnia Glabedaki	Charge transfer in cyclic carbynes via Tight Binding and RT-TDDFT.	
26	John Pispas	Charge transfer in dicyanopolyynes (NC…CC…CN) via Tight Binding and RT-TDDFT.	

C5	Demetrios Ntzioras	Electronic structure and charge transfer in benzene via DFT, TD-DFT and RT-TDDFT. Cosupervisor Konstantinos Lambropoulos.	
25	Neocleia Margariti	Charge transfer in DNA dimers: fishbone wire description at the base-pair level.	
24	Stefania Kaklamani	Perception of consonant - dissonant diphonies by human auditory cortex. A paradigm of stimulations with the help of a computer.	
23	Stamatina Georgiou	Monte Carlo simulations of classical Heisenberg model with many neighbors in tetragonal lattices. Pass it in tables and figures.	October 2021
C4	Iakovos Apostolou	Effect of vibrations on charge transfer in open carbynes. Cosupervisor Markos Antonios Alvertis.	July 2021
22	Lazaros Chalcopiadis	Rabi oscillations in two-level and multi-level system with and without rotating wave approximation.	Janurary 2021
21	Maria Chliara	Monte Carlo simulations of the classical Heisenberg ferromagnet in fcc lattice.	January 2020
20	Panagiota Bilia	Carrier transfer in periodic polymer B-DNA segments based on G-C & A-T monomers with purine on purine: Base-pair-level description within Tight-Binding Approach.	April 2019
19	Theodoros Adamantopoulos	Charge transfer in carbynes: Tight-Binding Approach.	October 2018
18	Phaedra Amargianou	Carrier transfer in polymer B-DNA segments between G and GGG (5′-3′) via a bridge: Base-pair-level description within the Tight-Binding Approach.	October 2017
17	Maria Bazini	Electronic structure of 1,3,5 triazine with linear combination of atomic and hybrid orbitals.	September 2017
16	Demetrios Nioras	Electronic structure of planar hydrocarbons with linear combination of p_z atomic orbitals.	September 2017
15	Evangelos Pappas	Study of nanoparticles of tetragonal crystal lattice.	September 2017
14	Christina Vantaraki	Carrier transfer in periodic polymer B-DNA segments based on the G-C monomer: Base-pair-level description within the Tight-Binding Approach.	July 2017
13	Adamantia Kosma	Charge transfer in DNA polymers: tight-binding description at the base-pair level.	September 2016
12	Antonios-Demetrios Stefanou	Electronic structure of planar organic molecules with linear combination of atomic orbitals: emphasis on molecules with oxygen inside–outside molecular ring.	September 2016
11	Stefanos - Basim Atata	Electronic structure of benzene with linear combination of atomic and hybrid orbitals.	September 2016
10	Marina Theodorakou	Charge transfer in B-DNA homopolymers: description at the single-base level.	September 2016
9	Konstantinos Kaklamanis	Charge transfer in small DNA segments: description at the single-base level.	September 2015
8	Nicolaos Kamilaris	Linear combination of orbitals for the study of planar organic molecules with emphasis on benzene and carbazole.	September 2015
T2	Maria Giotsaliti	Monte Carlo calculations of depth dose distributions of various qualities of Ionizing Radiation. Typical co-supervision for Physics Dept. NKUA. Supervised by Evangelos Pantelis, Medical School, NKUA.	September 2015
T1	Dimitra Manousou	Compound electronic gates of MOS technology based on graphene: The possible role of grapheme quantum capacitance. Typical co-supervision for Physics Dept. NKUA. Supervised by Athanasios Dimoulas, NCSR. Demokritos.	September 2015
7	Maria Chatzieleftheriou	Charge transfer in DNA polymers: description at the base-pair level.	May 2015
6	Marilena Mantela	Study of the electronic structure of modified or not DNA bases and similar molecules with the linear combination of atomic orbitals method.	April 2015
5	Spyridon Karydis	Study of nanoparticles of cubic crystal lattice.	April 2015
4	Stylianos Vasilogamvros	2-dimensional Bravais lattices.	November 2014
3	Claudiana Grosler	Study of the electronic structure of nucleic acid bases and analogues with linear combination of atomic orbitals.	August 2014
2	Konstantinos Lambropoulos	Charge transfer in small DNA segments: description at the base-pair level.	June 2014
1	Athanasios Alevizos	Study of the electronic structure of planar organic molecules with linear combination of atomic orbitals.	January 2014
C3	Demetrios Bronowski	An introduction to quantum transport. Co-supervision together with Georgios Triberis.	September 2011

C2	Konstantinos Koumpouras	Spintronics in dilute magnetic semiconductor quantum wells. Co-supervision together with Iosif Galanakis.	October 2008
C1	Laurence Hawke	Calculation of tight-binding parameters for the modeling of charge transfer along DNA. Co-supervision together with George Kalosakas.	October 2007

4. Examination of PhD Theses
(Member of 7-Member Exam Committee, * = supervisor, # = in 3-Member Advisory Committee)

Accomplished: All at Physics Department., NKUA.

#	name	title	finished
5 *	Konstantinos Lambropoulos	Energy structure and charge transport-transfer in molecular wires: carbynes, and periodic, deterministic aperiodic and random DNA.	12 February 2020
4 #	Aristotelis Patsopoulos	Dynamics of magnetization at finite temperature of composite nanostructured materials.	3 December 2019
3 #	Sigiava Aminalragia Giamini	Graphene and two-dimensional materials for nanoelectronic applications.	7 December 2017
2	Theodoros Papaconstantinou	Methods of Numerical Science and Statistical Physics for the study of Disordered Systems.	**1 June 2016**
1	Margarita Dimakogianni	Study of the electrical conductivity of one-dimensional disordered systems: Application to DNA and other similar structures.	18 January 2012

5. Examination of MSc Theses (Member of the 3-Member Exam Committee, * = supervisor)

All accomplished at Materials Physics MSc, Physics Department, NKUA.

#	name	title	finished
15	Stefanos - Basim Atata	Preparation of VO_2 and V_2O_3 with Fe impuriies in bulk and layer forms and study of their properties in the MIT regime.	25 July 2020
14	Anastasios Sourpis	Monte Carlo methods with mean field boundary conditions.	6 June 2020
13	Konstantinos Atzemis	Study of thermodynamical properties of (V,W/Fe)O2 compounds in the Metal Insulator Transition (MIT) regime.	12 July 2019
12	Anastasia Vrettou	Synthesis and electrical properties of Sr-Pd-O compounds.	8 July 2019
11 *	Marina Theodorakou	Charge transfer in aperiodic B-DNA segments, made of different base pairs: Tight Binding description at the base-pair level.	4 July 2018
10	Nina Georgoulea	Complete transfer of states inquantum wires with local symmeties.	14 June 2018
9 *	Konstantinos Kaklamanis	Monte Carlo simulations of the classical Heisenberg ferromagnet in lattices of cubic symmetry.	30 June 2017
8 *	Marilena Mantela	Charge transfer in aperiodic B-DNA segments: Tight Binding description at the base-pair level.	29 June 2017
7	Michael Akritidis	Quantum Ising chain in inhomogeneous transverse magnetic field.	11 May 2017
6 *	Christina Zacharaki	Theoretical study of electronic structure of planar organic molecules (purines, pyrimidines and similar molecules) with linear combination of orbitals.	22 February 2017
5 *	Georgios Georgiadis	Charge oscillations within one or two DNA base pairs: tight-binding description at the single-base level.	27 July 2016
4 *	Charalambos Maroulis	Charge transfer in one-dimensional periodic DNA segment: tight-binding description at the base-pair level.	1 July 2016
3 *	Konstantinos Lambropoulos	Charge transfer in periodic DNA segments: tight-binding description at the bas-pair level and at the single-base level.	29 March 2016
2	Aristoteles Patsopoulos	Study of the exchange polarization phenomenon in Bimagnetic Nanowires.	22 March 2016
1	Sofia Bousiadi	Calculation of the potential in an electrolytic cell with asymmetric electrodes.	29 October 2015

6. Secondary (Gymnasium - Lyceum) Education

1991-1994	Olympia Caravouzi Preparatory School, Aghiou Therapontos 14, Zografos, Athens. Lyceum Physics and Chemistry.
1993-1995	"Military" Preparatory School, Emmanuel Benaki 41, Athens. Lyceum Physics, preparation for University exams.
1997-1998	"Domi" Preparatory School, 14th May 35, Alexandroupolis. Geometry.
1997-1998	Institute of Professional Education, Catacouzinou 16, 68100 Alexandroupolis. Winter Semester.

	Semester Course for Decorators: "Technology of Materials".
1997 -1998	"Minors' Protection Society", Alexandroupolis.

7. Educational programs to Lyceum teachers

(1) C. Simserides - C. Kapetanides: "Physical Principles and Technological Applications of Semiconductor Nanostructures in electronics and optoelectronics. Digital Circuits. Computer Architecture and Networks. Laser Technology and applications". A 40h educational seminar to high school - lyceum teachers, Orestias, Greece, February - March 1998.

(2) Th. Nalbandi - **C. Simserides**. "Computer Applications". A 40h educational seminar to high school - lyceum teachers, Alexandroupolis, Greece, May - June 1998.