University of Sofia "St. Kliment Ohridsky"
Faculty of Physics, Sofia, Bulgaria

International Conference on Physics in Memoriam Acad. Prof. Matey Mateev

Modern Physics Course in Bulgaria

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Outline

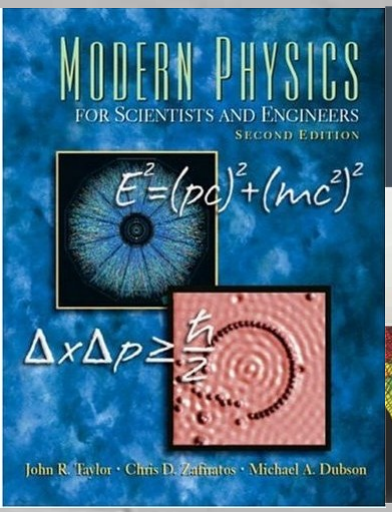
- The “Modern Physics” courses in universities in the world and in Bulgaria.
- New introductory course “Modern Physics for Engineers” included in the Curriculum of the M.Sc. Program “Wireless Network and Devices” in Faculty of Physics of Sofia University “St. Kliment Ohridski”.
- Basic education strategy and short description of the course.
- Conclusions and future work after the first cycle of lectures.

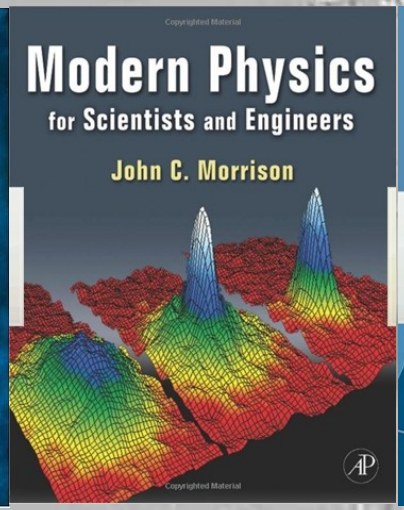
The Modern Physics

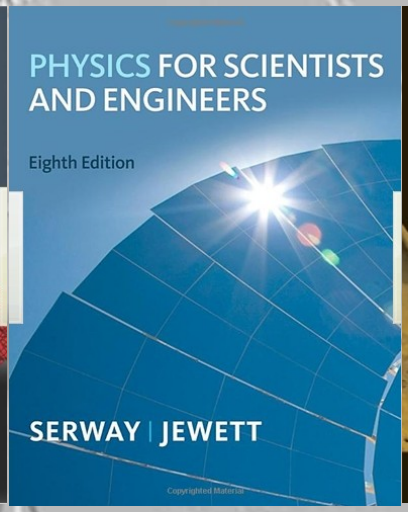
The **Modern Physics** is the Physics of XX century.

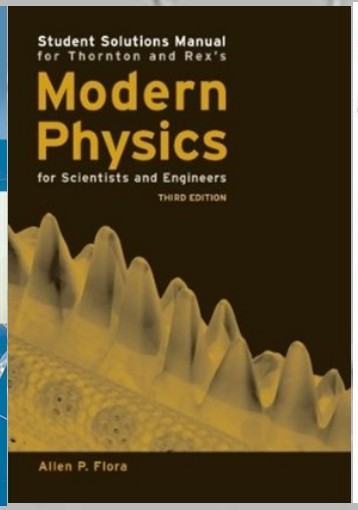
For years it is successively lecturing in chemical and physical faculties of many universities, in chemical technology universities, in technical, computer and information technology universities and so on. There are a lot of excellent manuals in English language; part of them translated in Russian.

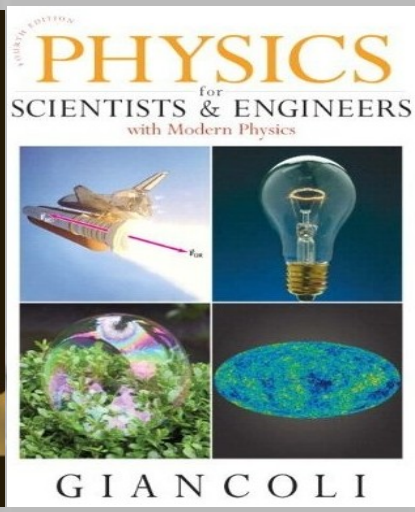
Unfortunately, there is nowhere such course in Bulgaria, nevertheless of our insistent suggestions in many universities here.











M.Sc. course: “Modern Physics for Engineers”

Finally, this year for the first time we started to lecture an introductory elective course “**Modern Physics for Engineers**” for the master students in the M.Sc. Program “Wireless Networks and Devices”.

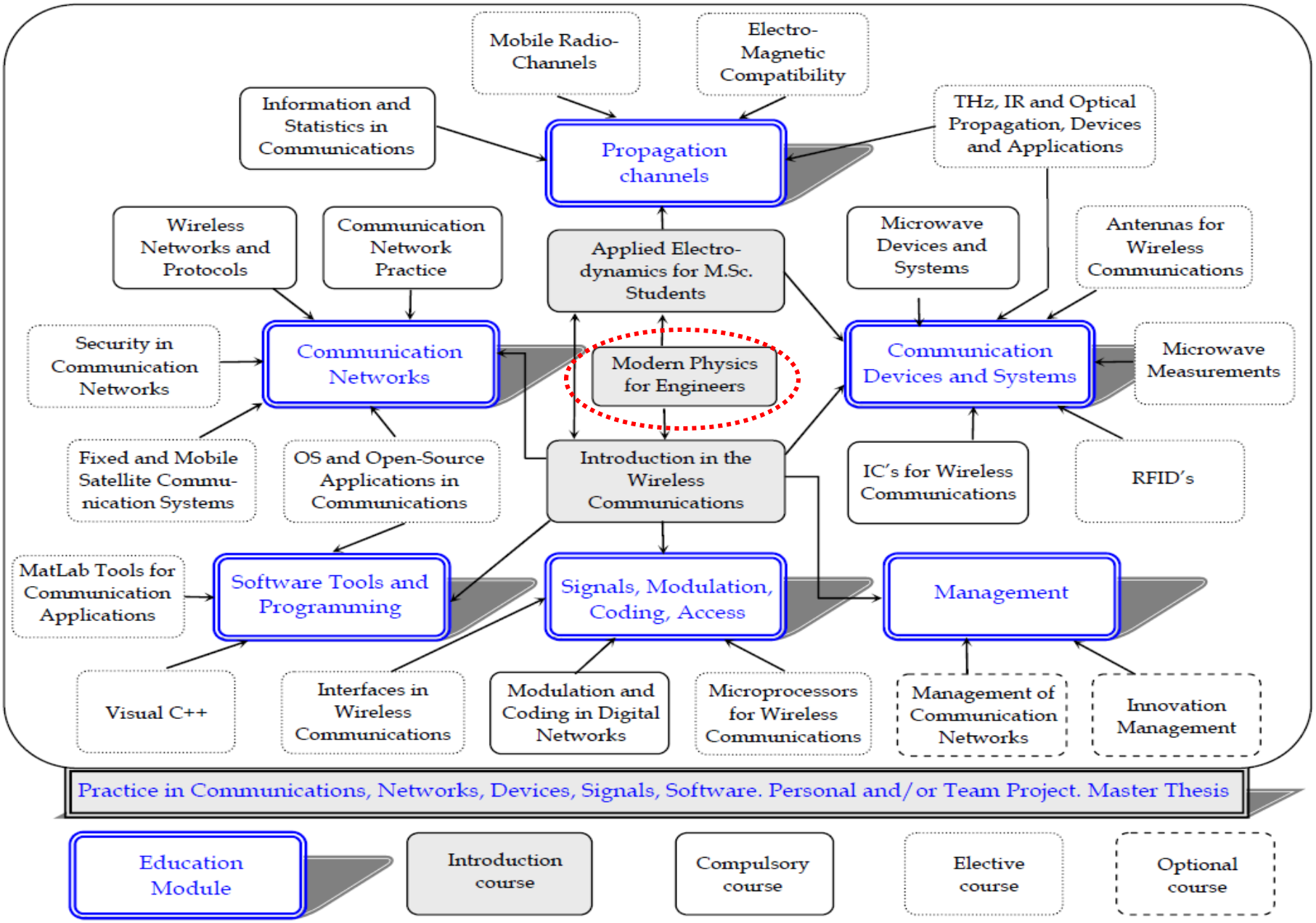
This is an introductory course. It is essential for the launch of the education process. Students usually come from different higher education institutions and they have received different B.Sc. specialties and levels of training. A main goal of this course is to align preliminary student knowledge in the area of physics as a base for many other specific courses in the program. The last years the number of students, who has received their bachelor degree in technical universities increase.

Short structure of the course:

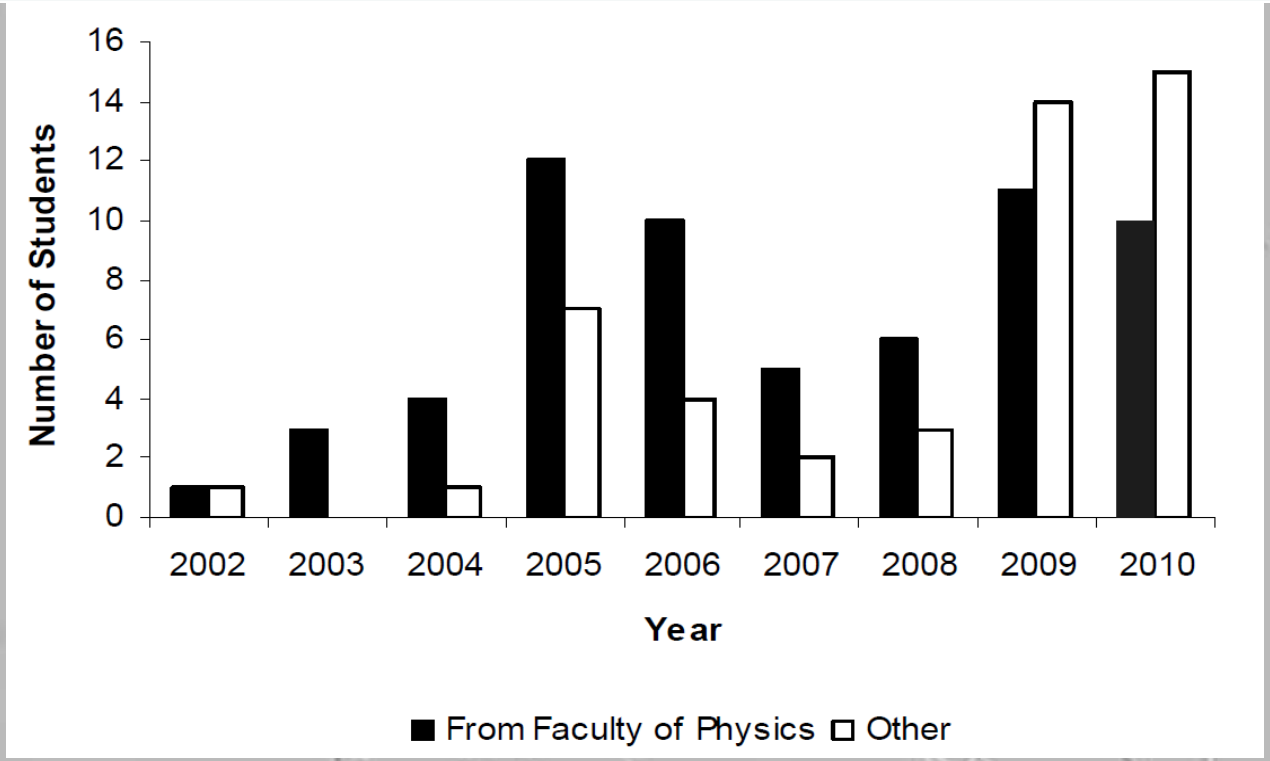
- ✓Relativistic Mechanics
- ✓Wave-Particle Duality
- ✓Operators and Waves
- ✓Hydrogen atom
- ✓Many-Electron Atoms
- ✓Statistical Physics

- ✓Electronic Structure of Solids
- ✓Charge Carriers in Semiconductors
- ✓Semiconductor Devices
- ✓Nuclear Physics
- ✓Nuclear Reactions
- ✓Particle Physics

M.Sc. Program "Wireless Networks and Devices"



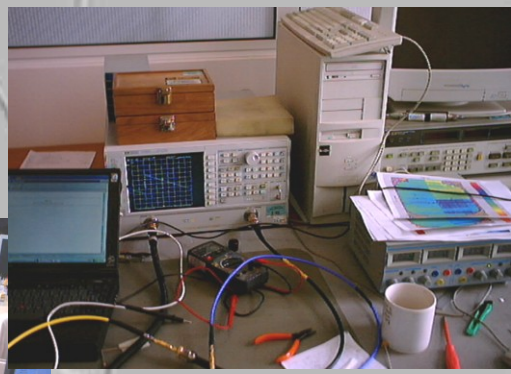
Number of students participating in the program



Special Features of the Education in the Microwave Area

Higher education in the area of microwaves: wave propagation, RF components and devices, antennas, wireless communication, etc. is among the most sophisticated for many reasons. First of all, electromagnetic modeling of microwave structures is based on pure circuit approximation as well as on pure wave approximation, combined to a specific extent in each particular case. Therefore, students have to acquire sound knowledge both in the areas of electronics and electrodynamics on very good science and engineering level.

Incessant development of research and modernization of key facilities, technical solutions and applied approximations in the microwave range urge lectures on contemporary physical level.



Education Strategy (1)

Our strategy in the course "Modern Physics for Engineers" is to give a logically coherent and sequential account of the basic principles of relativity and quantum theories of atomic and nuclear structure, and of a few topics in elementary particle, molecular and solid-state physics. We begin with a simple treatment of special relativity, because it the foundation of almost all later chapters, in which the photon is a completely relativistic particle. Then quantum effects are introduced and the wave properties of material particles are treated. After laying down the fundamental principles of wave mechanics, de Broglie's hypothesis, the wave function, the superposition and the uncertainty principle, we introduce the student to the Schrödinger theory of quantum physics. This theory is applied to a few examples – the infinite potential well, the step potential and the potential barrier, quantum harmonic oscillator, the Hydrogen atom, the two-atomic molecule, an the interaction of magnetic field with the electron in atom. We use these results, together with Pauli's exclusion principle, to determine the electron configuration and some of the properties of multi-electron atoms.




Education Strategy (2)

After short presence of the physical statistics the students are ready to study the electrical properties of materials. A brief discussion of the crystal structure precedes the presentation of the classical and quantum free electron models. In order to explain the large differences in the electrical properties of solids as well the peculiar properties of semiconductors, the existence of allows and the forbidden energy bands is investigated. We introduce the concepts of electron and hole effective mass. Intrinsic and dope semiconductors, the different types of movement of the charged particles and their electrical properties are discussed. A rather simple matter for students to understand the behavior and the characteristic of semiconductor devices: diodes, bipolar transistors, field-effect transistors, etc. The material of nuclear physics includes the nuclear models, nuclear decay and nuclear reactions. At the end we give a full exposition, at elementary level of elementary particle physics.




Main benefits for the students

Our aim is to treat the fundamental of physics fairly rigorously, but at elementary level. We put the accent on the physical sense of the phenomena. We make no pretense for comprehensive treatment the most topics of contemporary physics. Rather the lectures are intended as a meaningful introduction to those central ideas, which dominate modern physics, together with illustrations of how these general principles apply to some specialized areas.



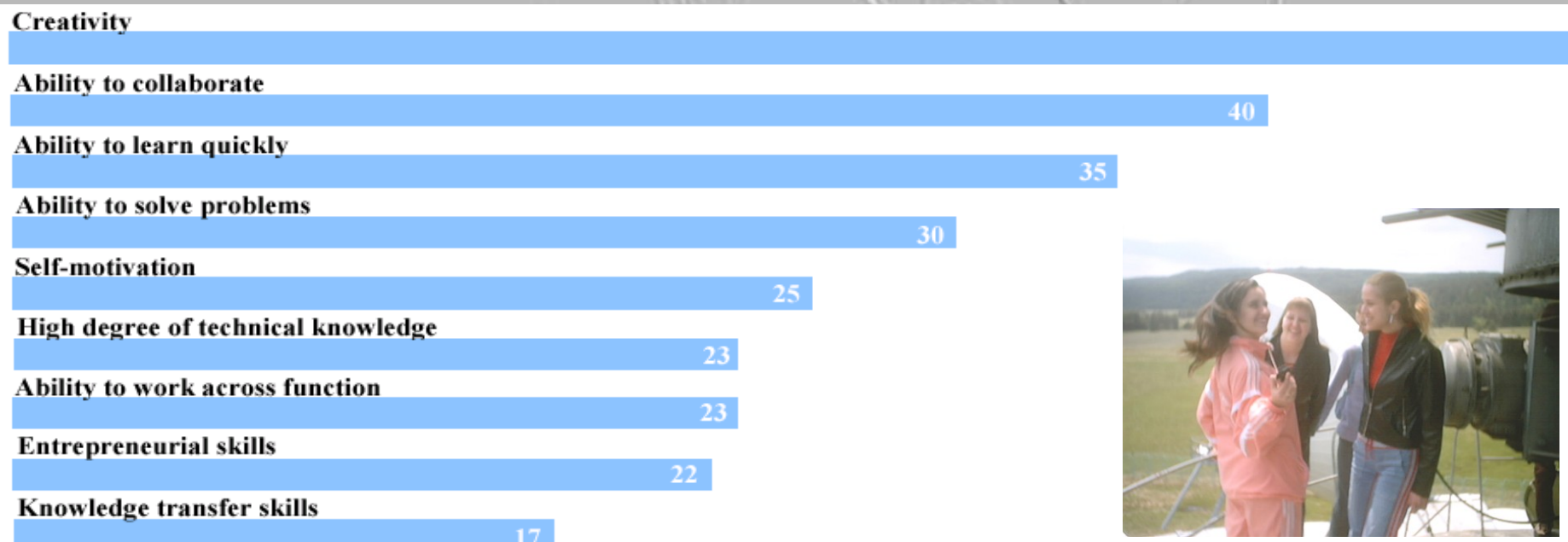





Focus on Student's Innovations

The ascertained key skills for innovation where creativity and ability to collaborate appear to be the most important. They are immediately followed by the ability to learn quickly, the ability to solve problems and by self-motivation. And all of them are followed by the high degree of technical knowledge. Such a structure of findings is clearly indicative that development of cutting-edge innovation skills should start as early as possible.

We believe that the proposed course Modern Physics is helping us to form this unique physical manner of thinking, which is suitable for the creative and self-motivated students with ability to solve complex problem and to learn quickly.



Source: Economist Intelligence Unite survey, July 2009

Thanks for your attention