NATIONAL TECHNICAL UNIVERSITY OF ATHENS
SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES

THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS (N.T.U.A.)

Founded in 1837, NTUA, the oldest Greek Technical University, was born almost simultaneously with the modern Greek State: A royal decree “on education in architecture” established originally a technical school, which immediately after its opening received a flood of applications. The high demand resulted to the rapid expansion of the school and its transformation to a “Technical University” committed since the beginning to observing high standards subject to ongoing regular evaluation. The school quickly embraced reforms that enabled it to meet successfully the needs of a country in ongoing development, in terms of reconstruction and industry. Originally, the Studies Curriculum was three-years long, it was regularly enriched with new disciplines, and the administration was entrusted to the Committee for the Encouragement of National Industry.

The increasing number of students enrolled and the ambitious plans of the school made increasingly pressing the need for a special campus area large enough to accommodate further expansion in the future. Thus, in 1871, the School relocated to new buildings on the Patission Street complex. The construction of these buildings was first funded by Nikolaos Stournaris, who in his will in 1852 noted that his “remaining monies I bequeath for the building of an illustrious “Politechnion” University in Athens.” His generosity and visions inspired relatives and fellow citizens from Metsovo (including Michail Tositsas, Eleni Tositsa and Yeorgios Averof) to embrace his vision and lead it to fulfillment. The “Ethnicon Metsovion Politechnion”, well known abroad as National Technical University of Athens (N.T.U.A), came into existence.

In 1887, with the introduction of a four-year degree course for Civil and Mechanical-Engineering the N.T.U.A. was able to announce that it “educates highly qualified engineers for the public service, industry and construction”, who are equivalent to “graduates from the well – known Engineering Schools of Western Europe”.

The final major reform in the organization and administration of N.T.U.A. took place in 1917. The “Ethnicon Metsovion Politechnion” acquired five high level Engineering Schools: Civil, Mechanical & Electrical, Architecture, Chemical and Surveying. Several changes introduced gradually since 1917, have led to its current structure: A prestigious University of Science and Technology, with eight Engineering Schools and a ninth School of Applied Mathematical and Physical Sciences.

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THE SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES

The School of Applied Mathematical and Physical Sciences is the newest of the nine Schools of the National Technical University of Athens. It developed out of the previously existing Department of General Sciences. The School accepted its first students during the academic year 1999-2000.

The School of Applied Mathematical and Physical Sciences consists of four Departments:

1. The Department of Mathematics
2. The Department of Physics
3. The Department of Mechanics
4. The Department of Humanities, Social Sciences and Law.

The School employs 118 members of Academic and Research staff (Professors, Associate Professors, Assistant Professors, Lecturers) , 3 Scientific Associates, 41 Administrative Staff members, 8 members of the Technical Staff and 6 members of Special Teaching Staff. It has 1.600 undergraduate students, 384 graduate students and 225 Ph.D candidates.

The School of Applied Mathematical and Physical Sciences was created in order to meet the needs for graduates highly qualified in the Applied Mathematical and Physical Sciences, who would combine a solid background in both Mathematics and Physics with more specialized skills in either of these as well as in Mechanics. Graduates are also expected to master the use of tools made available by modern Computing. Graduates of the School should be able to participate in research in the applied mathematical and physical sciences as well as to apply modern scientific and technological approaches to the solution of problems in industry and the services of the public or private sector. The graduates of the School should also be able to follow an academic career in secondary or tertiary education.

CONTACT DETAILS

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DEPARTMENT OF MATHEMATICS

The Department of Mathematics is served by a Faculty of 40 members of Academic and Research Staff, 5 Emeriti Professors, 1 Scientific Associate and 6 members of support staff.

The main goal of the Department is to offer an advanced mathematical education to the students and to promote research in mathematics into a theoretical and applied direction.

HISTORY OF THE DEPARTMENT

Mathematics has always been a central subject in the curriculum of engineering studies at the National Technical University of Athens. In fact, the significance of Mathematics was recognized right from the beginning, in the decree establishing N.T.U.A. in 1836. Since then, Mathematics has played a central role at the University by providing tools for technological advance, but also as an autonomous theoretical and applied science. Already in the 19th Century, the teaching of Mathematics at N.T.U.A. was not just limited to providing the necessary mathematical training for engineers but also followed and reflected contemporary mathematical developments and research. This trend was enhanced by the presence at N.T.U.A. of prominent Greek mathematicians such as K. Stephanos, I. Hadjidakis and G. Remoundos and also of C. Caratheodory who lectured at N.T.U.A. for two academic years in 1922-24. The development in more recent times, of the two-year mathematical curriculum suitable for engineering students, that forms the basis of their mathematical education until today, was mainly due to well-known mathematicians such as N. Kritikos and Ph. Vassiliou, who continued to emphasize the importance of advanced mathematical studies and mathematical research. Thus, it is not surprising that the only graduate course mentioned in the 1937 N.T.U.A. catalog was a seminar on "Convex analytic functions and conformal mapping". It was also not surprising that many of the graduates of N.T.U.A., among whom belong the late C. Papakyriakopoulos and S.Pichorides , pursued graduate studies and careers in Mathematics, advertising through their work both N.T.U.A. and their country. Strarting in the academic year 1999-2000 the Department of Mathematics plays crucial role in the newly founded School of Applied Mathematical and Physical Sciences and houses the Direction of Applied Mathematics.

THE EDUCATIONAL WORK OF THE PHYSICS DEPARTMENT

UNDERGRADUATE STUDIES

THE TEACHING OF MATHEMATICS AT THE SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES (SAMPS)

The Department of Mathematics supports all mathematical courses of the SAMPS core programme of studies (the first four semesters), the compulsory courses of the concentration of Applied Mathematics as well as the courses of the four streams of the concentration of Applied Mathematics. Theses courses aim to equip the students with the basic mathematical background, as well as provide specialized knowledge in particular areas of Applied Mathematics. These

courses provide our students with advanced abilities to resolve complex problems arising in practise.

THE TEACHING OF MATHEMATICS IN OTHER NTUA SCHOOLS

In our days the dissemination of mathematical methods and their importance in every field of science and technology make the mathematical education of engineers as important as ever in the past. The continuous interaction of mathematics with other fields creates new interdisiplinary domains where both pure and applied mathematics can be applied. The Department of Mathematics has the responsibility of teachning mathematics to all NTUA Schools.

POSTGRADUATE STUDIES

The Department of Mathematics coordinates two Interdepartmental Programs of Postgraduate Studies: **"Applied Mathematical Sciences"** and **"Mathematical Modelling in Modern Technologies and Financial Engineering"**.

Interdepartmental Programme of Postgraduate Studies (IPPS): ***Applied Mathematical Sciences***

The Shool of Applied Mathamatical and Physical Sciences and the collaborating Schools of Mechanical Engineering and Naval Architecture and Marine Engineering coordinate the organization of this Interdepartmental Programme of Postgraduate Studies. Members of staff from the School of Electrical and Computing Engineering also participate in the programme. The programme consists of three independent directions:

- Analysis and Differential Equations
- Computational Mathematics (Numerical Analysis & Computing)
- Statistics and Probabilities

The goal of each direction is to support the creation of scientists and researchers who will be able to work in research Centers and Organizations, in Greek and foreign Universities, in private business and industry, as well as analysts and scientific consultants. Many of the basic courses of this graduate programme are the same as the ones followed by the Ph.D candidates of the Department.

More for the IPPS ***Applied Mathematical Sciences*** can be found at the web site: www.apms.math.ntua.gr

Interdepartmental Programme of Postgraduate Studies (IPPS): ***Mathematical Modelling in Modern Technologies and Financial Engineering***

The School of Applied Mathamatical and Physical Sciences and the collaborating Schools of Electrical and Computing Engineering, Chemical Engineering, Naval Architecture and Marine Engineering coordinate the organization of this Interdepartmental Programme of Postgraduate Studies. Each School offers courses related to its scientific profile. In addition to this, professors from other universities, as well as other lecturers, participate in the Programme teaching a variety of courses which are not offered by NTUA staff. The Programme focus is on mathematical modeling and its applications to technology and economics. The IPPS includes two Directions: the Direction of Modern Technologies and the Direction of Economics, with emphasis on Financial Engineering.

More for the IPPS ***Mathematical Modelling in Modern Technologies and Financial***

Engineering can be found at the web site: www.mathtechfin.math.ntua.gr

The Department of Mathematics also participates in the IPPS “Science and Technology of Water Resources” (coordinated by the School of Civil Engineering), “Naval Technology and Science” (coordinated by the School of Naval Engineering) and “Logic and Theory of Algorithms” (coordinated by the Department of Mathematics of the University of Athens).

RESEARCH

There are active research groups in areas like functional analysis and nonlinear functional analysis, ordinary and partial differential equations, integral equations, numerical analysis, probability theory, statistics and stochastic processes, differential geometry, discrete mathematics and theoretical computer science, harmonic analysis, applied linear algebra, mathematical methods in physics and Lie groups, algebra, topology, mathematical systems theory and control, geometry, history of mathematics.

COMPUTING FACILITIES OF THE DEPARTMENT OF MATHEMATICS

The Department of Mathematics has a fully equipped computing laboratory for its research and teaching needs, as well as a fully equipped seminar room and other classrooms for graduate courses and presentations. The computing laboratory offers computing support for the teaching and research activities of the Department. The Department’s intranet is part of the advanced NTUA network and provides networking services to all members of the Department.

CONTACT DETAILS (DEPARTMENT OF MATHEMATICS)

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DEPARTMENT OF PHYSICS

THE HISTORY OF PHYSICS AT THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS

Physics was taught for the first time at the National Technical University (Polytechnic) in 1844 by the astronomer and professor in the University of Athens Georgios K. Vouris (1802-1860), without attracting any significant level of attention, and again in 1858 by the mathematician Vasilios Lakonas (1830-1900). The systematic teaching of the subject got under way in September 1863 following the reorganization of the Institute, its first professor being the great Greek chemist Anastasios K. Christomanos (1841-1906). Physics was taught initially in the higher classes of the three schools in the Technical University of Athens (Architecture, Surveying, Mechanical Engineering), with instruction accompanied by experimental demonstrations. For this purpose, in 1876, Christomanos took into his charge all the physics equipment already present in the Institute, which had mostly come from bequests, at the same time initiating regular purchases of equipment, leading to the establishment of a quite good collection, ranging from the most basic and simple instruments to the more complex.

With the reform of 1887 physics was included among the examination subjects in the entrance examinations for would-be students, with physics teaching transferred to the first years of studies, during which – in parallel with the teaching of higher mathematics – the necessary scholarly foundations were established for more difficult technical subjects. Although the law provided for experimental practice and grading of students at the experimental physics laboratory, as it turned out, this did not really take place at that time.

Following the death of Christomanos in 1906, Konstantinos C. Maltezos (1869-1951), who subsequently became a member of the Academy, was appointed to the chair of Physics, teaching there until his departure in 1938. In the 1909-1910 academic year the students of the Civil Engineering and Mechanical Engineering school had practice for the first time in the physics laboratories and the next year this was extended to the students in all the other schools that were being established, apart from Architecture.

In 1939 Achilleas N. Papapetrou (1907-1997) was elected as Professor Extraordinarius of Physics and taught until his dismissal in 1946. In the following years physics was taught at the Technical University of Athens by professors K. Palaiologos, P. Santorinis and T. Kouyoumtzelis.

After the fall of the Junta in 1974 the teaching of physics at the Technical University of Athens went into a new phase, firstly with the move of the related activities to the new (then) Physics building on the university campus at Zografou and the gradual establishment subsequently of new laboratories for the students of all the Engineering Schools of the NTUA to practice. 1976 saw the introduction, under the co-ordination of Professor G. Boudouris, of the collective translation of the five-volume “University of Berkeley Physics Course”, which was to become for many years the basic teaching textbook for Physics in all the Engineering schools of the Technical University of Athens.

THE EDUCATIONAL WORK OF THE PHYSICS DEPARTMENT

UNDERGRADUATE STUDIES

TEACHING PHYSICS AT THE SCHOOL OF APPLIED MATHEMATICAL AND PHYSICAL SCIENCES (SAMPS)

The Physics Department, like the other departments in the School, supports on the one hand the basic studies programme (the first four study semesters), on the other hand four of the five streams of the Applied Physics concentration (specifically the streams Theoretical and Computational Physics, Nuclear Physics and Elementary Particles, Optoelectronics and Lasers and Advanced Technology Materials).

Undergraduate physics courses at SAMPS consist of a series of physics foundation courses for the first four semesters and the two electives: Applied Mathematics and Applied Physics, which aim at providing students with the requisite basic knowledge of physics in a methodical and scientifically well-grounded manner. Next, a series of mandatory courses are taught for the Applied Physics concentration to round off the knowledge that is required of a physicist and the background necessary for in-depth understanding of advanced physics courses and the specialized electives offered in the later semesters. These electives aim at enabling the student to acquire a deeper understanding of certain specific areas, such as:

- Advanced Technology Materials, Materials Engineering,
- Optoelectronics and Lasers,
- Nuclear Physics and Elementary Particles,
- Theoretical and Computational Physics.

TEACHING PHYSICS AT THE OTHER SCHOOLS OF THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS

At the other schools of the National Technical University of Athens the Physics Department offers the basic mandatory courses in physics, the first semesters of the corresponding study programmes and electives for the later semesters, as follows:

a. A number of General Physics courses for the 2-4 first semesters of polytechnic education, which are mandatory for most of the schools in the National Technical University of Athens. These are foundation courses aimed at providing students with basic scientific knowledge in a methodical manner and familiarzing them with the scientific mode of thought. This formation comprises a firm background enabling the student to acquire a deeper understanding of the advanced technical courses as well as having the ability later in his professional career, to deal with the new problems created by technological developments.

b. A number of mandatory physics electives taught at various schools of the National Technical University of Athens after the 3rd semester and adapted to their more specific requirements. These aim at linking certain technological subjects to physics and reinforcing them with more advanced and specialized knowledge.

c. Certain more general, but also higher-level, physics electives that help the student to develop a deeper understanding of other subjects and of the scientific mode of thought. They also cover the traditional special interest of a number of the Institute's students in physics.

LABORATORY PRACTICE

One of the most important educational services of the Physics Department is laboratory practice for the students at the SAMPS and the other schools of the National Technical University of Athens, at the Department's educational laboratories. For the furtherance of this objective the Physics Department has a significant laboratory infrastructure for the use of students in laboratory practice courses in Engineering, Electrical Science, Wave Mechanics, Atomic and Nuclear Physics, Optics, Laser Physics, etc. It is also equipped with a noteworthy infrastucture of electronic computers and significant laboratory equipment in the fields of High Energy Physics, Solid State Physics, Lasers, Material Physics, Ultrasound Physics, Biophysics, etc. for the pursuit of research in these fields. In the Physics Department there is also an annex to the central library which has been developed through bequests from departing and deceased colleagues.

Detailed information on the exact number of students involved in laboratory practice, with listing of names in the groups to which they have been assigned, the week-by-week laboratory practice, the type of activity being conducted, and the names of members of the Deparment (permanent staff and Ph.D. students) responsible for supervising the students' laboratory practice are posted at the Physics Department website (http://www.physics.ntua.gr) and specifically at the URL

«Εκπαίδευση» → «Εκπ.Εργαστήρια» ("Education" → "Educational Laboratories")
(…/gr/ergasthria.htm)

As may be determined from the detailed information on students' laboratory practice for all the Schools of the NTUA, the laboratory practice workload handled by the Physics Department *per week* amounts to, and indeed exceeds, *(1.000 students)×(2 hours)*, in normal operating conditions for the academic semesters.

POSTGRADUATE STUDIES

The Physics Department organizes two Interdepartmental Postgraduate Study Programmes (IPSP) and also participates, through teaching by members of the Department's teaching and research staff, in other IPSPs conducted by the National Technical University of Athens and other institutions. The IPSPs organized by the Physics Department are the following:

"PHYSICS AND TECHNOLOGICAL APPLICATIONS" IPSP

The Programme is carried out in collaboration with the Nuclear Technology Department of the NTUA's School of Mechanical Engineering and the Institute of Materials Science of the Demokritos National Center of Scientific Research. .

It represents a continuation of the pre-doctoral studies programme that was in operation in the 1970s with collaboration from the National Technical University of Athens and Demokritos. The characteristic feature of the programme is the strong physics background at the post-graduate level for the purpose of specialization in technological applications of physics and at the same time continuation of postgraduate studies with a view to completing a doctoral thesis.

"MICROSYSTEMS AND NANO-ORGANIZATION" IPSP

This programme operates in collaboration with the schools of Electrical Engineering and Computer Systems Engineering, Mechanical Engineering, Marine Engineering and Chemical Engineering of the National Technical University and the Microelectronics Institute of the "Demokritos" National

Center of Scientific Research.

The programme aims at preparing students for specialization in the fields of very small-scale materials, systems and design that are the focus for microelectronics and nanotechnology, and provides an opportunity for continuing study to obtain a Ph.D.

As mentioned above, the Physics Department provides opportunities for preparing doctoral theses. PhD students are selected on the basis of written examinations in key aspects of physics.

The Physics Department participates in the “Science and Material Technology” IPSP under the co-ordination of the Chemical Engineering School of the National Technical University and “Medical Physics-Radiation Physics”, which is co-ordinated by the Medical School of the University of Athens.

RESEARCH ACTIVITY

A considerable number of research fields are handled successfully in the Physics Department. In many of them the research is carried out in collaboration with other departments in the National Technical University of Athens and with other institutions in Greece and abroad. Research activity is today being conducted inside the Physics Department in the areas of:

Theoretical Solid State Physics, Dielectric Spectroscopy, and Dielectric and Polymer Physics, Optical Spectroscopy of High-Concentration Materials, the Physics of Super-Superconducors for high-temperature transfer and related materials, Development of Laser Systems and Laser Applications, Theoretical High-Energy Physics, Electronics, Physics and Nanotechnology, Experimental High-Temperature Physics, Nuclear Physics and its Applications.

LABORATORY INFRASTRUCTURE

The Physics Department’s facilities and equipment (on which the research activities of its members are dependent) is valued at more than €4,000,000. It is distributed among the different research groups mentioned above and could be itemized, in summary, as follows:

Nuclear Spectrosccopy System a, b and c. Measurement systems for Radioactivity in Aquatic Environments. Cherenkov detector groups. Detection system for charged mesotrons (in the framework of the international ATLAS experiment). Automated V-UV diffraction meter (F 12.5cm), V-UV backscatter meter, computer banks - GRID system (hub of the international GRID system).

AC dielectric measurement system (Freq. Response), AC dielectric measurement system (Imp. Analyzer), AC dielectric measurement system (LCR precision meter), AC dielectric measurement system (Q-meter, capac. Bridges), DC electric measurement system, measurement system for absorption and diffusion of water.

Ruby, Excimer pulsed CO2 Lasers, Infrared power Laser (CO2), Energy meters – power Laser (pulsed – cw), Multiple-wavelength LIDAR system, Spectrometer and integrating sphere, optical trapping microscope, SPIRICON digital beam profiler, Laser -CO2, 500W, c.w. data collection systems (Industrial applications), HF, N2 CO2 Lasers (Biomedical applications), Er:YAG, pulsed Laser (experiments on interaction between laser radiation and material), HF Lasers, (Excitation studies – pre-ionization laser for measurement of environmental pollution).

SPEX single-grating spectrometer + MPR, SPEX double-grating spectrometer, Jobin Yvon triple-

grating spectrometer, Brucker IR spectrometer, 3×Ar+ Laser, 2 Coherent, 1 Spectra-Physics, 2 × Kr+ Laser, (2 Coherent), Coherent Dye Laser, Spectra-Physics Ti:Sapphire cw Laser 3 × Oxford kryostats, Optical Measurement Oven, Hydrostatic Systems with monoaxonic tensions, Vacuum systems.

Clear space (class 1000, sputtering system and accessories), two ion-emission sources and radio frequency generator, nanoparticle production source, vacuum systems, lithograph and high-resolution microscope. Electrical measurement systems.

XRD diffraction meter, AFM microscope, Field emission scanning electron microscope + e-beam lithography

DEPARTMENT OF MECHANICS

THE HISTORY OF MECHANICS AT THE NATIONAL TECHNICAL UNIVERSITY

The beginnings of the history of mechanics are lost in the depths of time when people turned their gaze towards the heavens and wondered about the laws that inform the movement of the heavenly bodies. One basic stage in its development is to be noted in the age of Galileo and Newton. It was then that the mechanistic image emerged, that sought to explain all phenomena, tending towards absolutist interpretations. Another crucial stage in the development of mechanics took place in the mid-nineteenth century and the early twentieth century, when the mechanistic image of the world was extended via a range of new concepts (energy, entropy, molecular movement, etc.) sidelining and at many points overturning the absolute mechanistic interpretation of phenomena. This stage of mechanics commences from the moment that microscopic phenomena could not be accounted for through simple mechanistic conceptions and it became necessary to develop new perspectives such as electrodynamics and quantum physics This is the phase to which the contribution of Poincaré is to be mentioned, this being the basis for the theory of dynamic systems and the dynamics of chaos. In contrast to preceding conceptions, Poincaré was the first to prove that there are problems in mechanics that are, and remain, unsolved from the viewpoint of the analytical approach. Not because of any lack of the necessary mathematical tools but because of nature itself and the natural complexity of the problems.

The term “mechanics” (in Greek “mechaniki”) to describe the first phase of operations of the National Technical University (the period of Zentner [1837-1843], Kaftanzoglou [1844-1862] is employed side by side with the terms “machinery design” (*ichnografia mechanon*), “construction” (*oikodomiki*), “explanation of machines and construction”. Mechanics did not have the prestige it later acquired (Skalistiris period [1864-1873] and afterwards). Nor was it considered a basic subject for studies at the Institute. The teaching of mechanics in the early period of the Institute is inextricably linked to teaching of the corresponding subjects at the Military Academy. The teaching of Mechanics was detached from military education and began only in 1874 to approximate the content that is today invested in the term, with the appointment of the first professor of the relevant subjects (“Applied Mechanics” and “Resistance of Matter”), Anastasios Soulis, who was not from the Military Academy: Anastasios Soulis also wrote the first textbooks “*Applied Mechanics*” and “*On the Resistance of Matter*” for the students at the Institution. Soulis offered his service to the Institution for more than thirty-five years, laying the foundations for qualitative upgrading of teaching in the Mechanics courses. The work of A. Soulis was continued and systematized by the tireless teacher Aristippos Kousidis, through whose efforts the teaching of *”Mechanics”* and of “*Material Resilience*” came even closer to its present-day form. Mechanics courses were taught at the end of the 19th and the beginning of the 20th centuries at the Technical University of Athens by distinguished mathematicians such as Nikolaos Gennimatas, Ioannis Hatzidakis, who gave the teaching of Mechanics the rigorous mathematic character that distinguishes it to this day.

Throughout the 20th century distinguished scientists of international stature taught Mechanics at the National Technical University, among them Georgikopoulos, Bitsakos, Theocaris and other notable men of science.

Mechanics today concentrates first and foremost on developing methods and techniques for explaining phenomena that have a bearing on complex problems. Problems, that is to say, where the behaviour of the the system as a whole cannot be predicted from a simple study of the laws

that conform the sub-systems constituting it. An important role in the development of theories along those lines must be attributed to Prigogine, with his contribution to developing conceptions of non-equilibrium in physics and mechanics. In the 21st century it can be stated with absolute certainty that no progress in any branch of technology can attain its goal if some fundamental modern theories of mechanics are not taken into account. Knowledge of mechanics is indispensable in a very broad range of research fields with practical applications extended from the construction of complexes of buildings, hydroelectic power stations and dams, bridges and roads, boats and aeroplanes, up to and including bio-engineering and bio-robotic systems, the comprehension of bio-dynamic, epidemiological and ecological phenomena and the design of materials and the micro- and nano- level. The laws of mechanics in any case govern a variety of functions and are implemented at the high point of research into mechanics as it took shape in the 21st century, including the study of phenomena and systems such as the movement of living creatures on dry land, the self-organization that makes its appearance in the flight of flocks of birds and insects, the swimming of fish, circulation of the blood in the living organism, the division of the cell, the functioning of the nervous system, the creation of micro-systems and micro-capsules for targeted treatment of diseases such as cancer, the systematic study and the modelling of seismic phenomena. Here the question arises: How is it that mechanics, whose laws were formulated centruries ago, has not exhausted itself and has not been reduced to an aggregation of predetermined rules and fields of inquiry? Where is the connection to be found between mechanics and other sciences and what is the connecting link? First of all, no sum total of the laws of a science can exhaust its content. This is analogous, for example, to requiring that everyone should be poets and composers of music because there are rules for writing poetry and music. Moreoever, a significant role in the development of mechanics has been played by the development of mathematics, which is an inseparable part of mechanics, thanks to which the study of problems can be carried out in a systematic,and indeed axiomatic, manner. Mathematics has even contributed at times to mechanics evolving in directions that were not initially evident. And many times the opposite also occurs, when problems in Mechanics provide the stimulus and the interpretational possibilities for many fields of Mathematics that would not otherwise have developed. .

THE EDUCATIONAL WORK OF THE DEPARTMENT

UNDERGRADUATE STUDIES

THE TEACHING OF MECHANICS AT THE SCHOOL OF APPLIED MATHEMATICS AND NATURAL SCIENCES

The Mechanics Department makes available the whole range of courses in Mechanics that are taught in the first four semesters of the School's core course in both the Applied Mathematics and the Applied Physics concentrations. Most of these courses are aimed at students in all streams of both concentrations but particularly in the streams **Applied Mechanics – Computer Simulations** and **Mechanics of Materials.**

The courses offered by the Department seek chiefly to provide students with the theoretical background necessary for clarification of the basic principles of Mechanics in a manner that is both methodical and scientifically well-grounded. At the same time, there is an aim to enable students to

acquire suitable knowledge in specific selected branches of applied Mechanics so as also to obtain a clear picture of the most up-to-date technological applications.

THE TEACHING OF MECHANICS AT THE OTHER SCHOOLS IN THE NATIONAL METSOVIO POLYTECNIC

The Mechanics Department also provides courses in Mechanics at the other Schools of the National Technical University (with the exception of the School of Architecture and the School of Rural and Surveying Engineering). In particular, courses in Experimental Materials Resistance and laboratory groups in Deformed Body Mechanics and Fracture Mechanics in the Schools of Civil Engineering, Mechanical Engineering, Naval Engineering and Mining Engineering are conducted in the well-equipped facilities of the Materials Resilience Laboratory.

POSTGRADUATE STUDIES

The Mechanics Department coordinates the Inter-departmental Postgraduate Study Programme in "Applied Mechanics".

"APPLIED MECHANICS" IPSP

The Schools of Mechanical Engineering, Civil Engineering and Naval Engineering of the National Technical University collaborate in the Programme. The Programme aims at providing graduates with the requisite knowledge for working as researchers at Higher Education Institutes, Technical Education Institutes and research centres, as staff members of public and private enterprises and organizations and as educators with higher qualifications. Many of the basic courses in the specific post-graduate programme are those that Ph.D. students in the Mechanics Department are required to attend.

The Mechanics Department paricipates in the programmes: **"Structural Static Planning and Construction Analysis"** (coordinated by the Civil Engineering School of the National Technical University)**, "Computational Engineering"** (coordinated by the Chemical Engineering School of the National Technical University of Athens)**, "Science and Materials Technology"** (co-ordinated by the Chemical Engineering School of the National Technical University of Athens), **"Automated Systems"** (coordinated by the Mechanical Engineering School of the National Technical University of Athens) and **"Conservation of Architectural Monuments"** (coordinated by the School of Architecture of the National Technical University of Athens).

RESEARCH ACTIVITY

The Mechanics Department is engaged in a variety of research activities. Both classic and modern areas of Mechanics are handled in the Department in a combination of experimental, theoretical and computational approaches covering a broad spectrum of activities and problems from nano- and small-scale to large-scale technology. The research fields can be divided generally into three broad categories. (**a**) Continuum Mechanics, (**b**) Mechanics of the Absolute Solid-Classic Dynamics (**c**) Computational Methods. There is indicative mention of sub-fields of the above in which sizeable groups of Interdepartmental Research Programme members, students and technicians, are engaged in intensive work and producing valuable research.

(A) RESEARCH FIELD OF CONTINUUM MECANICS

Geomaterials, Biomechanics, Fracture, Mathematical Theory of Elasticity and Plasticity

Non-Destructive Testing, Conjugate Field Mechanics, Polymer Materials, Fluid Mechanics, Seismic Phenomena

(B)RESEARCH FIELD OF MECHANICS OF THE ABSOLUTE SOLID-CLASSIC DYNAMIC

Diffusion of waves in materials, dynamics, structural stability, oscillations in structures

C) RESEARCH FIELD OF COMPUTATIONAL METHODS

Finite elements, Algorithmic resolution of Multiple-Timescale Phenomena, Simulation, Computer Analysis of Complex Problems

MECHANICS DEPARTMENT LABORATORY INFRASTRUCTURES

The Mechanics Department includes two official laboratories: the Materials Resilience Laboratory (MRL) and the Applied Mechanics and Photoelasticity Laboratory. The core of the Mechanics Department's facilities is the Materials Resilience Laboratory. The National Technical University of Athens was established in 1920 and the MRL is inextricably linked with its history. An iimportant contribution to providing it with its equipment was made by the late Pericles Theocaris. From its establishment until the present day the MRL has been developed and equipped with a a large number of experimental devices, static and dynamic charge frames, displacement and deformation recorders. A machine shop is also in operation, with a range of heavy machines exemplifying machine technology and engineering processes (lathes, planes, milling machines, drills, smoothing and cutting machines, electric welders) necessary for carrying out the tests and experiments. The facilities, covering an area of 3,500 m^2 include laboratories, a machine shop, a computer centre, seminar and lecture rooms, a library, a secretariat and staff offices. The laboratories are well provided with traditional and modern equipment used for teaching and research purposes in many branches of mechanics.

Today a PC Lab is being established in the Department, with 20 workplaces. Also under development is a workshop with a cluster-type computer system for dealing with large-scale and very large-scale computing problems. The cluster, which consists of a central unit (server, quad core 3.0GHz, XEON), four nodes (including nodes, quad core, 2.5GHz, XEON), a 42U rack, a voltage stabilizer (UPS, 6KVA) and the related LINUX software The cluster system has already been extended with additional nodes and the requisite equipment (UPS, extension of software permits).

The Department has a well-organized library covering the areas of Mechanics, Mathematics and related sciences.

QUALITY CONTROL AND MATERIALS RESILIENCE TESTING

Tests are conducted in the Materials Resilience Laboratory and dozens of certificates are issued each year (between 1916 and the present day they amount to more than 30,000) copies of which are on file at the Laboratory premises). It is from the income from this testing that the maintenance of the equipment and its partial upgrading is funded.

THE DEPARTMENT OF HUMANITIES, SOCIAL SCIENCES AND LAW

In the Department of Humanities, Social Sciences and Law (HSSL) there are eleven members of the teaching and research staff, 3 emeritus professors, two other collaborating scientists and a three-person support staff. The members of the teaching and research staff are distributed as follows: four professors, two associate professors, four assistant professors and one lecturer.

The HSSL holds undergraduate courses in a number of academic fields, covering all the Schools at the National Technical University of Athens. It its engaged with education in the humanities, without which engineering studies are unthinkable (Ancient, Modern and Contemporary Philosophy, Philosophy and History of Science and Technology, Environmental Philosophy, Philosophy of Art, History of Civilization, Sociology). It teaches Economics and Law, ancillary subjects for engineering studies pertaining to administration and management (Political Economy, History of Economic Theories, Micro- and Macro-economic Analysis, Business Economics and Elements of Law and Technical Legislation).

This should already give some idea of the broad background in humanistic and social science as distinct subject areas. Linkage of the study programme for an engineer at a technical university with the technological phenomenon represents a synthesizing approach to the study of its social and civilizational dimensions. This broad background consummates the intellectual equipment of the engineer and is a necessary component in it.

THE HISTORY OF HUMANITIES AND SOCIAL SCIENCES AT THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS

The Department was established under the enabling legislation 1268/82. Its initial staff occupied chairs of Economics (Professor P. Fakiolas) and Philosophy (Professor D. Nianias). Apart from Philosophy, Professor Nianias introduced into the Technical University of Athens the study of the Humanities and Social Sciences. He organized and taught courses in Philosophy, Logic, Aesthetics, History of Civilization and Sociology. For years he also published Greece's only journal of philosophy *Signum*, with his students among the contributors to it. In unfavourable conditions he very quickly succeeded in having these courses extended to all the schools of the National Technical University of Athens, simultaneously staffing the Philosophy Department with new researchers and broadening the range of its inquiry, so that the National Technical University of Athens became one of the most important centres for the study of Philosophy, Civilization and the Humanities in general in all of Greece.

THE EDUCATIONAL WORK OF THE DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

UNDERGRADUATE STUDIES

THE TEACHING OF HUMANITIES AND SOCIAL STUDIES AT THE SAMPS

The Department of Humanities, Social Sciences and Law is interdisciplinary in orientation, providing scholarly input both to the School of Applied Mathematics and Physics and to the other schools in N.T.U.A.. A mere enumeration of the course titles suffices to reveal the thematic variety of their content and highlight the significance for engineers and students of these applications: *Introduction to Philosophy, Philosophy of Physics, Philosophy of Mathematics, Introduction to the History of Science and Technology, History of 19th and 20th Century Physics, Sociology of Science, Environmental Policy, Philosophy of Science, Economic Analysis I, Economic Analysis II (Macroeconomics), Economic Policy III, (International Economics), Economic Analysis IV (Economics of Technology), Economic Analysis V (Business Economics), History of Economic Theories, Law and Principles of Education.*

THE TEACHING OF HUMANITIES, SOCIAL STUDIES AND LAW IN THE OTHER SCHOOLS AT THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS

Apart from essential enrichment of the Undergraduate Studies Programme in all the Schools of the National Technical University of Athens, the Department of Humanities, Social Sciences and Law has the responsibility for contributing to scholarly comprehension of the value of undergraduate studies at a technical university. In our day the quest for philosophical values in all sectors of theoretical and applied knowledge (meaning in science and technology) makes it indispensable for the engineer to acquire broader humanistic education. Indicatively, then, as well as courses in Philosophy (Epistemology, Philosophy of Science, Aesthetic Philosophy, Theory of Knowledge in Modern and Contemporary Philosophy, etc.) there are also courses in History and Philosphy of Science, History of Civilization, History and Philosophy of Technology and Philosophical Ideas, History of of Mechanics, Elements of Law and Technical Legislation, Sociology of Science and Technology, Political Economy, Applied Economics and Economic Analysis, Administration and Business Organization, Greek and International Merchant Shipping, History of Economic Theories, etc.

THE JOURNAL *SIGNUM*

The National Technical University of Athens decided to reprint the journal *Signum*, which was published in the 1970s and 1980s by Professor D. Nianias. The journal SIGNUM is published by the Department of Humanities, Social Studies and Law (HSSL) of the School of Applied Mathematical and Physical Sciences of the National Technical University of Athens under the auspices of, and initial financial support from, the institution's rectorship. It draws its subject matter from all the fields dealt with by the Department of Humanities, Social Sciences and Law (Philosophy, Sociology, Theoretical and Applied Economics, Economics of Technology, Philosophy and History of Civilization, Philosophy of Science, Philosophy and History of Art, Studies in Science and Technology, Law, etc.)

The scientific journal *Signum* is addressed to members of the teaching and research staff,

researchers, writers and students in all the above fields with a view to enhancing their understanding of the above mentioned subjects and is published twice a year. The journal is published in Greek, with the possibility of publication at the discretion of the editorial board of articles in English. The articles may focus on the above mentioned subjects but also combine this with an interdisciplinary approach. The possibility is also entertained on a case-by-case basis, of publishing articles in translation. The material in each issue includes articles selected by unsigned commentators, book reviews, announcements of conferences, information on the activity of the Department of Humanities, Social Sciences and Law of the School of Applied Mathematical and Physical Sciences, as well as other news that is of interest to the scientific community.

Signum is in circulation with the insignia 'University Publications of the National Technical University of Athens".

POSTGRADUATE STUDIES

Contributing to the general prestige of the National Technical University of Athens, the Department of Humanities, Social Sciences and Law, in collaboration with the Department of Methodology, History and Theory of Science (MHTS) of the University of Athens organizes the two-year Interdepartmental Postgraduate Study Programme "Philosophy of Science and Technology", with forty students, who are also given the opportunity, continuing their studies, to acquire a Ph.D. The Department also collaborates with the "Architecture, Spatial Design, Preservation of Monuments" IPSP of the School of Architectural Engineering of the National Technical University of Athens, with eighty postgraduate students who are also able to continue and work on a doctoral dissertation.

There is more information on the post-graduate studies programme at the Department's website www.aked.ntua.gr

"PHILOSOPHY OF SCIENCE AND TECHNOLOGY" IPSP

The IPSP in question is organized jointly with the MHTS Department of the University of Athens, with forty students who have the right to continue with a view to acquiring a Doctorate.

"ARCHITECTURE-SPATIAL PLANNING-PRESERVATION OF MONUMENTS" [2 INTERDEPARMENTAL POST-GRADUATE STUDY PROGRAMMES]

Organized in collaboration with the IPSP of the School of Architectural Engineers – Chemical Engineers and with SAMPS of the National Technical University of Athens, "Architecture-Spatial Planning- Preservation of Monuments" has eighty post-graduate students, who have the right to continue to work on a doctoral thesis. Courses are offered in Philosophy, Aesthetics and Law. Specifically in the framework of the one-year IPSP of the School of Architectural Engineers of the National Technical University of Athens (Architecture-Spatial Planning) there are seminars in "Philosophical and Architectural Constructions", "Aesthetic Theories" and "Legislation for the Protection of the Architectural Heritage".

"EXPERTISE FOR RESOLUTION OF LEGAL DISPUTES" IPSP

In the IPSPS of the same name there is collaboration with the IPSP of the School of Civil Engineers, SAMPS. .

RESEARCH ACTIVITY

Through its activities the Department of Humanities, Social Sciences and Law contributes to the general prestige of the National Technical University of Athens and plays a signifcant role in the cultural life of the country. The four research fields in which Department members are active are the fields of Philosophy, which is served by the Department's largest group, divided between a plethora of sub-fields, the field of Theoretical and Applied Economics, the field of Law and the field of Social Sciences.

Philosophy, Analytical Philosophy, Philosophy of Art – Aesthetics, Social Sciences, Studies in Science and Technology, Economy, Law.

WORKSHOP FACILITIES

The Department runs two fully-equipped study centres for its research and teaching needs: the "Pantelis Nikolakopoulos Workshop of Theoretical and Applied Philosophy & History of Science and Technology" and the "Workshop of Theoretical and Applied Economics, Social Sciences and Law". They aim at carrying out ancillary work and tasks of documentation as well as conducting studies and research to cover the educational, instructional and research needs in key subject areas.

The study centres are used, as required, as rooms for seminars, presentations, support for academic dissertations, theses, etc. The Department's internal information network, a section of the National Technical University of Athens's advanced network, provides technical support, electronic mail, connection to the internet, etc. This applies for all members of the Department and for post-graduate students.

THE SAMPS STUDY PROGRAMME

The Study Programme of the School of Applied Mathematical and Physical Sciences comprises two concentrations: **Applied Mathematics** and **Applied Physics.**

The concentration attended by the student is recorded on his diploma.

STRUCTURE OF THE UNDERGRADUATE STUDY PROGRAMME

The first four semesters of study at the School seek to impart basic knowledge of Mathematics, Physics, Mechanics and Informatics. There are also courses in Philosophy, History and Philosophy of Science, Economic Sciences, Law and Foreign Languages. From the fifth semester onwards the students choose one of the following two concentrations:

- **Applied Mathematics Concentration**
- **Applied Physics Concentration**

Choice of the concentration is a product of mature and well-documented reflection because it takes place after two years of systematic exposure to subject matter of many different kinds. The two concentrations are subdivided, each including a variety of specializations. The number of electives gradually increases between the 5^{th} and the 9^{th} semester. This makes it possible for the student in either concentration to acquire a deeper understanding of the specific scientific fields.

The Applied Mathematics Concentration includes the following streams:

✧ **Applied Analysis**
✧ **Statistics**
✧ **Mathematics of Information Science**
✧ **Applied Mechanics – Computer Simulation**

The Applied Physics Concentration includes the following streams:

✧ **Computational and Theoretical Physics**
✧ **Nuclear Physics and Elementary Particles**
✧ **Optoelectronics and Lasers**
✧ **Advanced Technological Materials**
✧ **Mechanics of Materials**

Each student is required to choose two of the streams in the concentration for which he has opted.

Both concentrations are supported by physics and engineering laboratories which have already been in operation for a number of years, covering the educational needs of all the specialized engineering schools of the National Technical University of Athens. In parallel, some of them have developed strong links with industry, carrying out specialized programmes of normative testing and a broad range of services for the public and private sectors. Support is also provided by the School's computing workshops.

Students who wish to pursue a career in education follow a full programme of pedagogical courses necessary for integrated development of a modern science teacher.

The Study Programme in the 10th semester includes work practice as an established part of the

students' educational process. It is performed in companies, organizations, institutions, etc. so that students can acquire workplace experience.
To obtain his/her degree the student must write a dissertation during the 10th semester. .

THE APPLIED MATHEMATICS CONCENTRATION

The programme of the Concentration aims at helping the students attending it on the one hand to acquire a strong background in knowledge of mathematics and on the other appropriate knowledge in areas of Applied Mathematics that will assist them in developing the special skills that are necessary for dealing with complex problems. Such problems arise in many technological, industrial, economic, biomedical and other productive activities. The above goals are to be achieved by means of:

- **a)** the seven mandatory core courses in the Concentration that are made available from the 5th to the 8th semester.
- **b** the mandatory courses in the streams (four or five per stream) and the student's obligation to complete at least six courses in order to pass in the chosen stream.
- **c**) the mandatory choice of two courses from a specific category of technical subjects that strengthen the profile of the new scientist, the engineer, being educated at the School.
- **d**) the freedom of the student to choose eight courses on the basis of his own preferences.

The total number of course subjects which the student must complete successfully in order to qualify for the award of a degree from the school in the Applied Mathematics concentration is 58.

The broad knowledge acquired by the student in the Applied Mathematics Concentration is supplemented by specialized knowledge depending on the stream he/she is planning to complete, as follows:

1. APPLIED ANALYSIS

Present-day analysis, based on fundamental mathematic concepts such as those of the limit and the infinite, comprises the background that is necessary for the shaping, study, analysis and arithmetical resolution of a broad range of problems in technology and in applications. The Applied Analysis stream provides a powerful knowledge base in the field of Mathematical Analysis, with particular emphasis on its reciprocal influence on virtually all fields of Mathematical Science, and on applications. It imparts to the students interested in the modern discipline of Mathematical Modelling the requisite analytical and computational skills, through the teaching of integrated theories that make it possible for them to deal in the optimum fashion with mathematical problems in various applications. The stream includes among its significant elements a thorough mastery of issues of Mathematical Control Theory, Dynamic Systems Theory, Optimization, both of Complex and Harmonic Analysis, as well as the application of the methodological tools of Analysis to Mathematical Economics and Mathematical Finance Theory. There is moreover a noteworthy emphasis on a numerical approach to problems, through the study of convergence and the stability of approximative methods (solving differential equations and problems of boundary values, solution of linear and non-linear systems, finite elements and difference, etc.), assessment of errors and algorithmic configuarion. Apart from the above mentioned, this specific stream also develops sectors of Theoretical Mathematics, responding to the concerns of of students who wish to cultivate their research skills in areas with a bearing on the foundations of mathematics.

2. STATISTICS

Statistics and Stochastic Mathematics are two subject areas in Mathematics with a host of applications that are employed chiefly in the experimental sciences. They have to do with problems whose key component is the collection and analysis of information and data. The Statistics stream provides students with integrated knowledge of the subject, emphasizing both the mathematical background of the science and its applications, utilizing a variety of software programmes. Some important modules in the Stream are Probabiliy, Mathematical Statistics, Stochastic Processes, Data Analysis with computers, Regression Analysis and Linear Models and Design. Morevoer students are able to choose a range of courses whose aim is a further deepening of knowledge of specific research areas in Statistics, such as Stochastic Calculus, with applications in Finance, in Econometry, in System Reliability, Sampling, Reliability and Survival Models, Statistical Quality Control and Computational Methods in Statistics. The student attending the stream in question will acquire the background necessary for data management, for the extraction of conclusions and the resolution of problems in conditions of pervasive uncertainty.

3. MATHEMATICS FOR INFORMATION SCIENCE

This stream has to do with the mathematical side of computer science. The problems that are dealt with are those in the mathematical science of computers that require advanced knowledge in subject areas such as Logic, Combinatorics, Number Theory and Algebra. The student will acquire a significant theoretical background in fundamental questons of the Computer Science (Automata and Formal Languages, Data Structures, Design and Analysis of Algorithms, Computational Models, Theory of Information and Codes, Cryptography, Mathematical Logic) which, in combination with knowledge of modern programming and the use of computational tools, will enable the student to become active in fields of applied science making high demands in terms of levels of Mathematics and Informatics.

4. APPLIED MECHANICS – COMPUTER SIMULATION

This stream represents on the one hand a further development of classical Applied Mathematics, with a central place occupied by “Mathematical Physics”, on the other the Mechanics that embraces Continuum Mechanics, Experimental Materials Mechanics, Systems Dynamics and Computational Methods. It equips the student with knowledge that enables him to solve the complex problems that can be encountered within a broad range of research and industrial applications, where what is required is analytical thought, a capacity for abstraction that makes possible an immediate pinpointing of the structural elements in the problem, and particular computational knowledge. This deepening of understanding pertains particularly to aspects of the Mechanics of Deformable Solids, of Fluid Mechanics, of Coupled Field Mechanics, of Finite Elements, of Classical Dynamics, of Bioengineering, of Composite and Polymeric Materials of Nonlinear Dynamic Analysis, of Differential Equations (Ordinary and Partial), of Integral Equations and questions of Numerical Analysis. The combination of this stream and Stream 1 provides the student with a noteworthy capacity for solving a broad range of problems in applied mathematics and physics from the nano- and micro- up to the macroscopic scale. Continuum Mechanics denotes a wide spectrum of research activities from the Theory of the Deformable Solid to Bioengineering, Fracture Theory, Fluid Mechanics, Nondestructive Material Testing, Coupled Field Mechanics, Earthquake Mechanics. The research field of Classical Dynamics includes activities such as wave transmission in materials, Celestial Dynamics and the problem of multiple bodies, Stability and Oscillation in construction. The research field of Computational Methods pertains to a

range of activites such as the Computational Mechanics of solid bodies through the development and application of Finite Elements, Computational Fluid Mechanics, Analysis of large-scale problems, Computer Simulation and Analysis of Dynamic Complex Problems

APPLIED PHYSICS CONCENTRATION

Students choosing the Applied Physics Concentration follow a programme of studies which has the following characteristics:

- **(a)** a strong core curriculum comprising a total of sixteen (16) mandatory courses of this Concentration, distributed between the 5th and the 9th study semester.
- **(b)** two groups, each of five elective courses (depending on the stream selected), each leading to the specialization chosen by the student, and
- **(c)** a small number (4, or 5) elective courses, freely chosen by the students.

In the 5th semester of their studies, the students in the Applied Physics concentration, follow a single programme of six (6) mandatory courses. The courses in the 5th semester of their studies comprise the necessary background knowledge for the physicist (Electromagnetism, Quantum Mechanics, Statistical Physics, Quantum Mechanics, Optics and the Laboratory, Laboratory Physics and General Chemistry) at the level necessary for one to proceed to the specialized streams. In the 6th semester of their studies, the students in the Concentration choose streams (two of the five, to be described below) from among the corresponding elective courses. In the period from the 6th to the 9th semester, in collaboration with the other Schools of the National Technical University of Athens, and within the the framework of the appropriate streams, courses common to all the specialities and concentrations at the National Technical University of Athens are also taught.

This programme provides students with the opportunity to specialize, from as early as their basic studies, in cutting-edge technologies such as New Technological Materials, Lasers and Optoelectronics, Electronic Physics, Nuclear Physics, High Energy Physics, Condensed Matter Physics, Applications of Physics to Biomedicine and the environment, and Computational and Theoretical Physics, with a view to strengthening the role of the applied physicist in the process of integrating new technologies with social and productive requirements.

The streams in the Applied Physics Concentration are as follows:

1. OPTOELECTRONICS AND LASERS

In this stream, on the basis of their knowledge from the mandatory course “Physics and Technology of the Laser” (in the 6th semester), the students round off the background to their specialization by means of the courses in “Signal Analysis” and “Optoelectronics”, on the basis of which they proceed to courses of more applied orientation, such as “Physics of Microelectronic Systems”, “Principles of Transmission of Microwaves and Optical Signals” (which is taught by the School of Mechanical Engineers and Computer Engineers”) or, alternatively, “Laser Applications in Biomedicine and the Environment” or “Introduction to Communications Networks”. This stream prepares students for employment in fields in and around modern optics (optic fibres, optical communications, sources and detectors in various areas of the spectrum) and lasers (applications in industry, in biomedicine, in environmental research including measurement of air pollution, but also in preparation of materials for the development of micro- and nano-scale structures) both from the viewpoint of basic research and from applications.

2.NUCLEAR PHYSICS AND ELEMENTARY PARTICLES

In this stream students specialize in subjects retraining to the structure of the nucleus and the dynamic of sub-atomic particles. Their preparation also commences with the “Signal Analysis” course in the 6th semester and then, in conjunction with the mandatory courses in “Nuclear Physics” and “Elementary Particles I” of this Concentration, are educated in aspects of the technology of Acceleration and Detection Systems, in the 7th semester. In the 8th Semester they can choose, depending on whether their preference is for subjects of basic or applied physics, the courses “Elementary Particles II” or “Nuclear Technology” (which is taught by the corresponding department in the school of Mechanical Engineering). The specialization is brought to completion with the course in “Nuclear Physics and Applications” and in particular “Applications of Ionizing Radiation in Medicine and Biology”.

Degree-holders who have attended the courses in this stream have suitable preparatory education either to continue their postgraduate studies in the very active field of Nuclear Physics and High Energy, or to turn to fields of more practical application such as radioenvironmental science and its applications in radiation physics and biology.

3.ADVANCED TECHNOLOGICAL MATERIALS

The Advanced Technological Materials stream is grounded in the basic knowledge made available through the mandatory courses “Condensed Matter Physics” and “Materials Science” in the 6th and 7th semester of the Concentration, respectively. The students’ education in this stream starts in the 6th semester with the laboratory course “Methods for Materials Characterization”, which is taught in collaboration with the Institute of Materials Science of the “Demokritos” National Research Centre and includes education in modern experimental study methods and characterization of technological materials, and continues in the 7th semester with the course in “Dielectric, Optical and Magnetic Properties of Materials” that is the continuation and consummation of the course in Condensed Matter Physics. In the two following semesters, the students are able to focus on their specialization either in materials as such, with the courses in “Polymers and Nanocomplex Materials” and “New Technological Materials”, or in the field of microsystems, with the courses “Physics of Microelectronic Systems” and “Microsystems and Nanotechnology”. Graduates who have attended this stream are equipped to involve themselves in fields such as semiconductors and photovoltaics, “smart” materials, superconductors, applications of new materials in nanotechnology but also more conventional fields of intense activity such as amorphous materials (polymers, ceramics, composite materials) and their applications.

4.MATERIALS ENGINEERING

The Materials Engineering stream is grounded in the basic Engineering (Statics, Deformable Solids, Material Resilience, Kinematic and Dynamic) of the School’s first four semesters, not to mention the Concentration’s mandatory “Fluid Mechanics” course in the sixth semester. It takes advantage of the tradition and the experience of the Engineering Deparment and the corresponding National Materials Resilience Laboratory. Specialization starts in the sixth semester with “Theory of Elasticity” and continues in the 7th semester “Continuum Mechanics”. In the next two semesters there are courses in “Computational Mechanics” and “Coupled Field Mechanics” as well as “New Technological Materials” and “Mechanics of Seismic Phenomena”. This programme can be combined with elective courses making available further specialization in fields extending from Inelasticity and Fracture Mechanics to Biomechanics and Computational Fluid Mechancis. The

phenomena examined by the students in this stream embrace a broad range of scales and also extend from questions of basic research to interesting applications in many different fields. .

5.COMPUTATIONAL AND THEORETICAL PHYSICS

The stream of Computational and Theoretical Physics is the only non-experimental stream, but not, nevertheless, the least applied. The programme of this stream is based on the mandatory Concentration courses but also on the very good mathematical and computational background the students have acquired from School's core programme of four common semesters. Both components of the stream (Theory and Computation) are developed in parallel with appropriate teaching time ("Group Theory in Physics", "Computational Physics" in the 6th and 7th Semester. The specialization continues with "Elementary Particles" or alternatively with "Cosmology" or an advanced course in "Computational Physics. II". With the two alternative courses of the 9th semester "Theoretical Physics" or "Many Body Physics" the opportunity is provided for focusing on High Energy or on Condensed Matter. The familiarity that the students in the stream have with advanced mathematical and computational tools makes it possible for them, above and beyond opportunities for postgraduate study in basic Physics and a corresponding research career, to enjoy the benefit of easy adjustment to adaptations requiring demanding analysis.