NATIONAL TECHNICAL UNIVERSITY OF ATHENS

SCHOOL OF CHEMICAL ENGINEERING

COURSE GUIDE

ACADEMIC YEAR OF 2022-2023

1st Edition

School of Chemical Engineering
National Technical University

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PREFACE

The School of Chemical Engineering of the National Technical University of Athens was founded in 1917 and has already completed over 100 years of continuous operation. During this time, its graduates supported the industrial reconstruction and economic development of the country, staffed the newest schools of Chemical Engineering and gained important positions in international universities and research centers. To this day, the School of Chemical Engineering holds one of the first places in the preferences of prospective students in science / technology, thus gathering in our halls a brilliant sample of dynamic and creative young people that we aspire to see continue the School's tradition in economy and society.

In this direction, the mission of the School, and therefore our role, is to train scientists-engineers who will have all the necessary knowledge and the ability to apply the principles of basic sciences (mathematics, physics, chemistry and biology), technical sciences, as well as economics / social sciences in the professional field they will choose to work in.

Today this field is constantly expanding and differentiating following the scientific developments, the limits set by the natural environment, but also the changes that take place in the sphere of economy and production. Chemical Engineering, which objectively focuses on the study of processes and the flows of matter and energy, provides our students with the ability to better understand, design and control the productive and physical systems in changing conditions. Thus, next to the conventional industry (chemicals, food, oil, cement, plastics) the Chemical Engineer today penetrates dynamically in new sectors of industry and services (biotechnology-biomedicine, nanomaterials, green economy, informatics, consultants-researchers) with a weighty role in business administration, quality management and innovation. Promoting and applying in all these fields the principles of sustainable production and consumption.

The new curriculum of our School, which since the previous academic year is applied in all semesters, attempts to integrate these developments with interventions in both the content and the structure of the material. However, believing that education is not just a linear process of assimilation of knowledge - modern and timeless - the organization of studies in our School aims to create a dynamic and interactive learning environment:

- By providing specialized knowledge / courses / specializations in the wider field of activity of Chemical Engineers that will allow you to follow your personal academic course, according to your inclinations and interests.
- By strengthening your personal analytical and synthetic skills, acquiring useful skills for practicing your profession and developing critical thinking and innovative approaches to solve problems. This direction is desired to be applied to the courses in total and in some cases is achieved through laboratory and computer exercises, elaboration and presentation of specific topics and integrated feasibility studies, dialogue and discussion in the class.
- By creating contacts with the real "world" that awaits you after graduation: companies, organizations, other academic institutions and research institutes both in Greece and abroad. In this direction are included visits to companies within the framework of the courses, the internships during the 9th semester, the facilitation of attendance and/or your participation in conferences or seminars, the encouragement of the ERASMUS program, the support of your participation in Greek and international student competitions.

Dear students

The message we want to convey to you is that our School does not aspire to provide you with just a paper/degree. It aspires to teach you to learn throughout your professional life, to shape integrated scientists and responsible citizens in a world without borders. Take advantage of all the opportunities offered to you, make the most of your time, seek knowledge, experience and skills, resist the easy, embark on the difficult.

The Professors and all the staff of our School are always by our students' side during their journey to the fascinating world of Chemical Engineering.

The Dean of the School of Chemical Engineering of NTUA.

Professor Glykeria Kakali

1. NATIONAL TECHNICAL UNIVERSITY

The National Technical University of Athens (NTUA) is the oldest and most prestigious educational institute of Greece in the field of Technological Education and is named in honor of its benefactors, G. Averoff, N. Stournaris, E. Tositsa and M. Tositsa, whose origin is from the town of Metsovo in Epirus. Since its foundation (1836), NTUA has made a significant contribution to the country's scientific, technical and economic development and is closely linked to Greece's struggle for independence, democracy and social progress.

1.1 History

NTUA was founded in **1836**, under the name "Royal School of Arts". It began functioning as a part-time vocational school (only Sundays and holidays) to train craftsmen, builders and master craftsmen. It quickly became known as "*Polytechnic*".

In **1840**, due to its increasing popularity and the changing socio-economic conditions in the new state, NTUA was upgraded to a daily technical school which worked along with the Sunday school, while the courses were expanded.

In **1843** a major restructuring was made. Three departments were created:

1. Part-Time Vocational School
2. Daily School
3. A new Higher School of Fine Arts

The new department was later renamed "School of Industrial and Fine Arts".

A second **restructuring** takes place during 1862-1864. The school became "Polytechnnic", with the introduction of several new technical courses. This restructuring continued steadily until **1873,** when it moved to its new campus in Patision Street and was known as "**National Metsovion Polytechnion**". At that time, the campus in Patision Street was even partially incomplete.

A third **restructuring** takes place in 1887, when the institution was partitioned into three schools of technical orientation, the schools of Structural Engineering, Architecture and Mechanical Engineering, all four-year degrees at the time. The last **radical reformation** in the organization and administration of the institution took place in **1917** by a special law, was now separated into the Higher Schools of Civil Engineering, Mechanical & Electrical Engineering, Chemical Engineering, Surveying Engineering and Architecture. Later, the schools of Naval Engineering, and Mining and Metallurgical Engineering were formed, and the school of Mechanical & Electrical Engineering was split up into two separate schools, Mechanical Engineering and Electrical and Computer Engineering, which is almost the form of schools maintained until now.

1.2 Current status of NTUA

NTUA was structured according to the standards of the Continental European Model of engineering education, with a strong theoretical background and a standard five-year duration. NTUA's graduates have been the central scientific lever of autonomous pre-war development and post-war reconstruction, staffing public and private technical services and companies with scientifically distinguished engineers, due to its high level of technical expertise and high quality infrastructure.

The 1997 reorganization creates "Study Cycles" for the specialization of students in the "directions-specializations" of their choice. Fundamental strategic choice of NTUA, is not only to maintain its position as a distinguished and internationally respected academic institution of science and technology, but also to constantly reinforce this position both in its mission and in all its fundamental functions. All other strategies, goals and actions must be compatible with this dominant strategic choice.

Honoring this distinguished position and fulfilling its national mission, NTUA:

- upgrades its educational and research offering both in Greece and Eurasia;
- supports the country's independent development through new scientific actions, and
- practically enhances the Greek presence in international productivity.

2. THE SCHOOL OF CHEMICAL ENGINEERING

2.1 History of the School

Following the reforms of 1887 and the foundation of the School of "Industrial Arts", the Schools of Civil Engineering, Mechanics, and of Land Surveyors were established. In the first two Schools, Chemistry was taught in the freshman year.

In 1914, within the framework of a reform in the Schools, the countdown for the founding of the School of Chemical Engineering started. Through Law 388 of 1914, at the same time with the new name of the Institute as "Metsovion Polytechnion", the School of Foremen of the Chemical and Metallurgical Industries was attached to the School of Mechanical Engineering.

Finally, in 1917, the government of Elefth. Venizelos modified Law 388/1914. The Schools of Chemical Engineering, of Architecture, and of Land Surveying were founded by Law 980 of the 24th of October of 1917. The founding Law of 1917 states: "The Ethnikon Metsovion Polytechnion is aiming at the education of the scientists and the provision of advanced technical knowledge for public and private needs, it is composed of the already functioning School of Civil Engineering, of the School of Mechanical Engineering, which is transformed into the School of Mechanical Engineering and of Electrical Engineering, and of the new Schools proposed by this Law, i.e. the School of Architecture, the School of Chemical Engineering, and the School of Land Surveying".

The School started its operation with an annual program on the following school year, 1918-1919. During 1917-18 the new necessary Laboratories were created.

In 1946, through Law 1021, the School of Chemical Engineering was split into three departments, each one with a 5 year program of studies:

- The Department of Chemical Engineering
- The Department of Mining Engineering
- The Department of Metallurgy.

Up until 1947, the School did not have sufficient installations and teaching spaces. At this point the decision was taken to construct the School's own building, in which the School was settled in 1954.

In the 50's and 60's there were changes in the teaching procedures as well as in the research activities. The gradual introduction of Mathematics and the teaching of new courses, such as Transport Phenomena, Chemical Reactor Design, and Unit Operations, upgraded the School, making it known both nationally and internationally, and transformed it into a modern School of Chemical Engineering.

It is worth mentioning that during this period, the research activity grew dramatically and the number of doctoral theses submitted, increased from one, up until 1950, to 16 in the period 1950-60. Since 1960, and through continuous endeavors, the School attained its present character, in an effort to fulfill the needs of the country. The development of the School slowed down during the period of the dictatorship (1967-1974) but the efforts of introducing new concepts continued.

In October 1975, with a Presidential Decree, the School was split into the two following Schools:

- The School of Chemical Engineering
- The School of Mining and Metallurgical Engineering.

Substantial changes in the way of running the School of Chemical Engineering were the results of Framework Law 1268 of 1982, which concerns the University Education. By this Law the concept of the Chair was abolished and the School was declared as Department of Chemical Engineering, with four Sections, as follows:

I. *Chemical Sciences*
II. *Process Analysis and Plant Design*
III. *Materials Science and Engineering*
IV. *Synthesis and Development of Industrial Processes*

The School continues its creative work and its efforts to evolve by introducing new courses and by intensifying its research activities. The latter, include basic and applied research, and they materialize through senior research theses, doctoral theses, and research programs carried out by the scientific staff of the Department.

The number of incoming students has increased through the years from 10 per year in the 1940's, to 40 in the 60's, 75 in the 70's, 160 in the 90's and ~180 after 2015. Thus, the increased needs in laboratory and teaching spaces, made necessary the relocation of the Department, from the City Center campus to the new installations of the Zografos campus.

Since the 2002-2003 academic year the Department of Chemical Engineering was declared again as *School of Chemical Engineering*.

The recent evolution of the studies (new curriculum adopted in 2017-18), includes introduction of four undergraduate specializations ("directions"), namely:

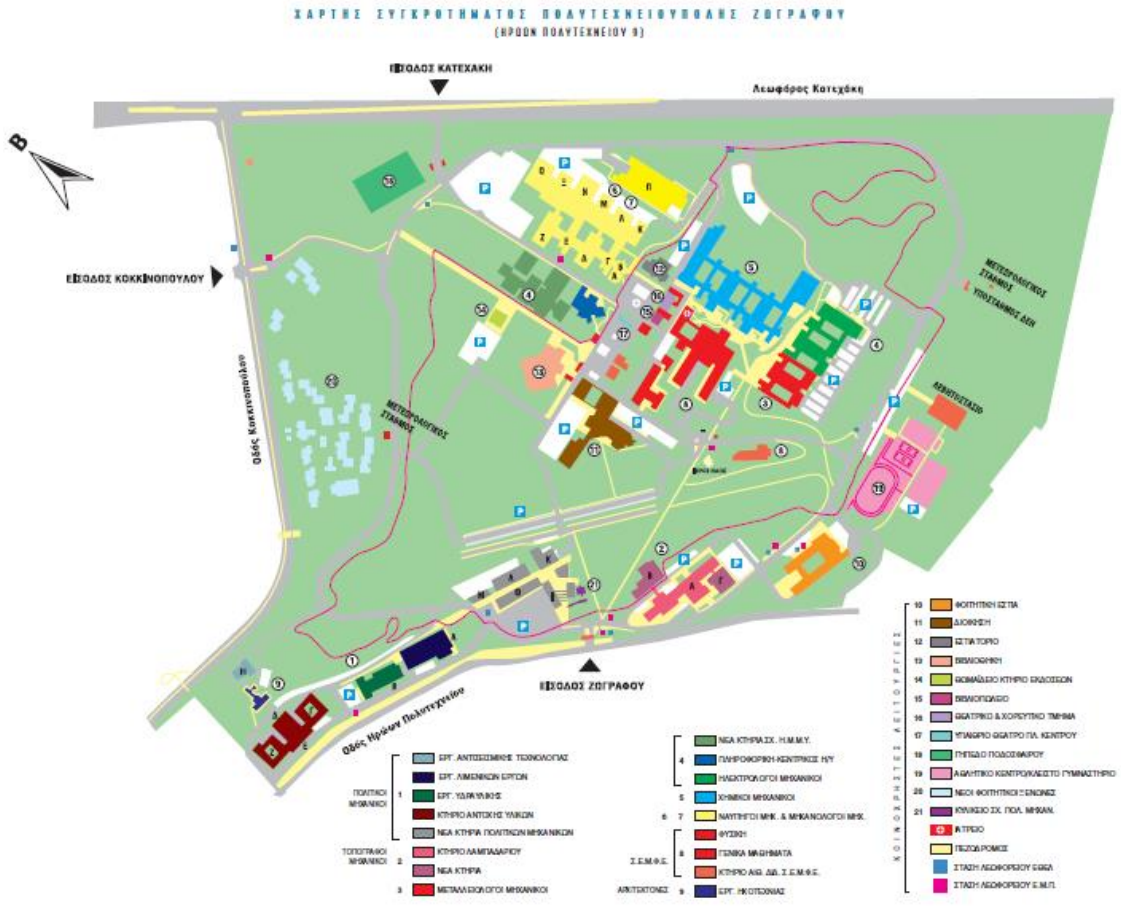
- Process Design
- Environment - Energy
- Food-Biotechnology
- Materials

beginning in the 8th (spring) Semester, as well as mandatory field training practice of the graduating students.

The School of Chemical Engineering continues its creative activity and continuous efforts to evolve with curriculum revisions and research intensification.

The research activity of the School extends to both basic and applied research, carried out in the context of diploma theses, the writing of doctoral theses and research programs of its staff. The results of the research are mainly reflected in publications in international scientific journals.

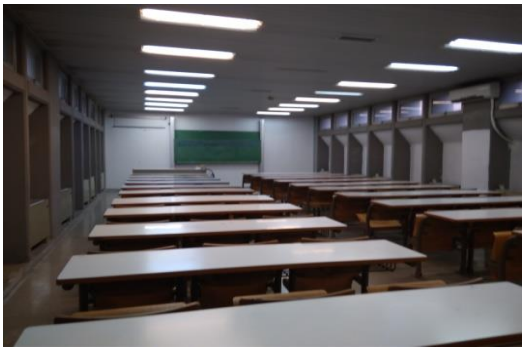
The increased demands of the School in laboratories and classrooms, made it imperative to accelerate the completion of the new facilities of the School in the Zografos Campus, which fully accommodate the educational and research needs of the School.



The School of Chemical Engineering NTUA at the Zografos Campus (the buildings of the School are marked in light blue).

The School, since 2015, receives 184 students annually. It is listed within the top 200 Chemical engineering Schools of the world and the top 50 of Europe. According to the QS–Top Universities/World University Ranking for 2017, our School is rated among the 151-200 best globally and 36-51 best European Schools

Chemical Engineering School's buildings occupy a surface of 12.500 m².



School's classrooms.

School's study hall.

School's canteen.

2.2 The scope of the School

The scope of the School is to provide knowledge, promote skills and advance the abilities of Engineers, in order to apply the principles of basic sciences, as well as of technological and economics/social sciences, within the fields of their activity. These fields include chemical/biochemical process plants, where the matter is subjected to treatments via the optimal conditions, in every respect (technical, economic and social).

The work of Chemical Engineers has to be conducted under the conditions of optimal use of energy, raw materials and resources, as well as of the environmental protection. Research in Chemical Engineering and in related interdisciplinary areas is an essential element of the School's curriculum. Engineers are able to develop a physico-chemical and/or biochemical process, starting from the laboratory bench, optimizing it through pilot/semi-industrial experiments, up to the level of mass production.

The challenge of today's education for Chemical Engineers is the understanding of processes from the molecular and microscopic level up to the macro scale. The core of the School's curriculum includes: applied mathematics, chemistry and physics, mass and energy balances, physics and properties of gases, liquids and solids, fluid mechanics, heat and mass transfer, thermodynamics, kinetics of chemical and biological reactions and reactor design, as well as process design, control and optimization.

A broad background of knowledge, emphasizing on both basic and engineering sciences, is provided to Chemical Engineers.

2.3 The scientific areas (Departments) of the School of Chemical Engineering

The educational, and research activities of the School are covered by the following four Departments:

- Department of Chemical Sciences (I)
- Department of Process Analysis and Plant Design (II)
- Department of Materials Science and Engineering (III)
- Department of Synthesis and Development of Industrial Processes (IV)

Department of Chemical Sciences (I)

The **Department of Chemical Sciences** covers education and research mainly in the fields of Inorganic Chemistry, Analytical Chemistry, General Chemistry, Organic Chemistry, Biochemistry and Environmental Science and supports the direction of Materials.

The Department of Chemical Sciences includes the following statutory laboratories:

1. General Chemistry Laboratory
2. Inorganic and Analytical Chemistry Laboratory
3. Organic Chemistry Laboratory

Department of Process Analysis and Plant Design (II)

The **Department of Process Analysis and Plant Design Sciences** covers education and research, mainly, in the fields of design of processes and systems applied in chemical engineering in practice and in Chemical Industry in general. The main aspect of the Department is the integrated technical and financial analysis of systems applied in Chemical Engineering.

The Department of Process Analysis and Plant Design Sciences includes the following statutory laboratories:

1. Industrial and Energy Economy Laboratory
2. Thermodynamics and Transport Phenomena Laboratory
3. Chemical Process Engineering Laboratory
4. Design and Process Analysis Laboratory

Department of Materials Science and Engineering (III)

The research and courses provided by the **Department of Materials Science and Engineering** include corrosion and protection of materials, advanced materials, photochemistry and heterogeneous catalysis, computational study of materials and modeling of properties and structure. It also covers the development and application of non-destructive methods, development and study of composite materials for construction, nanotechnology, nanomaterials, synthesis and study of polymers, ceramics, composite materials, biomaterials, as well as electrochemical reactions and interfacial phenomena.

The Department of Materials Science and Engineering includes the following statutory laboratories:

1. Physical Chemistry Laboratory
2. Materials Science and Engineering Laboratory
3. Advanced Materials, Nanomaterials, Nanooperations & Nanotechnology Laboratory

Department of Synthesis and Development of Industrial Processes (IV)

The **Department of Synthesis and Development of Industrial Processes** covers education and research mainly in the fields of Organic Chemical Technology, Food Science and Technology, Polymers Technology, Fuels and Lubricants Technology, Inorganic Chemical Technology and Industrial Technology.

The Department of Synthesis and Development of Industrial Processes includes the following statutory laboratories:

1. Inorganic Materials Technology Laboratory
2. Biotechnology Laboratory
3. Polymer Technology Laboratory
4. Fuels and Lubricants Technology Laboratory
5. Food Chemistry and Technology Laboratory
6. Organic Chemical Technology Laboratory

Interdepartmental School Units

1. Horizontal Lab of Quality Control of Processes and Products

The **Horizontal Laboratory of Quality Control of Processes and Products (HL)** is a unit of the School, equipped with high cost analytical instruments and supports all Educational and Research purposes in undergraduate and postgraduate levels as well as research programs.

https://www.chemeng.ntua.gr/the_products_and_operations_quality_control_lab

2. Semi-Industrial Unit of Chemical Engineering

Horizontal Lab of Quality Control of Processes and Products

Semi-Industrial Unit of Chemical Engineering

Other Laboratory Units/Teams

1. Solar Engineering Unit
2. Automatic Control and Informatics Unit
3. Computational Process Engineering Unit
4. Environmental and Energy Management Research Unit
5. Hydrocarbon and Biofuels Process Engineering Unit
6. Environmental Science and Technology Unit
7. Instrumental Methods of Analysis – Environment Research Team
8. Non-destructive Control Unit
9. Characterization and Synthesis of Inorganic Materials and Utilization of Industrial By-Products Unit
10. Computational Science and Materials Engineering Unit

The Computer Center

The **Computer Center** supports both the teaching and research activities of the School, providing the members of the department with computational facilities necessary for their teaching and research commitments. Computer Center staff offers special training to the students and computer support for their diploma and doctoral theses.

There are two work-station rooms (PC Labs), with a capacity of 60 and 24 seats each. A large number of lessons (almost 40) are carried out in the PC Labs. More information can be found on the site:

http://www.chemeng.ntua.gr/the_computer_center

Partial view of the PC Lab.

2.4 The staff of the School

Dean: Professor G. Kakali

Deputy Dean: Professor E. Voutsas

Dean's Office: G. Kakali (Professor), E. Voutsas (Professor), A. Karantonis (Associate Professor), D. Karonis (Professor), K. Kollia (Professor), K. Kordatos (Professor), E. Pavlatou (Professor), A. Detsi (Professor), G. Stefanidis (Associate Professor), A. Bakolas (Associate Professor), E. Topakas (Associate Professor), D. Vasilakopoulos (Representative of the Laboratory Teaching Staff), E. Kanellopoulou (Representative of the Technical Laboratory Staff).

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Director: Professor A. Detsi

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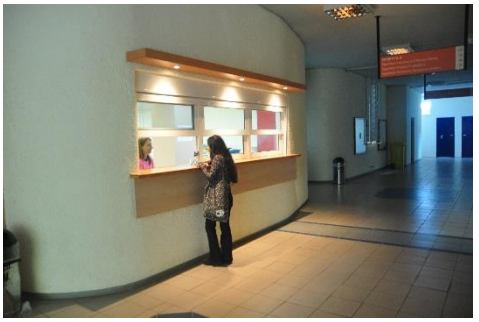
School Secretariat



Secretariat is situated on the ground level of the main building and is open to public every working day from 11:30 to 13:30. Staff members of Secretariat are responsible for the administrative support of all courses and activities of the School.
Email of the Secretariat:
secretariat@chemeng.ntua.gr
Postal Address: 9 Iroon Polytechneiou Str., Zografos Campus – 15772, Athens - Greece

Secretariat Staff:
Head of Administrative services: A. Manesi
Office of Undergraduate studies: Director of the office A. Papadimitriou, A. Manesi, E. Mikiroglou, S. Andri
Office of post-graduate studies: Director of the office E. Karametou, G. Sifaki, I. Georgiou
Personnel Office (Teaching staff promotions): A. Manesi
Personnel Office (Teaching, Technical and administrative staff): A. Poulikakou, K. Karaboulas
Personnel Office (Teaching staff), Research Programs: A. Poulikakou, K. Karaboulas
Financial Services Office: Director of the office G. Sifaki
Technical IT support, Student repository: A. Papadimitriou
E-Protocol: I. Georgiou
Erasmus Office, student exchange & Postgraduate Studies Programme "Conservation of Building Materials" B' Direction: **A. Labropoulou** (210-7721433, labrop@mail.ntua.gr)
Lodge - Supervision: **A. Gerasimou** (210-7723066, gerasimou@chemeng.ntua.gr)

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3. UNDERGRADUATE STUDIES AT THE NTUA

Student status is obtained by enrollment at NTUA and lasts till graduation. The student has the right to apply to the General Assembly of the School for suspension of studies for a certain period of time. During the suspension period student status is automatically lost and regained with a new application when suspension is finished. The period of suspension of attendance is not counted in the total study time, neither in the calculation of the minimum time required to obtain the degree or the calculation of the maximum time for the preservation of the student's rights.

The educational curriculum at NTUA is divided into ten independent academic semesters. All courses taught last one semester and studies in total last ten (five fall and five spring) semesters. Each semester covers in average 30 credit units and lasts 18 weeks; 13 weeks are devoted exclusively to teaching, 2 for the Christmas or Easter break, and the last 3 of each semester for final examinations in that semester's courses. In the fall semester, the week after the final exams is given over to vacations or special educational purposes.

At the beginning of each semester courses, students are required to fill in an application form declaring the courses they wish to attend. This form is a prerequisite for participation in the course exams. Students wishing to abstain from the exams of one or even all semester courses have to submit a signed request to School secretariat within the first three weeks of the semester.

The curriculum includes the titles and content of the mandatory and elective courses, the weekly hours of teaching (including every form of teaching) and the sequence or interdependence of courses. It is published every year in Greek and English. The General Assembly of the School is responsible for drawing up the curriculum, which comes under review every April. The School President sets up a programme committee consisting of members of the General Assembly of the School, lasting for one year, which submits a report to the General Assembly based on the suggestions of the departments.

Under the general principles which govern studies at NTUA, the university strives to ensure that the following demands and conditions are met:

- 25 to 26 teaching hours in total per week and 6 to 7 courses a semester.
- Classes are normally held between the hours of 08:45 and 15:30 from Monday to Friday.
- Class size is kept to a maximum of 80 students per lecturer.
- Teaching includes theory and practice in a coherent presentation.
- Academic tutorials and interim tests are assessed, to strengthen the step by step learning.
- Information technology and PC labs form an integral part of the curriculum
- Regular detailed audit of textbooks by a special School Committee.
- Distribution of textbooks, on time.
- A fixed timetable for courses, examination periods and announcement of results.

In the winter examination period (January-February), only the courses of the fall semester are examined. In the summer examination period (June-July), only the courses of the spring semester are examined.

In September, students may retake exams in any courses which they have either failed or have not previously been examined on or in which they wish to improve their grade

(provided the courses have been declared at registration). Students are assessed in each course by the course instructor, who must set written and/or oral examinations as he/she feels appropriate, based on intermediary educational procedures (e.g. reports, term papers, exercises, etc.).

Marking in all courses is determined by the professor who has the obligation of organizing the exams (written or oral) or any other assessment process made on a scale of 0-10, without using fraction of an integer, and with 5 as a passing mark. Thesis marking is an exception since it is allowed to use half marks (0.5), and the passing mark is 5.5.

The overall mark for the Diploma is calculated by summing the following:

- the arithmetic average of all course marks taken by the student during his/her studies, with a weighted coefficient of four fifths (4/5), and
- the Diploma Thesis mark, with a weighted average of one fifth (1/5).

The total quality of the student is assessed according to the following levels: excellent (9 to 10), very good (7 to 8.99) and good (5.0 to 6.99).

NTUA evaluates the teaching process with questionnaires in order to:

- pinpoint any weaknesses in the education offered and continuously improve its quality,
- introduce new modes of teaching which will strengthen the active participation of students (broadening and improving laboratory work, using multimedia, evaluation through electronic questionnaires, access to electronic libraries and material on academic staff personal web pages),
- improve communication between academic staff and students.

The questionnaires are distributed to students between the 7th and 10th week of each semester by the School Offices, during courses. They are optional and anonymous, and are offering vital information for achieving the above aims.

4. UNDERGRADUATE STUDIES AT THE SCHOOL OF CHEMICAL ENGINEERING

4.1 Practical Training (Internship)

The **practical training (internship)** takes place mainly in production units of private sector and is of principal importance since it connects education with professional environment.

The Internship has a duration of one (1) continuous calendar month and is conducted in private or public companies, with activity falling within the gnostic subjects of the School of Chemical Engineering (NTUA). Indicatively, the companies may cover fields of employment, such as Petroleum-Plastics, Medicines-Cosmetics, Food-Beverages, Minerals, etc.

The Internship takes place at the end of the 8th, as well as at the beginning of the 9th semester.

4.2 Diploma Thesis

The **final diploma thesis** refers to one of the topics offered by the School and is assigned to students after their application at the beginning of each semester. The thesis work lasts at least one semester (9th and/or 10th) and is conducted by each student under the supervising of a professor. The subjects are announced on a specific web page every September and February (https://www.chemeng.ntua.gr/the_diploma_thesis).

Collaborations with Research Institutes, industries and other NTUA Schools are encouraged during the elaboration of the diploma thesis. The diploma thesis can be written and presented in English, if it is conducted within the frame of the ERASMUS Program.

After completion of the Diploma Thesis, the student undergoes an oral examination, by a three-member examining committee, under the condition of having successfully integrated all previous semester courses. The examinations are held thrice per year in June, October and February. The final mark of the Diploma Thesis is calculated as the average of the marks of the 3 examiners, rounded to the closest integer or half unit of an integer. If the student fails the thesis exam can apply for one resit. In case of a second failure the student has to apply for a different thesis subject and be examined in the next period.

4.3 European Students Mobility

European Program ERASMUS+

Chemical Engineering School participates in the ERASMUS+ (2021-2027) program. For general information visit the site: http://erasmus.ntua.gr/en .

Through this program students can perform part of their studies in any of the collaborative universities of other countries. The list of collaborative universities can be found at http://erasmus.ntua.gr/en/interinstitutional_agreements. Students can attend semester courses or carry out part of their diploma or PhD thesis. The mobility period should last for a minimum of three months and a maximum of twelve per academic year.

All courses successfully accomplished are officially credited to students on their return to the collaborative universities.

In addition, student can also conduct their practical internship for a minimum of two months under the conditions reported in http://erasmus.ntua.gr/en/traineeships.

Outgoing Students

The selection of the outgoing students depends on several criteria such as number of courses successfully passed, grade achieved, semester of studies, language of visiting country, etc. More information:

http://erasmus.ntua.gr/en/application_procedure

Incoming students

Incoming students are obliged to attend and take exams of undergraduate courses. Students must be fluent either in Greek or in English as for the courses that can be offered also in English. These courses are listed in the following Table. More information: http://www.chemeng.ntua.gr/the_semester.

T.I.M.E. NET.

NTUA is a member of T.I.M.E. net "Top Industrial Managers for Europe" aiming to the globalization of a high-level engineers' education. Students can obtain two diplomas from two different Universities after having attended courses in both universities for six years in total out of which two years must be in the university abroad.

This program is recognized and financed by EU. Finance management is held by the founder member Ecole Centrale Paris (http://www.ecp.fr).

For more information regarding T.I.M.E. visit the site: https://www.time-association.org.

Our School has an active collaboration also with the Institution of the net: Politecnico di Milano (IT-PoliMi)

Information

More information on these programs is available on the site:
https://www.chemeng.ntua.gr/the_iac.

4.4 NTUA Facilities

4.4.1 Academic Identity Card

Academic identity card is offered to all students under- and post graduate and is valid for as long as it is required to obtain a degree plus two years. It is valid for one academic year and it offers discount on public mass transportation tickets (25-50%) as well as on some museums and cultural events. the card is issued at the School Secretariat and requires a photograph. Requirements for issuing the card can be found on Academic ID card acquisition service.

4.4.2 Student Restaurant Card

The Student Restaurant Card allows students to have lunch and dinner at NTUA's restaurants (at both the Zografou and Patision Campuses) at a very low price or for free for those who meet certain criteria (e.g. low income). For further queries about the card and how to apply, please contact the Student Support Office (Thomaidion Centre for Publications). For further information, you can contact Ms K. Giakoumaki (210-772-2192) and Ms. G. Sotiropoulou (210-772-2192).

Student Eating Card application form

4.4.3 Health Care

All students are entitled to free healthcare. It can be obtained with a student health book issued at the Zografou Health Centre on presentation of an identity card, student ID card, photographs and a statement of declaration (as per Law 1599/86). Healthcare includes immediate medical assistance, pharmaceutical care, dental care, treatment by a doctor, hospital care for inpatients and outpatients, health center examinations and special treatment, and care for chronic diseases. Pharmaceutical care involves the granting of free medicine to students from designated pharmacies.

More Information: Mrs. M. Katrani (210-772-1566), Doctor A. Antonopoulos (210-772-156).

4.4.4 Halls of Residence

At the Zografou campus, there are two Halls of residence: the old building and the new buildings at Zografou. The old 12-storey building (Iroon Polytechneiou Street) is mainly used by students of other Universities. The new Halls of Residence (15 buildings at Kokkinopoulou Street, 6A), are monitored by The Youth & Lifelong Learning Foundation.

New Halls of Residence in Zografou.

4.4.5 Housing Allowance

It is provided to students who study and live in a place other than their main place of residency and to those whose (family or individual) income is lower than a certain level. For further information contact Student Support Office (Thomaidion Centre for Publications) at 210-772-1936 (Ms. E. Taka) and 210-772-2154 (I. Sotiropoulou).

4.4.6 Central Library

The central library of NTUA occupies a space of 7.000 m^2 with a reading area of 500 seats, 38 seats for private studying, 6 group reading rooms, 6 seats for PC work and 4 photocopy machines operating with magnetic cards. The historical library of NTUA is also located in the same building. The library possesses around 60.000 books and journals published since 17th century till 1950.

The building of Central Library.

NTUA Library is accessible for all members of the academic community as well as NTUA alumni. All members should issue a Library card in order to have access to all library facilities. The card is strictly personal. Students who do not possess a card are allowed to use electronic or printed material only inside the Library building.

For more information contact: E. Karachristou, V. Karapataki, E. Tziamani, E. Gousouli at 210-772 2229, 210 772 2027 and 210-772 1250 or E-mail: libloan@central.ntua.gr.

4.4.7 Music Department

The music Department covers the divisions of music, dance, theater and photography and cinema. The Music Department also organises excursions and visits throughout Greece in cooperation with the NTUA Art Workshop. More information: G. Varsamakis, Music Department Head, phone: 210-772-4004, 210-772-3463, 210-772-1809.

Activities of the Music Department:

Mixed Choir, (in which all students can participate every Tuesday and Thursday 19.30-21.30, Patission 42, 3rd and 4th floor, Technical Service Building)
String orchestra (in which advanced students may participate)
Musical instruments lessons (guitar, piano, violin, cello, etc or join the NTUA Percussion Team).

For further information: Mr. Michalis Oikonomou, Choir & Orchestra Director and Ms Eleutheria Nathanail (Tel. 210-772-3463, Fax: 210-772-3464).

4.4.8 Dance Division

The Dance Division is made up of NTUA students who are interested in modern, traditional and folk dances from Greece. Apart from the existing group, there is also a beginner's section. Dance Division Hall phone: 210-772-2337 dance.ntua.gr.

4.4.9 Theater Department

The Theatre Department of NTUA was established in 1991. Directors, set designers, and actors are all students of NTUA who choose the plays and the way in which they will be presented. They meet once a week (or more than once) at the General Courses, Building C, Zografou Campus, Room of the Theatre department) while all students who wish to be on stage, can participate irrespectively of their experience in theatre. Tel.: 210-772-1031, 210-772-1895, 210-772-4004.

4.4.10 Restaurants and Canteens

The restaurant in Zografou Campus is open every day all day except holidays (Christmas, Easter and summer). It has reduced prices and serves university students and staff. Free meals are provided to students on relatively low incomes, as defined by law. Practically 90% of the students are entitled to free meals. Zografou Restaurant: 210-772-3068, Patission Restaurant: 210-772-3832.

Canteens are located in the Civil, Electrical, Chemical, Surveying and Mining Engineering school buildings, at the Applied Sciences School building, at the Sports Center and at the Administration building in Zografou Campus.

4.4.11 Sports Center

The Sports Centre has two gyms: one on Patission Street (on the 5th floor of the Bouboulina Building) and one on the Zografou Campus (near the student flats). Students who belong to sporting associations may join the university teams and take part in inter-university matches. Other students may use the sports facilities of NTUA and other facilities such as the Municipality of Athens swimming pool, the tennis courts in the same area, yacht clubs etc. The sports available to NTUA students include fitness training, aerobics, volleyball, football, handball, table tennis, tennis, swimming, water polo, rowing, sailing, windsurfing, sub-aqua diving, mountaineering, fencing, karate, judo, kendo, shooting, gliding, climbing, track and field, horse-riding, skiing, chess, bridge, rafting and paintball. Participation in sporting events is free, with the exception of some expensive sports for which students are required to pay a small part of the cost.

4.4.12 Special Counsellor

At the National Technical University of Athens, a group of experts-counselors provide their services to students who face difficulties in relation to their studies, stress and anxiety, difficulty in dealing with student life or living in the city, or other problems such as those related to social relations (conflicts with the family, or friends), feelings of isolation and mood change, health problems, and other personal issues. For further information, contact the Career Office and specifically Mrs. Eleni Paspaliari and Mrs. S. Nika (tel. 210-772-1089, 210-772-2590, e-mail: career@central.ntua.gr).

4.4.13 Tutors

A specific professor is appointed as tutor for each first year student. Tutors consult and support students throughout their studies, helping them to confront any problem. The tutor remains the same till the end of the studies. At the beginning of each academic year tutors are assigned with 3-4 first year students. At least 2 group meetings take place at the beginning of the semesters, after a corresponding e-mail from the professor, reporting the place and time. Professor is available also for private meetings, if the students wish so. During private meetings personal problems can also be discussed in addition to academic ones. Needless to say, that the context of these discussions is strictly confidential.

5. UNDERGRADUATE STUDIES PROGRAM

5.1 Expected learning outcomes of the New Undergraduate Curriculum

The Undergraduate Curriculum of the School of Chemical Engineering aims to provide a high level of education to students of Chemical Engineering, in order to acquire the knowledge, skills and ability to apply the principles of science - mathematics, physics, chemistry and biology-engineering, as well as economics/social sciences in their fields of activity. These fields are characterized by processes of transformation of matter and are applied in chemical/biochemical installations, where matter is processed in the best way from a technical, economic and social point of view. More specifically, the subject of the science of Chemical Engineering includes fields of study such as:

- Properties and states of matter. Energy exchanges and transformations during the transformation of matter and/or energy.
- Physical, physicochemical, chemical, biochemical and biological processes and systems.
- Mass and Energy Balances, Thermodynamics, Chemical Kinetics and Transfer Phenomena.
- Analysis, design, development and regulation of processes and systems.
- Materials science, engineering and technology.
- Environmental Protection and Management.
- Health and safety.
- Energy systems management and energy saving.
- Industrial and Energy Economics - Management and Organization.
- Systems and Quality Control.
- Other fields of engineering: Technical Engineering (Static, Strength of Materials), Electromechanical equipment, Technical Designs.

Upon successful completion of the 5-year curriculum of the School that leads to a Master's Degree, the graduate is expected to possess the necessary scientific knowledge, abilities and skills to understand and solve physical, chemical and biological problems in both laboratory and industrial scale. In particular, after the completion of the School's Curriculum, the graduate is expected to be able:

- ✓ To capture, design and manage processes for the production, transformation and transportation of products (materials and energy).
- ✓ To participate in the research, development, production, improvement and support of industrial production methods.
- ✓ To participate in the standardization, quality control, certification and marketing of materials of all kinds.
- ✓ To prepare scientific and technical studies of construction, operation of equipment and technical support, projects or industrial facilities.
- ✓ To prepare environmental impact studies, risk assessment and management, restoration and quality assurance, health and safety at work.
- ✓ To manage and/or coordinate projects related to environmental impact studies, risk assessment and management, rehabilitation, quality assurance, health and safety at work.
- ✓ To carry out Inspections, Audits, Expertise, Arbitrations on issues related to their realm, drafting technical reports and opinions.
- ✓ To undertake the development, management, installation, certification and

inspection of quality assurance systems.
- ✓ To participate in human resource management.
- ✓ To work as a teacher of Secondary and Technical Education.
- ✓ To work as a researcher in international organizations and companies.
- ✓ To work individually and collectively, in complex technical activities, with responsibility and awareness of professional and moral responsibility towards both the society and the environment.

According to the School's curriculum, forty (**40**) mandatory core courses are offered, as well as three kinds of free selection courses. Free selection courses include: thirty one (**31**) "specialization" courses (allowing the students to select five among them), four (**4**) courses of foreign languages (allowing the students to select one language) and fifteen (**15**) elective courses, allowing the student to select three out of them (one from the field of humanities and two from the field of technology).

5.2 Directions - Specializations

Concerning the 31 "specialization" courses, the curriculum allows the selection of five courses from a list of four Directions, during the 8th to 10th semester. Each of them consists of two sub-groups, containing four interrelated courses.

The Directions are the following ones:

- **Process Design** containing the sub-groups of Process Engineering and Economics/Business Administration, with special emphasis on the principles and methodologies related to analysis, synthesis and simulation of processes, installations and equipment of Chemical Industry.
- **Environment - Energy** containing the sub-groups of Environment and Energy, with emphasis on environmental technologies, water and waste management as well as fuels and energy management.
- **Food - Biotechnology**, containing the sub-groups of Food Science and Engineering and of Biotechnology, focusing on food industry, as well as on biotechnology and bioengineering.
- **Materials,** containing the sub-groups of Functional and multi-scale Materials and of Polymer and Composite Materials, focusing on the understanding of basic principles and methods correlated to materials structure, properties and processing techniques.

Table 1. Hourly timetable of Direction – Specialization courses.

COURSES OF DIRECTIONS - SPECIALIZATIONS				
CODE-TITLE OF THE COURSES	**Sem.**	**Lect.**	**Exerc.**	**Lab. Exerc.**
DIRECTION: PROCESS DESIGN				
SPECIALIZATION: *PROCESS ENGINEERING*				
5299-Advanced Fluid Mechanics	9	5	-	-
5182-Advanced Thermodynamics	**8[1],** 10	3	-	2
5296-Industrial Reactor Engineering	9	2	3	-
5309-Advanced Process Control	8, **10[1]**	3	2	-
SPECIALIZATION: *ECONOMICS/BUSINESS ADMINISTRATION*				
5305-Technology, Innovation and Entrepreneurship	9	3	-	2
5286-Competition Analysis and Market Research	**8**, 10	3	-	2
5308-Project Management	8, **10**	3	-	2
DIRECTION: ENVIRONMENT - ENERGY				
SPECIALIZATION: *ENVIRONMENT*				
5301-Dispersion of Pollutants	8, **10**	3	-	2
5297-Environmental Assessment and Optimization of Industrial Processes	9	3	-	2
5288-Industrial Waste Management	**8**, 10	3	-	2
5294-Water Management	9	2	-	3
5304-Green Chemistry and Engineering	**8**,10	2	1	2
SPECIALIZATION: *ENERGY*				
5157-Liquid Fuels	**8,** 10	3	-	2
5293-Gaseous and Solid Fuels	9	3	-	2
5298-Advanced Technologies For Energy Production And Storage	9	3	2	-
5170-Sustainable Management of Energy Systems	8, **10**	3	-	2

CODE-TITLE OF THE COURSES	Sem.	Lect.	Exerc.	Lab. Exerc.
DIRECTION: FOOD-BIOTECHNOLOGY				
SPECIALIZATION: *FOOD SCIENCE AND ENGINEERING*				
5292-Chemistry, Microbiology and Food Preservation Principles	**8**, 10	2	-	3
5311-Food Engineering	9	2	-	3
5310-Design of Food Industries - Quality and Safety Assurance of Foods	8, **10**	3	-	2
SPECIALIZATION: *BIOTECHNOLOGY*				
5287-Industrial Biotechnology	**8,** 10	3	-	2
5307-Bioengineering	9	3	-	2
5175-Environmental Biotechnology	8, **10**	3	-	2
5300-Pharmaceutical Chemistry and Technology	9	3	-	2
DIRECTION: MATERIALS				
SPECIALIZATION: *FUNCTIONAL AND MULTI-SCALE MATERIALS*				
5291-Structure-Property Relationships in Materials	**8**, 10	3	1	1
5174-Metallic Materials Science and Engineering	9	3	-	2
5295-Construction and Ceramic Materials	9	3	-	2
5302-Nanomaterials and Nanotechnology	8, **10**	3	-	2
SPECIALIZATION: *POLYMER AND COMPOSITE MATERIALS*				
5289-Polymer Science	**8,** 10	3	-	2
5154-Polymer Production Engineering	9	3	-	2
5306-Polymers Processing	8, **10**	3	-	2
5257-Composite Materials	9	3	-	2

[1]With bold is indicated the semester in which the specialization course appears during the online course registration. It is reminded that the students of the 8th semester have the ability to select from higher semesters, choosing up to three (3) specialization courses from Spring Semesters. Students of the 9th semester have the ability to choose up to (2) specialization courses.

6. UNDERGRADUATE STUDIES PROGRAM OF THE ACADEMIC YEAR 2019-2020

6.1 Academic Calendar

The Academic Calendar with the important dates concerning undergraduate studies, can be found at:

https://www.chemeng.ntua.gr/the_secretariat_news/3606/akadimaiko_imerologio_proptyxiakwn_spoydwn_akad_etoys_2022_2023

6.2 Analytical Hourly Timetable Undergraduate Curriculum

The analytical hourly timetable of the undergraduate curriculum for the academic year 2022-2023 was approved by the General Assembly of the School on the 17th of May 2022 and is reported in Table 2.

The number of corresponding ECTS units according to the European Credit Transfer System was approved on the 10th of October 2018 and is also reported is Table 2.

More information on lessons context is provided in the relevant course id sheet that attends the analytical description of each course in Paragraph 7 of the guide.

Table 2 Hourly timetable of Undergraduate Syllabus and corresponding ECTS units

1st Semester							
COURSE CODE-TITLE OF THE COURSE		**LECUTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
CORE - COMPULSORY		***(HOURS PER WEEK)***				
5122	Inorganic Chemistry	3	-	5	8	7
5063	Computer Programming - Basic Software Tools	2	-	3	5	5
5005	Physics I	4	-	1	5	5
5268	Mathematics I (Calculus of Functions of One Real Variable)	4	-	-	4	5
5213	Introduction to Chemical Engineering	2	1	1	4	5
5085	Technical Drawing	1	-	1	2	3
TOTAL		**16**	**1**	**11**	**28**	**30**
LANGUAGE - ONE ELECTIVE						
5027	English Language	2	-	-	2	
5003	French Language	2	-	-	2	
TOTAL HOURS		**2**	**-**	**-**	**2**	
SEMESTER TOTAL		**18**	**1**	**11**	**30**	**30**

2nd SEMESTER							
COURSE CODE-TITLE OF THE COURSE		LECTURE	EXERCISES	LABORA-TORY	TOTAL HOURS	ECTS
CORE - COMPULSORY		*(HOURS PER WEEK))*				
5272	Thermodynamics I	3	-	2	5	6
5267	Mathematics II (Linear Algebra)	4	-	-	4	5
5125	Analytical Chemistry	2	-	2	4	5
5002	Mathematics III (Functions of multiple variables)	4	-	-	4	5
5062	Physics II	4	-	1	5	5
5026	Engineering Mechanics	3	-	-	3	4
TOTAL		**20**	**-**	**5**	**25**	**30**
LANGUAGE - ONE ELECTIVE						
5071	English Language	2	-		2	
5072	French Language	2	-		2	
TOTAL HOURS		**2**	**-**	**-**	**2**	
SEMESTER TOTAL		**22**	**-**	**5**	**27**	**30**

3rd SEMESTER						
COURSE CODE-TITLE OF THE COURSE		LECTURE	EXERCISES	LABORA-TORY	TOTAL HOURS	ECTS
CORE - COMPULSORY		*(HOURS PER WEEK)*				
5088	Structure and States of Matter	4	2	2	8	7
5126	Mathematics IV (Differential equations)	4	-	-	4	5
5109	Thermodynamics II	3	-	2	5	6
5069	Instrumental Methods of Chemical Analysis	2	-	2	4	5
5273	Statistics and Experimental Design	3	-	2	5	6
TOTAL		**16**	**2**	**8**	**26**	**29**
LANGUAGE - ONE ELECTIVE						
5030	English Language	2	-	-	2	
5031	French Language	2	-	-	2	
TOTAL		**2**	**-**	**-**	**2**	
SEMESTER TOTAL		**18**	**2**	**8**	**28**	**29**

4th SEMESTER						
COURSE CODE-TITLE OF THE COURSE		LECTURE	EXERCISES	LABORA-TORY	TOTAL HOURS	ECTS
CORE - COMPULSORY		*(HOURS PER WEEK)*				
5276	Organic Chemistry	4	-	4	8	7
5225	Chemical Kinetics & Electrochemistry	4	2	2	8	7
5098	Transport Phenomena I: Fluid Mechanics	4	-	-	4	5
5269	Numerical Methods for Engineers	2	-	2	4	5
TOTAL		**14**	**2**	**8**	**24**	**24**
LANGUAGE - ONE ELECTIVE						
5075	English Technical Terminology	2	-	-	2	5
5076	French Language and Terminology	2	-	-	2	5
TOTAL		**2**	**-**	**-**	**2**	**5**
ONE ELECTIVE -						
HUMAN AND SOCIAL SCIENCES SECTOR						
5210	Sociology of Science and Technology	2	-	-	2	2
5275	History and Philosophy of Science and Technology	2	-	-	2	2
5274	Applied Didactics of Natural Sciences and Technology	1	-	1	2	2
5208	Introduction to Economics	2	-	-	2	2
5227	Elements of Law and Technical Legislation	2	-	-	2	2
TOTAL		**1 or 2**	**-**	**0 or 1**	**2**	**2**
SEMESTER TOTAL		**17 or 18**	**2**	**8 or 9**	**28**	**31**

5th SEMESTER						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
CORE - COMPULSORY		***(HOURS PER WEEK)***				
5165	Materials Science and Engineering	3	1	3	7	7
5064	Physical Processes Engineering I	2	2	*$1\frac{1}{2}$	$5\frac{1}{2}$	6
5232	Principles of Cell Biology and Biochemistry	4	-	-	4	5
5099	Transport Phenomena II: Heat and Mass Transfer	2	2	-	4	5
5279	Electromechanical Processes Equipment	3	1	-	4	5
TOTAL		**14**	**6**	$\mathbf{4\frac{1}{2}}$	$\mathbf{24\frac{1}{2}}$	**28**
ONE ELECTIVE						
ENGINEERING SECTOR						
5278	Selected topics of bio-organic chemistry and chemistry of natural products	$2\frac{1}{3}$**	-	$\frac{2}{3}$***	3	3
5281	Materials Decay and Protection	2	-	1	3	3
5280	Advanced Ceramics	3	-	-	3	3
5277	Quality Management	1	1	1	3	3
TOTAL		**1 or 2 or $2\frac{1}{3}$ or 3**	**0 or 1**	**0 or $\frac{2}{3}$ or 1**	**3**	**3**
SEMESTER TOTAL		**15 or 16 or $16\frac{1}{3}$ or 17**	**6 or 7**	**$4\frac{1}{2}$ or $5\frac{1}{6}$ or $5\frac{1}{2}$**	**$27\frac{1}{2}$**	**31**

*Every student performs one laboratory exercise with a duration of 3hours every 2nd week.
**Every student keeps up lectures lasting 3 hours for 10 consecutive instructional weeks.
***Every student performs one laboratory exercise lasting 3 hours for 3 instructional weeks.

6th SEMESTER						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
CORE - COMPULSORY		***(HOURS PER WEEK)***				
5012	Physical Processes Engineering II	4	-	$1\frac{1}{2}$	$5\frac{1}{2}$	6
5057	Chemical Reaction Engineering I	2	2	$1\frac{1}{2}$	$5\frac{1}{2}$	6
5239	Environmental Science and Technology	$2\frac{1}{2}$	$\frac{1}{2}$	-	3	3
5147	Polymer Engineering	3	-		3	3
5303	Food Science and Technology	3	-	-	3	3
5283	Economic Analysis and Business Administration (for engineers)	3	-	1	4	5
TOTAL		**$17\frac{1}{2}$**	**$2\frac{1}{2}$**	**4**	**24**	**26**
ONE ELECTIVE						
ENGINEERING SECTOR						
5231	Environment & Development *(inter-departmental)*	3	-	-	3	3
5265	Products Design	1	1	1	3	3
5246	Computational Transport Phenomena	1	-	2	3	3
5282	Inorganic Chemical Technology	2	1	-	3	3
5226	Nuclear Chemistry and Technology	3	-	-	3	3
5284	Modern Tools in Chemical Analysis	$2\frac{1}{2}$	-	$\frac{1}{2}$	3	3
TOTAL		**1 or 2 or 3**	**0 or $\frac{1}{2}$ or 1**	**0 or $\frac{1}{2}$ or 1 or 2**	**3**	**3**
SEMESTER TOTAL		**$18\frac{1}{2}$ or $19\frac{1}{2}$ or $20\frac{1}{2}$**	**$2\frac{1}{2}$ or 2 or $3\frac{1}{2}$**	**4 or $4\frac{1}{2}$ or 5 or 6**	**27**	**29**

* Every student performs one laboratory exercise with a duration of 3hours every 2nd week.

7th SEMESTER						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
CORE - COMPULSORY		***(HOURS PER WEEK)***				
5240	Chemical Processes Engineering II	2	2	$*1\frac{1}{2}$	$5\frac{1}{2}$	6
5285	Biochemical Engineering	3	2	-	5	6
5084	Process Control	4	-	1	5	6
5156	Energy Technologies	3	2	-	5	6
5177	Process Design I	3	-	3	6	7
SEMESTER TOTAL		**15**	**6**	$\mathbf{5\frac{1}{2}}$	$\mathbf{26\frac{1}{2}}$	**31**

* Every student performs one laboratory exercise with a duration of 3hours every 2nd week.

8th SEMESTER						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
CORE - COMPULSORY		***(HOURS PER WEEK)***				
		TOTAL WEEKS: 8				
5253	Environmental Engineering	4	2	-	6	6
5290	Process Design II	3	3	-	6	7
5000	Internship (Practical Training)	*(ONE MONTH)*				7
TOTAL		**7**	**5**	**-**	**12**	**20**
COMPULSORY SPECIALISATION COURSES						
Specialization- Spring Semester		*The hours differ depending on course*			5	7
TOTAL SEMESTER					**17**	**27**

SPECIALIZATION COURSES OF 8th SEMESTER						
[The student is able to select one to three courses. The selection could be realised within the catalogue of courses from 8th and 10th Semester.]						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
		(HOURS PER WEEK) TOTAL WEEKS: 8				
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: PROCESS ENGINEERING						
5182	Advanced Thermodynamics	3	-	2	5	7
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: ECONOMICS/BUSINESS ADMINISTRATION						
5286	Competition Analysis and Market Research	3	-	2	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENVIRONMENT						
5288	Industrial Waste Management	3	-	2	5	7
5304	Green Chemistry and Engineering	2	1	2	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENERGY						
5157	Liquid Fuels	3	-	2	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: FOOD SCIENCE AND ENGINEERING						
5292	Chemistry, Microbiology and Food Preservation Principles	2	-	3	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: BIOTECHNOLOGY						
5287	Industrial Biotechnology	3	-	2	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: FUNCTIONAL AND MULTI-SCALE MATERIALS						
5291	Structure-Property Relationships in Materials	3	1	1	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: POLYMER AND COMPOSITE MATERIALS						
5289	Polymer Science	3	-	2	5	7

9th SEMESTER						
COURSE CODE-TITLE OF THE COURSE CORE - COMPULSORY		LECTURE	EXERCISES	LABORA-TORY	TOTAL HOURS	ECTS
		(HOURS PER WEEK)				
		TOTAL WEEKS: 8				
5149	Safety of Industrial Installations	2	-	1	3	4
TOTAL		**2**	**0**	**1**	**3**	**4**
*** SPECIALIZATION COURSES**						
Specialization- Winter Semester		*The hours differ depending on course*			5	7
Specialization- Winter Semester		*The hours differ depending on course*			5	7
Diploma thesis						
SEMESTER TOTAL					**13**	**18**

SPECIALIZATION COURSES OF 9th SEMESTER *[The student is able to select one or two courses]*						
COURSE CODE-TITLE OF THE COURSE		LECTURE	EXERCISES	LABORA-TORY	TOTAL HOURS	ECTS
		(HOURS PER WEEK)				
		TOTAL WEEKS: 8				
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: PROCESS ENGINEERING						
5299	Advanced Fluid Mechanics	5	-	-	5	7
5296	Industrial Reactor Engineering	2	3	-	5	7
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: ECONOMICS/BUSINESS ADMINISTRATION						
5305	Technology, Innovation and Entrepreneurship	3	-	2	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENVIRONMENT						
5297	Environmental Assessment and Optimization of Industrial Processes	3	-	2	5	7
5294	Water Management	2	-	3	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENERGY						
5293	Gaseous and Solid Fuels	3	-	2	5	7
5298	Advanced Technologies For Energy Production And Storage	3	2	-	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: FOOD SCIENCE AND ENGINEERING						
5311	Food Engineering	2	-	3	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: BIOTECHNOLOGY						
5307	Bioengineering	3	-	2	5	7
5300	Pharmaceutical Chemistry and Technology	3	-	2	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: FUNCTIONAL AND MULTI-SCALE MATERIALS						
5174	Metallic Materials Science and Engineering	3	-	2	5	7
5295	Construction and Ceramic Materials	3	-	2	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: POLYMER AND COMPOSITE MATERIALS						
5154	Polymer Production Engineering	3	-	2	5	7
5257	Composite Materials	3	-	2	5	7

SPECIALIZATION COURSES OF 10th SEMESTER *[The student is able to select yp to two courses]*						
COURSE CODE-TITLE OF THE COURSE		**LECTURE**	**EXERCISES**	**LABORA-TORY**	**TOTAL HOURS**	**ECTS**
		(HOURS PER WEEK)				
		TOTAL WEEKS: 8				
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: PROCESS ENGINEERING						
5309	Advanced Process Control	3	-	2	5	7
DIRECTION: PROCESS DESIGN						
SPECIALIZATION: ECONOMICS/BUSINESS ADMINISTRATION						
5308	Project Management	3	-	2	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENVIRONMENT						
5301	Dispersion of Pollutants	3	-	2	5	7
DIRECTION: ENVIRONMENT - ENERGY						
SPECIALIZATION: ENERGY						
5170	Sustainable Management of Energy Systems	3	-	2	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: FOOD SCIENCE AND ENGINEERING						
5310	Design of Food Industries - Quality and Safety Assurance of Foods	3	-	2	5	7
DIRECTION: FOOD-BIOTECHNOLOGY						
SPECIALIZATION: BIOTECHNOLOGY						
5175	Environmental Biotechnology	3	-	2	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: FUNCTIONAL AND MULTI-SCALE MATERIALS						
5302	Nanomaterials and Nanotechnology	3	-	2	5	7
DIRECTION: MATERIALS						
SPECIALIZATION: POLYMER AND COMPOSITE MATERIALS						
5306	Polymers Processing	3	-	2	5	7
SEMESTER TOTAL		**6**		**4**	**10**	**14**

DIPLOMA THESIS 9th & 10th SEMESTER	30 ECTS

7. COURSE CATALOG

(bracketed is the course code)
The list includes the courses and their contents per semester. The content refers to the theoretical part of the course. Many of the courses include laboratory and / or tutorial exercises.

1st SEMESTER

CORE-COMPULSORY COURSES

Inorganic Chemistry (5122)

[Course ID Sheet]

The course deals with: i) the structure of the atoms; ii) the periodicity of their physical and chemical properties; iii) the types of chemical bonds; iv) the structure and geometry of the molecules; and v) the macroscopic behavior of materials in connection with their molecular structure. In addition to teaching, the course also includes individual laboratory training of students. Students are trained in basic experimental technics, in a lab scale approach of some chemical engineering processes and also in good laboratory practices and application of safety rules in the chemical lab.

Lecturers: G. Kakali (Coordinator), K. Kordatos
Laboratory: G. Kakali, K. Kordatos, N. Tzamtzis-Pilalis
Laboratory Teaching Staff: A. Altzoumailis, D. Vasilakopoulos, A. Georgiadou, P. Gyftou, A. Karamperi, S. Karma, M. Komiotou, L. Mendrinos, K. Mikedi, K. Balta, Th. Lymberopoulou, L.-A. Tsakanika

Computer Programming – Basic Software Tools (5063)

[Course ID Sheet]

The purpose of the course is to introduce students to modern PCs, with some basic software tools and, above all, the basic programming principles as implemented in MATLAB and FORTRAN 90/95. The course is entirely taught in the School's PC-Lab.

Lecturer: Ch. Kiranoudis (Coordinator)
Laboratory: A. Spyropoulos, F. Doganis (Laboratory Teaching Staff)
Exercises: N. Mandellos (Laboratory Teaching Staff)

Physics I (5005)

[Course ID Sheet]

Basic lessons in engineering and the necessary mathematics are taught within the framework of this course. Specifically, are taught: Vector formulation of natural laws. Newton's Laws. Forces: gravitational, electric, magnetic. Equations of motion. Study of motion in 1 and 3 dimensions. Frames of reference. Conservation of momentum. Collisions. Variable-mass systems. Work. Kinetic energy. Conservative forces. Potential energy. Conservation of energy. Motion of particle systems. Force Momentum. Angular momentum. Moment of inertia. Conservation of angular

momentum. Study of the motion of a solid object. Oscillations. Harmonic oscillator. Damped Harmonic Oscillator. Forced oscillations. Coupled oscillations with two or many degrees of freedom. Wave equation. Wave motion of mechanical systems.

Lecturers: A. Georgakilas, V. Giannopapas (Coordinator)
Laboratory: H. Karkanis (Laboratory Teaching Staff)

Mathematics I (Calculus of Functions of One Real Variable) (5268)

[Course ID Sheet]

The main objects of the course are the differential and integral calculation of real functions of a real variable. Analytically: Introduction to real numbers. Sequences and Series. Limits and continuity of functions. Inverse trigonometric functions. Hyperbolic functions. Differential calculus (Taylor's theorem). Integral calculus (definitions, integration techniques). Applications of definite integral. General integral. Differential equations of first and second order with constant coefficients.

Lecturer: I. Gasparis (Coordinator)

Introduction to Chemical Engineering (5213)

[Course ID Sheet]

The aim of the course is to reinforce foundational concepts related to processes and systems encountered in the Chemical Industry. It contains the following sections: Definition of Science and Description of the role of a Chemical Engineer. Fundamental Concepts, purpose and Applications of Chemical Engineering in the Chemical Industry. Introduction to Technical Calculations. Units and dimensions, problem solving methods, chemical equations. Material Balances (mass - some, total, without and with reactions). Mass balance problem analysis methodology, recycling, bypass and material disposal processes. Solids, Liquids, Vapor, Gases. Vapor pressure, saturation and humidity, condensation and evaporation mass balances. Energy balances: Concepts and units, calculation of changes, enthalpy without phase change and phase changes, general energy balance, etc. Combination of Mass and Energy Balances. Graphical methods of data analysis and presentation - Approximate methods of data integration and correlation. Solving computing problems on a PC.

Lecturers: E. Pavlatou (Coordinator), S. Tsivilis
Computer Lab-Exercises: F. Doganis, Th. Xenidou, P. Gyftou (Laboratory Teaching Staff)

Technical Drawing (5085)

[Course ID Sheet]

The aim of the course is to learn the rules of mechanical and manual design, as well as in the computer, to acquire the knowledge of reading industrial design equipment and to have a basic knowledge of machine components and machineries. Units: Introduction: Purpose and Division of Mechanical Designs. Organizing a Drawing Room. Drawing Instruments and Length and Angle Measuring Instruments. Dimensional conversions. Design of a plan. Sketch. Drawing with pencil, ink, PC. Design Technique: Types and Lines. Types and ways of writing. Dimensions and types of drawing paper. Legend, scales, info graphics. Useful flat geometric constructions. Geometric constructions in space. Aspects. Sections. Dimensions. Dimensional Listing, Threads, Items,

Introduction to CAD / CAM: Definitions, Uses, Applications. Two-dimensional (2D) Computer Design: Autodesk AutoCAD.

Lecturers: D. Koulocheris (Coordinator), N. Chronis
Laboratory: N. Chronis, D. Asvesta (Technical Laboratory Staff), S. Tomara (Technical Laboratory Staff)

COMPULSORY FOREIGN LANGUAGE (One elective)

English Language (5027)

[Course ID Sheet]

The English language course aims at familiarizing students with language use in a variety of social contexts and communicative tasks (development of linguistic awareness). Practice in basic grammatical and syntactic structures. Practice in understanding and production of relatively simple written language. The language level the course targets is A2, as defined by the Common European Framework of Reference for Languages.

Lecturer: P. Togia (Coordinator)

French Language (5003)

[Course ID Sheet]

The course introduces students to the basic concepts of French scientific terminology, in order to meet the contemporary needs of multidisciplinary. At the same time, basic morpho-syntactic phenomena of the French language are taught through specialty texts. The course is supported by the corresponding teaching material of the lecturer and the E-Learning Platform of NTUA.

Lecturer: Z. Exarchou (Coordinator)

2nd SEMESTER

CORE-COMPULSORY COURSES

Thermodynamics I (5272)

[Course ID Sheet]

The aim of this course is to provide the theoretical knowledge and the necessary computational methodological tools in the following broad areas: Study of Process Feasibility and Energy Efficiency, Determination of Thermophysical Properties of Pure Fluids. Units included: Forms of Energy. Phase diagrams of pure substances. 1st Thermodynamic principle for closed and open systems. 2nd Thermodynamic principle. Principles of operation of thermal and cooling cycles. Calculations of entropic changes. Lost work. TdS equations. Fundamental equation. Energy available. Legendre transformations. Thermodynamic potentials, Helmholtz and Gibbs energies. Expression of thermodynamic derivatives as a function of measurable sizes. Simple thermodynamic calculations in processes with ideal gases. Thermodynamic analysis of simple power cycles. Complex power cycles. Thermodynamic analysis of cooling cycles. Volumetric behavior of pure substances. Other physical properties. Calculation of thermodynamic properties. Deviation functions. Chemical potential.

Lecturers: K. Magoulas (Coordinator), E. Voutsas
Laboratory: V. Louli, Ch. Vavva (Laboratory Teaching Staff)

Mathematics II (Linear Algebra) (5267)

[Course ID Sheet]

The main object of the course is to understand the basic concepts of Linear Algebra and Analytical Geometry. Units included: Linear Spaces, Sub-Spaces, Linear Case, Linear Independence, Base, Dimension, Sum and Intersection of sub-spaces. Rectangulation, Tables, Linear Illustrations, Limits, Applications in Geometry – Definitions, Cayley-Hamilton Theorem, Symmetric Tables, Square Forms.

Lecturers: P. Psarrakos (Coordinator), G. Manousakis (Laboratory Teaching Staff)

Analytical Chemistry (5125)

[Course ID Sheet]

The aim of the course is to acquire theoretical knowledge regarding the methods of classical chemical analysis. At the laboratory level, the aim is to become familiar with the method of working in an analytical/research laboratory, that is, to learn the proper sample preparation, the measurement process, the statistical processing and the evaluation of the final result. Units included: Introduction-Classification of analytical methods-Sampling, sample processing, measurements and statistical treatment -Chemical equilibrium-Acid-base theory-Theory of complexes, redox and precipitation, Quantimetric analysis - Volumetric analysis: Volumetric analysis Reduction, precipitation titrations) - Weighted analysis.

Lecturers: N. Tzamtzis-Pilalis (Coordinator), F. Tsopelas
Laboratory: N. Tzamtzis-Pilalis, F. Tsopelas

Laboratory Teaching Staff: A. Altzoumailis, A. Georgiadou, P. Gyftou, A. Karamperi, S. Karma, M. Komiotou, Th. Lymberopoulou, L. Mendrinos, K. Mikedi, K. Balta, L.-A. Tsakanika

Mathematics III (Functions of Several Variables) (5002)

[Course ID Sheet]

The aim of the course is Differential and Integral Functions of Multiple Real Variables. Units included: Introduction to Euclidean spaces. Multiple Variable Functions - Surfaces. Limits and continuity. Some derivatives of 1st and higher order. Jacobian table. Directional derivative. Vector functions. Differential Operators: Slope, Deviation, Laplace Function. Double integral. Triple integral. Complex integrals. Surface integrals. Complicated functions. Stokes and Gauss theorems. Various coordinate systems (polar, cylindrical and spherical coordinates).

Lecturer: I. Gasparis (Coordinator)

Physics II (5062)

[Course ID Sheet]

The main objects of the course are: (a) Introduction to the basic laws of electric and magnetic fields (Coulomb, Gauss, Biot-Savart, Ampere, Faraday laws). (b) Introduction to electromagnetic waves. (c) Introduction to Optics, in particular the reflection, refraction and polarization of electromagnetic waves, Young's experiment and the contribution and diffraction data. Along with teaching, the course includes laboratory training of the students, which aims to better consolidate phenomena developed in theory and to familiarize with basic laboratory methods of analyzing results. Units: Electric charge. Coulomb's law. Electrostatic field. Gauss's law. Electrostatic potential. Equations of Poisson and Laplace. Electrostatic energy. Conductors. Dielectrics. Polarization. Capacitance, capacitors. Moving charges, electric current, Ohm's law. Magnetic field. Matter in electric and magnetic fields. Lorentz force. Laws of Ampere and Biot-Savart. Induction, Faraday's law. Displacement current. Maxwell's equations. Electromagnetic waves: propagation, polarization, interference, diffraction. Geometrical optics. Basic laws of optics: reflection, refraction. Lens, prism. Dispersion, optical spectrum. Optical instruments. Spectroscopes, spectrographs.

Lecturers: A. Kechagias (Coordinator), I. Theodonis (Laboratory Teaching Staff)
Laboratory: H. Karkanis (Laboratory Teaching Staff)

Mechanics of Materials (5026)

[Course ID Sheet]

The aim of the course is to introduce the student to basic concepts of Mechanics, such as the carrier, its support, its internal forces, as well as its underlying stresses, as well as the trends, deformations, and displacements that a carrier passes through under basic stress. Units: Introduction to Static, Introduction to Elasticity Theory, Introduction to Material Strength, Introduction to Composites.

Lecturers: A. Antoniou (Coordinator), A. Charalambakis

COMPULSORY FOREIGN LANGUAGE (One elective)

English Language (5071)

[Course ID Sheet]

The English language course aims at familiarizing students with language use in a variety of social contexts and communicative tasks (development of linguistic awareness). Practice activities involving a range of grammatical and syntactic structures, as well as understanding and production of both spoken and written language. The language level at the end of the semester is expected to be B2, as it is defined by the Common European Framework of Reference for Languages.

Lecturer: M. Stathopoulou (Coordinator)

French Language (5072)

[Course ID Sheet]

The aim of the course is to complete the teaching of the most basic morpho-syntactic phenomena of the French language, while using texts to enable students to practice comprehension and summary techniques, while enriching their vocabulary and acquaintance with vocabulary. It is also distributed by the tutors, the relevant teaching material, using digital tools. The course is also supported by the Asynchronous E-Learning Platform of NTUA.

Lecturer: Z. Exarchou (Coordinator)

3rd SEMESTER

CORE-COMPULSORY COURSES

Structure and States of Matter (5088)

[Course ID Sheet]

The aim of the course is to understand and quantify the structure, movement and interactions at molecular level in gaseous, liquid and solid phases of pure substances and mixtures and to correlate them with macroscopic properties. Phase diagrams and interfacial phenomena. Units included: Introduction to Statistical Engineering. Intermolecular forces. Kinetic theory of dilute gases: Maxwell-Boltzmann distribution of molecular speeds, mean free path, frequency of molecular collisions. Viscosity, thermal conductivity, diffusivity in the gaseous state. Real gases: virial equation of state. Van der Waals equation of state and its predictions for phase equilibria and criticality. Joule-Thomson coefficient. Liquids: vapor pressure, viscosity, surface tension, wetting and spreading, capillary phenomena. Solids: Crystal systems and lattices. Amorphous solids. Heat capacities of solids, elements of Einstein and Debye theories. Multicomponent systems: Partial molar properties. Ideal and real solutions. Colligative properties (vapor pressure reduction, boiling point elevation, melting point depression, osmotic equilibria). Vapor-liquid equilibria, azeotropes. Partially miscible liquids. Solid-liquid phase diagrams in binary systems. Eutectic and peritectic points. Ternary mixtures, Gibbs-Roozeboom diagram. Sorption equilibria. Colloids.

Lecturers: Th. Theodorou (Coordinator), G. Papadopoulos
Laboratory: Th. Theodorou, G. Papadopoulos, C. Charitidis, L. Zoumpoulakis, K. Beltsios
Laboratory Teaching Staff: M. Karoglou, V. Dritsa, E. Daflou, S. Soulis, E. Rakanta, G. Grigoriadis, A. Delegou, K. Lampropoulos, P. Papandreopoulos, P. Georgiou, A. Konstanti

Mathematics IV (Differential Equations) (5126)

[Course ID Sheet]

Introduction, Definitions, Solution Concept, Initial-Boundary Price Problems, First-Order Linear Equations, Homogeneous Equations, Accurate Equations and Integrating Factors, Linear n-Order, General Theory, Homogeneous with constant coefficients, Method of parameter variation, Coefficient of determination, Euler equation, Solving second-order linear systems with finite series, Solution at smooth point, Legendre equation, Solution to normal zap point, Laplace transform, Definition and properties, Heaviside function, Solving equations with discontinuity, Laplace transformation convolution, Solving special form integral equations, First order linear equation systems, Phase Level for Linear Systems, Autonomous Systems and Stability, Fourier Trigonometric Lines, Convergence Theorem, Sturm-Liouville Boundary Problems, Physical Origin of Diffusion Equation by Fick's Law, Solving Problems of Initial-Boundary Heat Equation by Variable Separation Method for Homogeneous and Non-Homogeneous Boundary Conditions.

Lecturers: V. Kalpakidis (Coordinator), E. Protopapas (Laboratory Teaching Staff)

Thermodynamics II (5109)

[Course ID Sheet]

The course aims to provide the appropriate theoretical knowledge and the necessary computational-methodological tools in the following two broad areas: i) Determination of

thermophysical properties of pure fluids and mixtures, ii) Phase Balance and Chemical Balance Study. Units Included: Introduction. Intermolecular forces. Molar properties. Mixture properties. Applications. Mixing properties. Excess properties. Vapor-liquid balance at low pressures. Activity coefficients (pressure dependence, temperature, concentration, calculation models). Bubble point calculations and cooling at low pressures. Predicting multi-component phase equilibrium from binary data. Predicting phase balance with UNIFAC. Vapor-liquid equilibrium at high pressures (methods of calculating coefficients, dew point, boiling point, etc.). Liquid-liquid phase equilibrium. Solid-liquid phase equilibrium. Chemical reaction equilibrium (constant equilibrium calculations, gas phase reaction conversion, liquid phase reaction calculation and heterogeneous systems, factors affecting conversion, phase law, Duhem's theorem, multiple reactions).

Lecturers: K. Magoulas (Coordinator), E. Voutsas
Laboratory: G. Pappa, Ch. Vavva (Laboratory Teaching Staff)

Instrumental Methods of Chemical Analysis (5069)

[Course ID Sheet]

The aim of the course is to familiarize the students in theoretical and practical level with the modern instrumental methods of chemical analysis. Units included: Introduction. Characteristics of standard methods of inorganic chemical analysis. Analytical calibration. Atomic Absorption Spectrometry (AAS). Inductively Coupled Plasma (ICP) spectrometry. X-ray diffraction spectrometry (XRD). Visible - UV spectrometry (UV - Vis). Infrared Spectrometry (FT-IR). Mass Spectrometry (MS). Thermal methods (TGA). Chromatographic methods: Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC). Combined analytical techniques. Modern trends in instrumental chemical analysis.

Lecturers: N. Tzamtzis-Pilalis (Coordinator). F. Tsopelas
Laboratory: N. Tzamtzis-Pilalis, F. Tsopelas
Laboratory Teaching Staff: A. Altzoumailis, A. Georgiadou, P. Gyftou, A. Karamperi, S. Karma, Th. Lymperopoulou, L. Mendrinos, K. Mikedi, P. Papandreopoulos, P, Schinas, L.-A. Tsakanika. K. Balta

Statistics and Experimental Design (5273)

[Course ID Sheet]

The course contains 3 units: a) Basic Probability Principles, b) Applied Statistics and c) Experimental Design. The aim of the first unit is to familiarize students with the basic concepts of probability theory, in order to gain the theoretical competence that will then enable them, to evaluate in practice experimental data. The purpose of the second unit - including practical application of techniques and tools in the PC-Lab - is to familiarize students with the basic statistical techniques required for data analysis, in order to be able to perform quantitative and qualitative research, to analyze and process experimental data or field research results, and evaluate the results of statistical tests (conclusions). Finally, the third unit analyzes the concepts of factorial design with two or more factors and two or more price levels, as well as optimal experimental design.

Lecturers: A. Tsakanikas (Coordinator), Ch. Koukouvinos
Laboratory: A. Tsakanikas, N. Kalogeropoulos (Laboratory Teaching Staff), N. Mandellos (Laboratory Teaching Staff), A. Protogerou (Laboratory Teaching Staff), I. Kastelli (Laboratory Teaching Staff)

Exercises: A. Protogerou (Laboratory Teaching Staff), I. Kastelli (Laboratory Teaching Staff)

COMPULSORY FOREIGN LANGUAGE (One elective)

English Language (5030)

[Course ID Sheet]

The English language course aims to familiarize students with language use in a variety of social contexts and communicative tasks (development of linguistic awareness). Progressive vocabulary enrichment through the use of original texts on modern political, cultural, social, etc. issues. Practice, involving a range of advanced grammatical and syntactic structures, as well as understanding and production of both spoken and written language. The language level at the end of the semester is expected to be C1, as it is defined by the Common European Framework of Reference for Languages.

Lecturer: M. Stathopoulou (Coordinator)

French Language (5031)

[Course ID Sheet]

The course uses the French language through the study and analysis of scientific texts, in order the students to be able to use them at a research level. They also practice writing techniques to meet contemporary scientific needs at undergraduate and postgraduate level. The course is supported by the corresponding teaching material and the Asynchronous E-Learning Platform of NTUA.

Lecturer: Z. Exarchou (Coordinator)

4th SEMESTER

CORE-COMPULSORY COURSES

Organic Chemistry (5276)

[Course ID Sheet]

The course material is part of the field of Basic Organic Chemistry and has as its main objective the study of the structure and reactions of organic molecules. In particular, the topics covered in the lectures fall into the following areas: (i) *Organic molecules structure and reactions*: how to form bonds in carbon compounds, stereochemistry and reaction classes of organic compounds. (ii) *Alkanes*: structure, activity and characteristic reaction of alkanes (free radical substitution), cycloalkanes (structure, conformational analysis and reactions). (iii) *Alkenes*: alkene structure, mechanism of electrophilic addition reaction, elimination reactions (alcohol dehydration, dehydrohalogenation of alkyl halides, mechanisms E1, E2). (iv) *Alkynes*: structure and activity of alkynes, keto-enol tautomerism, acidity of alkynes. (v) *Conjugated dienes*: structure, activity and reactions of conjugated dienes (1,2- and 1,4- addition). (vi) *Aromatic compounds*: aromatic character, benzene structure and characteristic reaction (electrophilic aromatic substitution). (vii) *Alkyl halides*: structure and activity of alkyl halides, nucleophilic substitution reactions (SN1 & SN2 mechanisms). (viii) *Alcohols*: preparation reactions, physical and chemical properties of alcohols, mechanisms of characteristic reactions of alcohols. (ix) *Ethers and epoxides*: preparation reactions and mechanisms of characteristic ether and epoxide reactions. (x) *Aldehydes and ketones*: aldehyde and ketone preparation reactions, carbonyl addition reactions, activity of the α -hydrogen and condensation reactions. (xi) *Carboxylic acids and their derivatives*: preparation reactions and physicochemical properties of carboxylic acids and their derivatives (acid chlorides, anhydrides, esters, amides) as well as their physicochemical properties. (xii) *Carboxylic Acid Derivatives*: nucleophilic acyl substitution reactions. (xiii) *Characteristic reactions of carbonyl compounds*: mechanisms of characteristic reactions (name reactions) - e.g. Claisen condensation. (xiv) *Amines*: amines basicity, preparations and characteristic reactions of amines.

Lecturers: S. Hamilakis (Coordinator), A. Detsi
Laboratory: S. Hamilakis, A. Detsi
Laboratory Teaching Staff: D. Vasilakopoulos, Z. Katsanevaki, Th. Lymberopoulou, S. Mai, D. Malamis, K. Moustakas, E. Barabouti, A. Papadopoulos

Chemical Kinetics - Electrochemistry (5225)

[Course ID Sheet]

The aim of the course is to study the speed and mechanisms of chemical reactions (homogeneous, heterogeneous, catalytic) and the factors that influence them. Study of the properties of electrolytic solutions, electrochemical interfaces, electrolytic and galvanic cells and kinetic electrode actions. Chemical Kinetics: Scope of Chemical Kinetics. Reaction stoichiometry. Rates of consumption and formation. Extent of reaction. Rate of reaction. Rate equation (rate laws) and rate constant. Order and molecularity of a reaction. Kinetics of elementary reactions: first-order, second-order, third-order and zero-order kinetics. Determination of the order of a reaction: differential, integration, isolation and half-life time method. Kinetics of opposing (reversible), consecutive and parallel reactions. Opposing reactions and relaxation methods. The influence of temperature on rate constant, Arrhenius equation. Collision theory. Transition state theory. Rate equations (rate laws) for composite mechanisms: the rate determining step approximation, the steady state approximation. Lindemann mechanism. Catalysis. Homogeneous and heterogeneous catalysis. Diffusion. Adsorption on solid surfaces. Adsorption isotherms. Mechanisms of heterogeneous reactions: Langmuir–Hinshelwood, Langmuir–Rideal. Synthesis of catalysts.

Electrochemistry: General Description of Electrochemical Systems: Galvanic and electrolytic cells. Electroneutrality. The Faraday laws. Thermodynamics of electrochemical reactions. Properties of Electrolytic Solutions at Equilibrium: Activity and activity coefficient. Electrochemical potential. Ion-ion interactions. Debye-Huckel theory. Mass Transport in Electrochemical Electric and specific electric conductivity. Molar and equivalent conductivity. Ionic mobility. Transport numbers. Diffusion of particles. The Electrochemical Interface: Description of the electrochemical interface. Electrical properties of the electrochemical interface. Ideally polarized and non-polarized electrodes. The structure of the electrochemical interface: Helmholtz model, Gouy-Chapmann model and Stern model. Thermodynamics of Electrochemical Systems and Galvanic Cells: Thermodynamics of electrochemical systems. The electrode potential. Types of electrodes. Types of galvanic cells and applications. Electrochemical Kinetics: The rate of an electrochemical reaction as a function of the electrode potential. Charge transfer overpotential. Butler – Volmer equation. Limiting forms of Butler-Volmer equation. Multi-step electrode reactions. Diffusion overpotential. Semi-empirical study of electrochemical processes. Kinetics of Nernstian electrochemical processes.

Lecturers: A. Karantonis (Coordinator)
Laboratory: A. Karantonis, C. Charitidis, A. Bakolas
Laboratory Teaching Staff: P. Georgiou, A. Delegou, V. Dritsa, M. Karoglou, A. Konstanti, K. Lambropoulos, E. Daflou, P. Papandreopoulos, E. Rakanda
Technical Laboratory Staff: E. Kanellopoulou

Transport Phenomena I: Fluid Mechanics (5098)

[Course ID Sheet]

The aim of the course is to physically and mathematically investigate the flow phenomena leading to theoretical prediction and experimental verification, with the primary objective of documented, safe and immediate technical application. The course covers the following units: Basic concepts and definitions. Properties of fluids. Kinematics. Newtonian and non-Newtonian fluids. Macroscopic flow analysis. Differential equations of flow. Boundary layer theory. Introduction to Viscous flow. The course is accompanied by an optional computational laboratory, designed to familiarize students with approximate solution to flow problems that cannot be solved by analytical mathematics and graphical representation of flow.

Lecturers: G. Lyberatos (Coordinator), G. Kokkoris, A. Boudouvis
Laboratory: M. Kavousanakis, K. Papadopoulou (Laboratory Teaching Staff)

Computational Methods for Engineers (5269)

[Course ID Sheet]

The aim of the course is to introduce students to Mathematical Modeling and Computational Problem Solving. Introduction to basic numerical analysis techniques and their application in MATLAB programming. Units included: Introduction to Mathematical Modeling and computational analysis of engineering problems. Solution of algebraic equations. Curve fitting. Numerical differentiation/integration. Numerical solution of ordinary differential equations. Initial value problems. Boundary value problems. PC-Lab training and implementation of computational methods in MATLAB or Octave software.

Lecturers: A. Papathanasiou (Coordinator), M. Kavousanakis
Laboratory: A. Spiropoulos (Laboratory Teaching Staff)

COMPULSORY COURSES (One elective)
HUMAN AND SOCIAL SCIENCES SECTOR

Sociology of Science and Technology (5210)

[Course ID Sheet]

The course examines a range of technological practices that affect our daily lives. In particular, students are exploring the ways that technology shapes and is shaped by social and political interests. The ways in which technologies are developed and used, allow us to make decisions and act responsibly in matters of social, political and ethical relevance to scientific and technological progress. The course emphasizes on the inter-construction of technology and society, and in particular gender – technology relations.

Lecturer: M. Maniou (Coordinator)

History and Philosophy of Science and Technology (5275)

[Course ID Sheet]

The course addresses the emergence and evolution of science that has changed and continues to radically change the world. It focuses on the major developments in the field of scientific thought, from the revolutionary ideas of the 17th and 18th centuries - Scientific Revolution and Revolution in Chemistry, to the issues raised today by evolutionary theory, genetics, nuclear physics and modern cosmology. At the same time, a wide range of scientific fields and contemporary themes, such as the relation of science and technology, the popularization of science, the impact of war on science, and the position of women in the history of science, are examined.

Lecturers: K. Theologou (Coordinator), K. Stergiopoulos

Applied Didactics of Natural Science and Technology (5274)

[Course ID Sheet]

The aim of the course is to provide students with knowledge and skills, in order to enable them to design and implement teaching/learning pathways using modern teaching tools in the field of Science and Technology, taking into account modern teaching approaches.

Lecturer: E. Pavlatou (Coordinator)
Laboratory: N. Kalogeropoulos (Laboratory Teaching Staff)

Introduction to Economics (5208)

[Course ID Sheet]

The aim of this course is to introduce the basic concepts of macro-economics and micro-economics and to familiarize engineers with the functioning of the financial system. During the course, the students are introduced to how individuals and businesses make decisions, and how and under what circumstances these decisions interact with each other. At micro-level, the

behavior of the different units of the economy (consumers and producers) in the context of the functioning of the various forms of markets is studied. In the macro-economic part of the course, the students are introduced to the economic models and circles of economics, but also to the basic macroeconomic figures, such as GDP, inflation, etc. Also analyzes the role of banks in the economy, international trade and related indicators of competitiveness, as well as the role of the state in the economy.

Lecturer: A. Tsakanikas (Coordinator)
Laboratory-Exercises: I. Kastelli (Laboratory Teaching Staff)

Elements of Law and Technical Legislation (5227)

[Course ID Sheet]

The course has a twofold aim: First, it provides basic, general knowledge of the meaning of law and its rules, the basic legal concepts and their interpretation, the way that justice is administered and the concept of judicial reasoning. Secondly, it assists engineers in practicing their profession. The course's content includes: Public Law (Constitutional Law, Administrative Law), EU Law (Nature of European Law, Institutions, Acts, Community Freedoms), Private Law, Civil Law (General Principles, Criminal Law, Law), Commercial Law (Commercial Act Law, Company Law, Securities Law and Industrial Property Law), Labor Law (Accident / Engineer Liability).

Lecturer: E. Tzannini (Coordinator)

COMPULSORY FOREIGN LANGUAGE (One elective)

English Language and Technical Terminology (5075)

[Course ID Sheet]

The course aims to introduce students to technical terminology related to the subject of Electrical and Computer Engineering through texts from a variety of sources. More specifically, the aims of the course are to:
-familiarize students with technical terminology relevant to their field of science,
-understand the linguistic characteristics of academic writing and its differentiation from technical writing,
-examine the structure and language of academic articles and articles in popular science journals or in newspaper columns,
-examine the structure and language of other species, including, for example, summaries of academic articles and bibliographic reviews.
In this way students practice the use of technical language in specific types of texts, understand the conventions and characteristics of academic discourse and also broaden their knowledge in English, mainly, in terms of text comprehension and writing skills.

Lecturer: P. Togia (Coordinator)

French Language and Technical Terminology (5076)

[Course ID Sheet]

The course aims to familiarize students with French scientific backgrounds. The course proposes activities with experiential extensions, in order for students to meet their general scientific activity (study abroad through the Erasmus Program, for postgraduate or doctoral studies in French-speaking countries, attending conferences, seminars, conferences, seminars French language). The course is also supported by the Asynchronous E-Learning Platform of NTUA.

Lecturer: Z. Exarchou (Coordinator)

5th SEMESTER

CORE-COMPULSORY COURSES

Materials Science and Engineering (5165)

[Course ID Sheet]

The course, from the Materials Science aspect, develops the fundamental relationships between the structure, properties and technical processing of materials, as endogenous parameters that characterize materials, as well as the phenomena and mechanisms of influence of exogenous parameters (environmental factors) characteristics of materials at micro- and macro-structural level. From the Materials Engineering aspect, methods of design, treatment and behavior (structure and properties) of specific materials are developed, such as metal, polymers, ceramics, composites, advanced, liquid crystalline materials, etc. In the laboratory, students are getting familiar with methods of materials control and protection, applications, instrumental and non-destructive techniques to control the quality of materials/installations/ works and to assess their environmental impact.

Lecturers: L. Zoumpoulakis, A. Bakolas (Coordinator)
Laboratory: L. Zoumpoulakis, A. Bakolas
Laboratory Teaching Staff: A. Delegou, V. Dritsa, M. Karoglou, A. Konstanti, K. Lambropoulos, P. Papandreopoulos, S. Soulis, G. Grigoriadis
Laboratory Exercises: K. Beltsios

Physical Processes Engineering I (5064)

[Course ID Sheet]

The aim of the course is to introduce students to the Analysis and Design of basic chemical engineering processes. Units included: Introduction, Basic Principles of Process Analysis and Planning. Analysis and design of experiments. Fluid Flow (Flow in pipes, flow in fixed and fluidized particle beds, fluid mixing, pumps, air compressors). Particle Technique (sieving, filtration, centrifugation, settling, cyclones, filters, crystallization, fracture, aggregation). Thermal Processes (heat exchange, evaporation, cooling and freezing, heat pumps). Thermal processes with simultaneous mass transfer (wetting, dehumidifying, drying).

Lecturer: Z. Maroulis (Coordinator)
Laboratory: M. Krokida, Z. Maroulis
Laboratory Teaching Staff: N. Panagiotou, Ch. Boukouvalas, G. Pappa, V. Louli, Th. Xenidou
Technical Laboratory Staff: P. Michaelides

Principles of Cell Biology and Biochemistry (5232)

[Course ID Sheet]

The aim of the course is to provide students with a brief, concise but accurate and in-depth presentation of the basic concepts of cell biology, including a taste of the latest relevant scientific findings to stimulate the curiosity and interest of the students. The book provides the basics for understanding at molecular level, how a cell works, how it uses and produces energy, how it maintains its structure, how it recognizes and processes messages, how it grows, etc. This basic

knowledge is the foundation for the development and understanding of modern Biotechnology. Units included: Cell Structures. Nucleic Acids, Proteins, Polysaccharides, Lipids. Energy, Catalysis and Biosynthesis. DNA and Chromosomes. DNA Copy, Repair and Recombination. Structure of Membranes. Lipid Bilayer. Membrane proteins. Membrane transport. Cells obtain energy from food.

Lecturers: E. Topakas (Coordinator), A. Detsi, D. Mamma

Transport Phenomena II – Heat and Mass Transfer (5099)

[Course ID Sheet]

The aim of this course is to introduce to the students, the laws concerning the heat and mass transfer processes, as well as the methods for calculating fundamental transport quantities. It offers the basic knowledge on which Physical and Chemical Process Design courses will be based in the following semesters. Unit included: Heat transfer mechanisms. Thermodynamics. Macroscopic balances. Transfer by Action. Thermal Conductivity (solids, liquids, gases). Fourier Law. Heat equation. Thermal Resistance. Integrated form of Heat Equation. Composite Walls (planes - cylindrical - spherical). Heat transfer from expanding surfaces. Efficiency - Effectiveness. Mass transfer. Mixtures, definitions. Fick diffusion law. Diffusion – Advection. Diffusion Equation. Diffusion with Homogeneous, Heterogeneous Reaction, etc.

Lecturers: A. Papathanassiou (Coordinator), M. Kavousanakis
Laboratory Exercises: A. Spiropoulos (Laboratory Teaching Staff)

Electromechanical Processes Equipment (5279)

[Course ID Sheet]

The course aims to familiarize students with the mechanical and electrical equipment (pipelines, pumps, compressors, circuits, sensors, transformers, electric machines) used in the chemical industry, as well as the selection process, installation and operation of this equipment. Units included: Transporting of liquids. Compressor flow and gas handling. Electrical systems.

Lecturers: G. Lyberatos (Coordinator), A. Papathanasiou, N. Chronis
Exercises: K. Papadopoulou (Laboratory Teaching Staff),
I. Tzigounakis (Technical Laboratory Staff

COMPULSORY COURSES (One selective)
ENGINEERING SECTOR

Selected Topics of Bio-Organic Chemistry and Chemistry of Natural Products (5278)

[Course ID Sheet]

The aim of the course is to acquaint students (a) with some of the most important categories of organic biomolecules (amino acids, peptides, steroids) and (b) with the main principles of natural product chemistry (categories of natural products, isolation methods, study and characterization of structure and applications in pharmaceutics, cosmetics, food, dyes, antioxidants, etc.) These selected topics are the state of the art of modern research and applications of Organic and Bioorganic Chemistry and Natural Product Chemistry. They are adapted to the directions and studies of the Chemical Engineer and can lay the foundations for the student's involvement with relevant cutting-edge research areas at postgraduate or doctoral level.

Lecturers: S. Hamilakis (Coordinator), A. Detsi
Laboratory: S. Hamilakis, A. Detsi
Laboratory Teaching Staff: D. Vasilakopoulos, Z. Katsanevaki, A. Papadopoulos

Materials Decay and Protection (5281)

[Course ID Sheet]

The aim of the course is to educate students so that they can study:
• The tendency of a material (metal or porous material) to decay, in a certain environment (susceptibility), or a system to resist decay (durability)
• The attenuation of its mechanical properties / resistance and the effects of wear on it
• The most common forms of decay
• The speed of the decay
• The dependence of decay from environmental conditions
• Modifying the properties of the material and the parameters of the environment
• The study of the material-environment system to reduce the speed and tendency of decay
• The protection of materials at the industrial plants and structures scale
Course content includes topics on corrosion and protection of metallic materials and systems and the physico-chemistry of decay, maintenance of porous materials.

Lecturers: A. Bakolas (Coordinator), A. Karantonis
Laboratory: A. Karantonis, A. Bakolas
Laboratory Teaching Staff: V. Dritsa, A. Delegou, M. Karoglou, K. Lambropoulos, E. Daflou, E. Rakanta, P. Papandreopoulos

Advanced Ceramics (5280)

[Course ID Sheet]

The main aim of the course is the presentation of modern methods of developing advanced ceramic materials with specific properties. A focus will be made on new innovative technologies for the production and application of ceramic materials and glasses. The relationship between structure and properties of ceramics and electroceramics will be explained, emphasizing on solid mass transfer and conductivity in ceramic materials. In addition, a focus will be made on the thermal properties of the materials and how they affect the final product. Industrial applications of advanced ceramic materials with emphasis on energy applications will be developed. The role

of production quality, the life cycle of materials, as well as the sustainability in the field of advanced ceramic materials and their energy applications will be explained.

Lecturer: Ch. Argirusis (Coordinator)

Quality Management (5277)

[Course ID Sheet]

The course aims to familiarize students with the mathematical tools and methodology for Improving the Quality of Products, Processes and Services. The course deals with Quality Assurance and Control of products (or processes or services) with Statistics tools. The classic definition of quality is the satisfaction of the customer/consumer needs of the producer/supplier when the needs are defined by the customer himself, who may be an individual (B2C) or a collective, e.g. public, other business (B2B), regulatory authority. Quality is distinguished by: (1) Quality Improvement for Existing Products and (2) Quality-in-Designing New Products. Quality Improvement is the subject of the course described here. The methodology for Quality Improvement is taught, including the following steps: (1) Problem Identification, (2) Measurement, (3) Analysis, (4) Optimization and (5) Control. The engineer translates the needs into measurable quantities that characterize the quality of the product and selects CQAs according to specifications (LSL, USL). It recognizes the factors affecting CQA, that is, the composition and properties of raw materials and operating conditions, and selects Critical Material Characteristics (CMAs) and Critical Process Parameters (CPPs), respectively. Designs experiments with controlled raw materials and operating conditions, arranges for CQA measurements for different CMA and CPP values, and develops approximate relationships between CQA, CMA and CPP. It recognizes the values of quality agents, CMA and CPP, which optimize quality, CQA, and sets control limits for agents that ensure quality in accordance with specifications. The methodology for Quality Improvement, using tools from Statistics and Experimental Design (DOE) and Statistical Process Control (SPC) techniques, is taught through lectures and exercises using the MINITAB software in the small computer lab.

Lecturer: An. Vlysidis (Coordinator)
Laboratory-Exercises: L. Karaoglanoglou, D. Koullas (Laboratory Teaching Staff)

6th SEMESTER

CORE-COMPULSORY COURSES

Physical Processes Engineering II (5012)

[Course ID Sheet]

The course aims to introduce Process Planning, Basic Physical Process Analysis, the development of the theoretical background on which Process Setup, Industrial Facility Security, Design Planning and Designing Courses will be based in the following semesters. Fractional distillation. Absorption - desorption. Extraction. Membrane separations. These processes will also be studied using simulators in representative applications/problems.

Lecturer: M. Krokida (Coordinator)
Laboratory: M. Krokida, Z. Maroulis
Laboratory Teaching Staff: Ch. Boukouvalas, N. Panagiotou, G. Pappa, V. Louli, Th. Xenidou
Technical Laboratory Staff: P. Michaelides

Chemical Processes Engineering I (5057)

[Course ID Sheet]

The aim of the course is to analyze the processes that will lead to the calculation of chemical reactors by understanding the chemical kinetics and transport phenomena occurring in reactive systems. Units included: Homogeneous Chemical Process Techniques (Thermodynamic Chemical Reactions, Continuous Work Reactors, etc.). Technique of Heterogeneous Chemical Processes: Gas-Solid Reactions, Fluid-Fluid Reactions, Three-Phase Reactions, Absorption Reactors.

Lecturers: K. Filippopoulos (Coordinator), G. Stefanidis
Exercises: K. Hatzilimberis
Laboratory: K. Filippopoulos, G. Stefanidis
Laboratory Teaching Staff: N. Panagiotou, I. Sempos, K. Hatzilimberis

Environmental Science and Technology (5239)

[Course ID Sheet]

The course aims to scientifically examine the quality and pollution of the environment, as well as the global extent of environmental disturbances from predominantly anthropogenic causes, to approach and address environmental problems, and to become familiar with the available technological options for waste/resource management, developing the optimal solution and promoting integrated development. Units Included: Introduction to Environmental Science. Atmospheric and Air Pollution. Water Environment and Water Pollution. Liquid waste and environmental pollution. Soil and soil degradation. Solid waste and environmental pollution.

Lecturers: K. Kollia (Coordinator), E. Pavlatou
Exercises: K. Moustakas, D. Malamis (Laboratory Teaching Staff)

Polymer Engineering (5147)

[Course ID Sheet]

The aim of the course is to introduce students to the Science and Technology of Polymers and to understand the basic concepts that control the production and processing of these materials. Initially, the polymerization processes that enable the synthesis and production of polymers are analyzed. Then, follows the presentation of critical physicochemical properties of polymers in solid state, in melt and in solution, with the aim to construct and optimize structure-properties relationships. Finally, an overview of the basic polymers processing/molding techniques is provided leading to the production of shaped plastic articles. Units included: Polymerization processes. Polymer Structure and Thermal Transitions. Mechanical properties. Polymer solutions and melts. Basic polymer processing techniques.

Lecturer: S. Vouyiouka (Coordinator)

Food Science and Technology (5303)

[Course ID Sheet]

The course provides the fundamentals of Food Science and Technology. It covers food as a composite material (composition, structure and properties), food chemistry and microbiology, quality and safety. It, also, covers the basic preservation processes, in particular cooling, freezing and thermal processing. Additionally, food packaging materials and functionality in food products are studied. Units included: Introduction. Food Chemistry. Introduction to food microbiology. Principles of kinetics in chemical and biological actions in food. Quality assurance. Food Preservation Process Design (Cooling, Freezing, Thermal Processes). Food packaging.

Lecturer: P. Taoukis (Coordinator)

Economic Analysis and Business Administration (for Engineers) (5283)

[Course ID Sheet]

The aim of this course is to understand the role, functions, management and decision-making processes, as well as the determining factors of a company's performance. The course will first describe the basic concepts of the overall functioning of the financial environment, and then analyze the role and form of modern business. In the next unit, it focuses on the intra-business and explores its core functions, such as product development, sales, technology and innovation management, human resources management, financial management, etc. Finally, in the third unit of the course, methods of costing and pricing, as well as basic investment valuation tools and techniques are analyzed to form an integrated view of how decisions are made and a business strategy is formulated.

Lecturer: A. Tsakanikas (Coordinator)
Laboratory: I. Kastelli (Laboratory Teaching Staff), A. Protogerou (Laboratory Teaching Staff)

CORE-COMPULSORY COURSES (One elective)

ENGINEERING SECTOR

Environment and Development (Interschool Course) (5231)

[Course ID Sheet]

The aim of the course is:

• To show students the complex nature of modern developmental, technological environmental problems, and to familiarize them with the need for multidisciplinary and integrated approach, research and treatment.

• Bring students in touch with the real dilemmas they will face after their graduation, many of which are not solely located in the technological field.

• Provide the theoretical background for analyzing these problems.

• To provide a learning environment where the student will not only attend presentations, but will also try to get a well-documented position.

Units included: theoretical background and tools related to sustainable development and critical thinking, environmental and development policies, management and technological tools. The role of an Engineer in the confrontation between environment and development. Areas of interest that are analyzed: global climate change, lignite gas and alternative energy - technological and environmental approaches, environment as an economic activity - a second life for former industrial sites, waste management - waste recycling, the role of justice and environmental development, sustainable mobility.

Lecturer: K. Kollia (Coordinator)

Products Design (5265)

[Course ID Sheet]

The course aims to familiarize the Chemical Engineer with the background knowledge and methodology for answering the key questions: "what product should be manufactured" and "how will it be manufactured", in order to present the best economic and technical characteristics and meet the current environmental requirements and specifications. The fundamental components of the Products Design course are: technological suitability, environmental respect, economic feasibility, and social acceptance and benefits. The course content provides information and knowledge on:

- Needs: Identifying consumer or customer needs and converting them into measurable product features with relevant specifications.
- Ideas: Gathering ideas that may be able to deliver the desired result to meet the needs of the consumer or customer. Evaluate concentrated ideas and select a small number of the best ones.
- Option: Detailed calculations for the best ideas (calculations refer to technical and financial figures). Choice of the idea to be realized.
- Production: Designing the industrial production of the new product (mainly processes).).

Lecturer: P. Tarantili (Coordinator)
Laboratory/Exercises: D. Koullas, L. Karaoglanoglou, K. Papadopoulou (Laboratory Teaching Staff)

Computational Analysis of Transport Phenomena (5246)

[Course ID Sheet]

The course aims at the theoretical analysis and application of basic numerical methods of approximate solution (in a PC), of differential equations of transport phenomena, having ultimate aim to investigate and highlight the physical content of predictive mathematical models of problems. Course content includes: Boundary Value Problem Solving, Galerkin Weighted Balances, Base Functions on Finite Elements, Calculation of Discretionary Equations, Non-linear Equations, Coding of Finite Element Method, Applying Methods of Computational Fluid Dynamics in complex Transport Phenomena problems.

Lecturers: A. Papathanasiou (Coordinator), M. Kavousanakis

Inorganic Chemical Technology (5282)

[Course ID Sheet]

The course includes:

- General view of the inorganic chemical industry (products, financial data, geographical distribution of production).
- Reference to basic inorganic chemicals and products (raw materials, fuels, manufacturing process, mass and energy balances and economic data).
- Inorganic chemical industry and pollution (sustainability, by-products, energy saving, waste disposal).

Upon successful completion of the course students should be able to:

- List the main inorganic chemicals and products based on their production / application range.
- Write down the main chemical reactions of the production process.
- Describe the production process.
- Identify the impact of individual production processes on product properties.
- Design the flowchart of the production process.
- Identify sources of pollution during the production process and how to deal with them
- Solve mass-energy balance exercises.

Lecturers: S. Tsivilis (Coordinator), G. Kakali

Nuclear Chemistry and Technology (5226)

[Course ID Sheet]

The aim of the course is to acquire basic knowledge about (a) the properties of atomic nuclei, the nuclear modifications and the chemical phenomena associated with them, (b) the technological applications of radionuclides, (c) the basic processes and techniques that are used in the nuclear industry/technology - from isotope separation methods to nuclear power reactors, and (d) nuclear fuel cycles to nuclear reactors, or radionuclides to the environment. The area of Nuclear Chemistry includes the study of the chemistry of natural and artificial radioactive elements, as well as the heavier elements (Z> 83, actinides, etc.), for which the decomposition of radioactive elements is an essential part of their properties. Nuclear Chemical Technology is primarily concerned with the study of chemical engineering processes and the treatment of chemical problems in the nuclear industry, which are dominated by chemical engineering processes that make the presence of a Chemical Engineer indispensable and crucial.

Lecturer: M. Bouroushian (Coordinator)

Modern Tools in Chemical Analysis (5284)

[Course ID Sheet]

The course aims to the acquisition of analytical chemical thinking for solving problems that demand real-time chemical analysis in industrial production, environment application, occupational exposure, safety and life sciences. The course focuses on real time chemical analysis and it includes: introduction to real-time chemical analysis and key terms, simple chemical sensors and sophisticated chemical analyzers in real-time chemical analysis, real-time monitoring of physical and chemical processes in industry, field chemical analysis and wireless communications, calibration and maintenance of chemical analysers, specifications and purchasing of chemical analysers, software of analyzers, basics in chemometrics for advanced data processing. The course also includes lectures by invited experts in industrial real-time chemical analysis, field chemical analysis, communications and analytical instrumentation. The course provides job training in the related subjects and enhances team working.

Lecturers: F. Tsopelas (Coordinator)
Exercises/Laboratory: F. Tsopelas, K. Mikedi (Laboratory Teaching Staff), L.-A. Tsakanika (Laboratory Teaching Staff)

7th SEMESTER

CORE-COMPULSORY COURCES

Chemical Processes Engineering II (5240)

[Course ID Sheet]

The aim of this course is to analyze and synthesize the physical and chemical phenomena that will lead to the simulation and design of heterogeneous catalytic chemical reactors. Units included: Heterogeneous catalysis and kinetics. Heterogeneous catalytic reactors. Non-ideal flow in reactive systems.

Lecturers: G. Stefanidis (Coordinator)
Laboratory: K. Filippopoulos, G. Stefanidis,
K. Hatzilimberis, I. Sebos, N. Panagiotou (Laboratory Teaching Staff)
Exercises: K. Hatzilimberis, (Laboratory Teaching Staff)

Biochemical Engineering (5285)

[Course ID Sheet]

The course aims to teach bio-process analysis, design, control and optimization. The course uses the basic tools of chemical engineering in the design and operation of cell and enzyme bioreactors.

Lecturers: G. Lyberatos (Coordinator), D. Mamma
Laboratory-Exercises: G. Lyberatos, D. Mamma, K. Papadopoulou (Laboratory Teaching Staff)

Process Control (5084)

[Course ID Sheet]

The aim of the course is the introduction to the analysis and automatic adjustment of dynamic systems and to present methodologies of design and simulation of automatic adjustment systems with emphasis on PID controllers.

Lecturer: Ch. Sarimveis (Coordinator)
Laboratory: F. Doganis, A. Nikolakopoulos (Laboratory Teaching Staff)

Energy Technologies (5156)

[Course ID Sheet]

The course aims to convert primary energy into end use energy from conventional and renewable energy resources, using natural and chemical processes. Units included: Primary Energy – End use Energy. Conventional energy resources. Renewable energy resources. Energy conversion. Alternative forms of energy - Energy storage.

Lecturer: D. Karonis (Coordinator)
Laboratory-Exercises: F. Zannikos, D. Karonis,
G. Anastopoulos (Laboratory Teaching Staff), Y. Zannikou (Technical Laboratory Staff), M.
Komiotou (Laboratory Teaching Staff), P. Schinas (Laboratory Teaching Staff)

Process Design I (5177)

[Course ID Sheet]

The aims of the course are: - Acquisition of design knowledge for the development and completion of a chemical industrial unit. - Development of skills in the selection of equipment and its operational parameters. -Development of process and equipment integration skills. - Evaluation of fixed-cost hedges. -Using simulation software to standardize flow charts (in steady state) based on production and design specifications. - Development of equipment design skills. Familiarization with commercial software. -Investment sustainability study. The course includes the conduction of an integrated design topic.

Lecturers: A. Kokosis (Coordinator), Ch. Kiranoudis
Laboratory: A. Nikolakopoulos, K. Hatzilyberis, L. Karaoglanoglou, Ch. Vavva (Laboratory Teaching Staff)
Exercises: A. Nikolakopoulos (Laboratory Teaching Staff), P. Michaelides (Technical Laboratory Staff)

8th SEMESTER

CORE-COMPULSORY COURSES

Environmental Engineering (5253)

[Course ID Sheet]

The aim of this course is to familiarize students with environmental issues and to protect the environment from anthropogenic activities. Analysis of relevant processes and design of gaseous, liquid and solid waste treatment plants. Units included: Liquid wastes. Solid wastes. Gaseous wastes.

Lecturers: G. Lyberatos (Coordinator), An. Vlysidis
Exercises: S. Mai, E. Barabouti, K. Papadopoulou, D. Malamis (Laboratory Teaching Staff)

Process Design II (5290)

[Course ID Sheet]

The aims of the course are: - Acquisition of design knowledge in specialized areas of integrated design of a chemical plant. -Development of skills in the selection of different types of chemical reactors and separators. -Development of skills in redesigning and expanding an existing unit. - Familiarization with holistic evaluation techniques of the unit. - Skills development. - Examination of environmental parameters and Life Cycle Analysis of the proposed design solution. -Using simulation software to achieve all of the abovementioned goals for specific design specifications each time. The course provides a process design project.

Lecturers: A. Kokosis (Coordinator), Ch. Kiranoudis
Exercises: A. Nikolakopoulos, L. Karaoglanoglou (Laboratory Teaching Staff), Ch. Vavva (Laboratory Teaching Staff), P. Michaelidis (Technical Laboratory Staff)

Internship (Practical Training) (5000)

[Course ID Sheet]

SPECIALIZATION COURSES

DIRECTION: PROCESS DESIGN

SPECIALIZATION: PROCESS ENGINEERING

Advanced Thermodynamics (5182)

[Course ID Sheet]

The aim of the course is to familiarize students with advanced knowledge regarding Thermodynamic Chemical Engineering and its applications. This course also aims to familiarize students with complex forms of phase equilibrium, which are addressed in applications of chemical engineering, as well as advanced thermodynamic tools. Finally, examples are given of where thermodynamics is used in order to solve basic problems in other sciences.

Lecturers: K. Magoulas, E. Voutsas (Coordinator)
Laboratory: G. Pappa (Laboratory Teaching Staff)

SPECIALIZATION: ECONOMICS AND BUSINESS ADMINISTRATION

Competition Analysis and Market Research (5286)

[Course ID Sheet]

Research and analysis of market and competition are an integral part of the necessary administrative and financial knowledge of a modern Engineer. After all, the design and development of successful and user-friendly products (goods and services), functional units, and viable business ventures, require a good knowledge of the needs and requirements of users, features, structure and trends of the respective market. Finally, professional employment of engineers in areas and activities, such as Marketing, Technical Sales, Supplies, Technology and Innovation Management, Plant Design and Project Management require knowledge and techniques related to market research and analysis.

Lecturer: A. Tsakanikas (Coordinator)
Laboratory: I. Kastelli (Laboratory Teaching Staff), A. Protogerou (Laboratory Teaching Staff)

DIRECTION: ENVIRONMENT – ENERGY

SPECIALIZATION: ENVIRONMENT

Industrial Waste Management (5288)

[Course ID Sheet]

Categories - General characteristics of solid wastes - Classification codes. Hazardous wastes: Characterization (toxicity, corrosivity, flammability, etc.). Risk storage and transportation. Physico-chemical, biological and thermal methods for the treatment and disposal of hazardous wastes. Risk assessment. Environmental impacts. Special types of Solid Wastes: End-of-Life Vehicles (OTKZs), Used Tires, Excavation, Construction and Demolition Wastes (AEKK), Wastes of Electrical and Electronic Equipment (WEEE), agricultural wastes, hospital wastes.

Lecturers: M. Bouroushian (Coordinator), An. Vlysidis
Laboratory: M. Bouroushian, An. Vlysidis
Laboratory Teaching Staff: D. Malamis, K. Moustakas, S. Mai, E. Barabouti, L. Karaoglanoglou, D. Koullas, K. Papadopoulou

Green Chemistry and Engineering (5304)

[Course ID Sheet]

Green Chemistry and Green Engineering Development Framework: Objectives, Principles, Tools. Indicators for measuring the efficiency of reactions and processes (metrics). Reaction and process efficiency. Calculation of atomic yield and chemical reaction mass. Process optimization, modifications and product re-design. Alternative Raw Materials, Solvents and Catalysts in the Chemical Industry. The contribution of Green Chemistry to sustainable agriculture. Performance evaluation based on chemical structure, chemical reaction and chemical transformation. Examples and exercises of green raw materials, reactions, reagents, solvents, reaction conditions and chemicals. Large-scale case studies of green processes. The role of ionic liquids (ILs, ionic liquids) and deep eutectic solvents (DES, Deep Eutectic Solvents). Chemical reactions of increased energy efficiency. High Energy Techniques (microwave, ultrasound). New Trends in Green Chemistry and Engineering - Biomimetic and Multifunctional Systems.
Laboratory of Green Chemistry and Engineering: Synthesis and characterization of ionic liquids (IUs) and deep eutectic solvents (DES). Organic compositions with green processes. Synthesis of natural compounds and bio-degradable materials by green techniques. Synthesis of polymers from natural materials. Use of renewable raw materials in processes. Acquisition of natural waste materials through green techniques. Characterization of green secondary products.

Lecturer: A. Detsi (Coordinator)
Laboratory: A. Detsi, D. Vasilakopoulos (Laboratory Teaching Staff), L. Karaoglanoglou (Laboratory Teaching Staff), Z. Katsanevaki, D. Koullas, A. Papadopoulos
Exercises: A. Papadopoulos (Laboratory Teaching Staff)

SPECIALIZATION: ENERGY

Liquid Fuels (5157)

[Course ID Sheet]

Transport Fuels. Petrol: octane number, volatility, composition. Component mixing, nonlinear properties calculations. Diesel: anti-static, cetane number, cold properties, lubricating capacity. Nonlinear mixing properties. Bio-fuels. Bio-ethanol: Characterization, properties. Properties of bioethanol - gasoline mixtures. Biodiesel: Characterization, properties. Microbial contamination, oxidative stability. Hydrotreated vegetable oil (HVO) fuels. Production processes, properties / Aviation Fuels. Aviation gasoline: properties, anti-volatility, volatility. Aerosol kerosene: Volatility, Conductivity, Freezing Point / Residual Fuels - Shipping Fuels: Viscosity, blend calculations, component compatibility. Ignition quality, combustion properties, heteroatoms content. Low sulfur fuels. Lubricants: Lubricant properties. Classification, of lubricants. Viscosity, viscosity index. Additives. Lubricant regeneration. Greases: production properties, thickeners. By-products, etc. Exercises: Density, Distillation and Cetane Index of Petroleum Fractions, Determination of Cetane in Diesel, Determination of Petrol Vapor, Determination of Citrate Additives, Oil Additives Testing of Petroleum Products Tracers, Viscosity and Viscosity Lubrication Indicator, Penetration Point and Grease Point Determination.

Lecturers: F. Zannikos (Coordinator), D. Karonis
Laboratory: F. Zannikos, D. Karonis

Laboratory Teaching Staff: G. Anastopoulos, M. Komiotou, D. Koullas, P. Schinas
Technical Teaching Staff: Y. Zannikou

DIRECTION: FOOD-BIOTECHNOLOGY

SPECIALIZATION: FOOD SCIENCE AND TECHNOLOGY

Chemistry, Microbiology and Food Preservation Principles (5292)

[Course ID Sheet]

The course provides Chemical Engineers knowledge in advanced Food Chemistry, Food Microbiology and Food Preservation topics. It covers the study of food composition and ingredients and their physicochemical, nutritional and bio-functional properties, chemical and microbiological actions in food, food quality and safety, and the effects and behavior of food systems under the conditions of production and preservation processes, packaging and shelf life. Overall objective is the knowledge of food as a complex and active biological system. This knowledge is prerequisite for the optimal design of food products, processes and preservation throughout the food chain from production to the final use in a farm to fork approach. Topics discussed include food product innovation, sustainability, energy and environmental impact optimization, circular economy.

Lecturer: P. Taoukis (Coordinator)
Laboratory: P. Taoukis, M. Giannakourou, E. Nikolaivits
Laboratory Teaching Staff: V. Giannou, E. Dermesonlouoglou, D. Tsimogiannis

SPECIALIZATION: BIOTECHNOLOGY

Industrial Biotechnology (5287)

[Course ID Sheet]

The aim of the course is to study the sustainable production of biotechnological products, using enzymatic and microbial catalysis, as well as downstream processing to isolate them. Industrial or White Biotechnology is a subset of Biotechnology along with Blue, Green and Red Biotechnology. It is the application of Biotechnology for industrial purposes, including processes such as industrial fermentation. It involves the use of cells such as microorganisms, or cell components such as enzymes to create industry-useful products in areas, such as chemistry, food and nutrition, detergents, paper, clothing and textiles and finally biofuels. To this end, Industrial Biotechnology uses renewable raw materials, such as the fraction of vegetable biomass, in order to reduce greenhouse gas emissions thus reducing our dependence on petrochemicals.

Lecturers: E. Topakas (Coordinator), D. Mamma
Laboratory: E. Topakas, D. Mamma, E. Nikolaivits
Laboratory Teaching Staff: Th. Lymberopoulou

DIRECTION: MATERIALS

SPECIALIZATION: OPERATIONAL AND MULTIPLE SCALE MATERIALS

Structure – Property Relationships in Materials (5291)

[Course ID Sheet]

The aim of the course is to study and interpret the macroscopic properties (mechanical, thermal, electrical, magnetic, optical, transport) of the solid phase (mainly crystalline solids) with reference to the microscopic and fundamental structure.

Lecturers: Th. Theodorou (Coordinator), C. Charitidis
Laboratory: Th. Theodorou, A. Karantonis, C. Charitidis
Laboratory Teaching Staff: P. Georgiou, S. Soulis

SPECIALIZATION: POLYMERS AND COMPOSITE MATERIALS

Polymer Science (5289)

[Course ID Sheet]

The aim of the course is to understand and quantify the thermal, rheological, mechanical and interfacial properties of polymers, their solutions and mixtures based on the chemical composition and architecture of macromolecular chains.

Lecturers: Th. Theodorou (Coordinator), K. Beltsios
Laboratory: Th. Theodorou, L. Zoumboulakis
Laboratory Teaching Staff: P. Georgiou, S. Soulis

9th SEMESTER

CORE-COMPULSORY COURSES

Safety of Industrial Installations (5149)

[Course ID Sheet]

The aim of the course is to describe, map and simulate the key phenomena, occurring during the various phases of accidents at industrial plants that produce, store and/or handle toxic and/or flammable substances. Major Hazard Industrial Accidents (MHIA). National and Community institutional framework, emergency planning, risk assessment methodologies of Major Industrial Accidents, multiplier effects, safety studies..

Lecturer: M. Krokida (Coordinator)
Laboratory: Ch. Boukouvalas, N. Panagiotou, S. Karma (Laboratory Teaching Staff)

DIRECTION: PROCESS DESIGN

SPECIALIZATION: PROCESS ENGINEERING

Advanced Fluid Mechanics (5299)

[Course ID Sheet]

The course is of postgraduate level, and its main goal is to introduce and elaborate on methods of analysis, from first principles, of fluid flow and their application in a wide range of spatial scales, from cellular to atmospheric.
The basic aim of the course is to bring together the mathematical formulation and the physical understanding of the flow. The course builds on basic undergraduate courses, such as Transport Phenomena I: Fluid Mechanics, Transport Phenomena II: Heat and Mass Transport; also, on courses that cover fluid flow phenomena and processes, such as Electro-Mechanical Process Equipment, Unit Operations, Chemical Reaction Engineering.
Theoretical teaching is combined with computational exercises. The course covers the following topics: Elements of vector and tensor calculus and continuum mechanics. Differential analysis of flow. Analysis of flow-transport problems analysis with the methods of separation of variables, similarity transformations, perturbation theory and order-of-magnitude theory. Boundary layer flow - differential and Integral analysis. Elements of interfacial fluid mechanics. Analysis of simultaneous transport phenomena analysis – with convection, diffusion and chemical reaction.

Lecturers: A. Boudouvis (Coordinator), M. Kavousanakis
Exercises: A. Spyropoulos (Laboratory Teaching Staff)

Industrial Reactor Engineering (5296)

[Course ID Sheet]

Contents: 1. Dynamics of Chemical Processes Systems, 1.1 First-order Chemical Processes Systems. Responses to Standard Enforcement. 1.2 Second order Chemical Processes Systems. 1.3 Delayed transfer to ideal embolic and laminar flow reactors, 1.4 Intense exothermic reactions

reactor dynamics. - Safety of chemical reactors. 2. Industrial Reactor Design Applications, 2.1 Simulation of Reactors with Theoretical Standards, 2.2 Operation of Multiple Reactions Reactors, 2.4. Semi-batch Reactors, etc.

Lecturer: K. Filippopoulos (Coordinator)
Exercises: K. Hantzilimberis (Laboratory Teaching Staff)

SPECIALIZATION: ECONOMICS AND BUSINESS ADMINISTRATOR

Technology, Innovation and Entrepreneurship (5305)

[Course ID Sheet]

The course aims to provide training in innovation and entrepreneurship, and in particular business venture planning based on the utilization of knowledge and technology and the initial support of all those who intend to attempt to implement them in the real world of business. In addition, students are encouraged in teamwork for completing a business plan, to practice, to evaluate technical, financial and operational data, to support and make decisions, and to organize their implementation.

Lecturer: A. Tsakanikas (Coordinator)
Laboratory: A. Tsakanikas, I. Kastelli (Laboratory Teaching Staff), A. Protogerou (Laboratory Teaching Staff)

DIRECTION: ENVIRONMENT – ENERGY

SPECIALIZATION: ENVIRONMENT

Environmental Assessment and Optimization of Industrial Processes (5297)

[Course ID Sheet]

The scope of this course is to familiarize the students with the basic concepts of Life Cycle Analysis (LCA) and the methodological framework provided for the evaluation and analysis of industrial processes in relation to their environmental impacts, sustainability concerns as well as more general societal effects. Example solving with holistic and integrated approaches to redesign and goal setting with demonstration of optimization applications in water use and wastewater management. LCA methodology according to ISO 14040/14044. Description of limitations and assumptions during the implementation of a LCA study. Analysis of the different allocation methodologies. Description of Life Cycle Inventory in a LCA study and how to use specialized libraries with environmental data. Assessment of environmental impacts of industrial processes and analysis of the results through examples and exercises. Hot spot analysis. Designing of "clean" industries based on the "pinch-point" of water use. Methodology for designing industrial processes with the aim of minimizing waste production through reuse and recycling.

Lecturers: A. Kokosis (Coordinator), An. Vlysidis
Laboratory: D. Koullas, L. Karaoglanoglou (Laboratory Teaching Staff)

Water Management (5294)

[Course ID Sheet]

The aim of the course is to cover a wide range of issues related to water resources and water quality. These include environmental importance, management, chemistry, quality, uses of natural water resources and seawater utilization. Contents: 1. Distribution, uses and quality of water. Current situation regarding water at international and national level. National and European legislation. Water Resources (conventional - non-conventional). Climate change and impacts on water resources. 2. Aquatic Chemistry: Natural aquatic systems-water composition - aqueous phase chemicals. Main pH variables, p. Acid-base effects (pC-pH diagrams). 3. Drinking (urban) water (Quality-management) Gray water (Quality-management) Irrigation water (Quality-management). 4. Reuse of treated waste, 5. Desalination of brackish and sea water (thermal, membranes, electrodialysis), 6. Water & Energy. Water footprint and Virtual water concept. Blue Growth.

Lecturers: E. Pavlatou (Coordinator), K. Kollia
Laboratory: E. Pavlatou, K. Kollia
Laboratory Teaching Staff: D. Malamis, K. Moustakas, S. Mai, E. Barabouti

SPECIALIZATION: ENERGY

Gaseous and Solid Fuels (5293)

[Course ID Sheet]

The aim of the course is to learn the basic properties and characteristics of gaseous and solid fuels, conversion and upgrading of solid fuels and biomass. Contents: NATURAL GAS: Natural gas production, natural gas processing, transportation, storage and distribution, liquefied natural gas. LPG: Production, properties and uses of LPG, etc. BIOGAS: Biogas production and collection, biogas properties and uses. SOLID FUELS: Composition, classification of solid fuels, production, combustion of solid fuels. BIOMASS: Biomass characteristics, biomass power generation. SOLID FUELS UPGRADE. Pyrolysis, gasification of solid fuels and biomass, synthesis gas production, Fischer-Tropsch synthesis.

Lecturers: F. Zannikos (Coordinator), D. Karonis
Laboratory: F. Zannikos, D. Karonis
Laboratory Teaching Staff: G. Anastopoulos, M. Komiotou, P. Schinas
Technical Teaching Staff: Y. Zannikou

Advanced Technologies for Energy Production and Storage (5298)

[Course ID Sheet]

In this course, three types of energy production and storage technologies will be analyzed. The first type is the batteries, whose principle of operation is based on the spontaneous conversion of the chemical energy of the reactants inside the battery into electricity. The second type is the fuel cells, where spontaneous conversion of chemical energy into electricity again occurs, but the chemical reactants are continuously provided into the electrochemical device. The third type concerns the production, storage and management of hydrogen, which is a zero-emission fuel and could be used in both electrochemical power plants and internal combustion engines.

Lecturers: Ch. Argirusis (Coordinator), A. Karantonis
Exercises: Ch. Argirusis

DIRECTION: FOOD-BIOTECHNOLOGY

SPECIALIZATION: FOOD SCIENCE AND TECHOLOGY

Food Engineering (5311)

[Course ID Sheet]

The course aims to provide knowledge and problem-solving skills in the core processes of the food industry, such as pasteurization, cooling, freezing, drying, etc., but also by innovative non-thermal processes (high pressure, pulsed electric fields). The basic parameters of food packaging will also be analyzed. Contents: Introduction to Food Processing. Liquid and powdered solid food transport systems - related properties. Heat transfer: heating and cooling in food processing, thermal properties, use of f & j coefficients. Food processing procedures. Maintenance heat treatment processes: scalding, pasteurization, sterilization. Non-thermal maintenance treatment processes: high pressure, pulsed electric fields. Cooling, Freezing. Drying: types of dryers, spray drying, freeze drying. Rheology - viscoelasticity. Texture – Macro-, Micro- and Nano-Structure. Balance processes, separations. Rinse. Extract for recovering ingredients with food-compatible solvents. Membrane Separations: Filtration, Ultrafiltration, Applications in the Food Industry. Packaging, packaging materials: gas permeability, impact on food life.

Lecturer: M. Giannakourou (Coordinator)
Laboratory: P. Taoukis, M. Giannakourou
Laboratory Teaching Staff: V. Giannou, E. Dermesonlouoglou, D. Tsimogiannis

SPECIALIZATION: BIOTECHNOLOGY

Bioengineering (5307)

[Course ID Sheet]

The aim of the course is to provide students an insight to basic principles, methods and applications in Biotechnology and Biomedical Engineering and the most recent relevant scientific achievements in this field, and to highlight the need of Chemical Engineers to occupy at a multidisciplinary field, at the crossroads of Biology, Medicine and Engineering. A brief presentation of key knowledge that will be the foundation for the development and understanding of Biotechnology/Biomedicine as well as modern experimental methods/tools in the hands of Biotechnologists and Biomedical Engineers will be conducted.

Lecturers: E. Topakas (Coordinator), N. Chronis
Laboratory: E. Topakas, N. Chronis, D. Mamma
Laboratory Teaching Staff: G. Anastopoulos

Pharmaceutical Chemistry and Technology (5300)

[Course ID Sheet]

The course aims to introduce students to the field of chemistry and drug technology, the process of designing new drugs, the development of new formulations (drug delivery) and drug quality control. The course is tailored to the scientific fields of a Chemical Engineer, for whom the pharmaceutical industry is an important field of activity. At the same time, it provides essential knowledge for students interested in specializing in pharmaceutical chemistry and technology at

a master's level. Introduction to Pharmaceutical Chemistry and Technology. Pharmacodynamic and pharmacokinetic data. Classification of drugs into major categories according to their pharmacological action (anti-inflammatory, analgesic, narcotic, cardiological, etc.). Chemistry of selected drug classes. Introduction to drug design. In silico methodologies. Biomimetic chromatography. Quantitative Structure-Action Relationships (QSAR). Development of formulations. Introduction to drug quality control. Laboratory: Synthesis of a pharmaceutical active ingredient, preparation of a formulation. Use of biomimetic liquid chromatography in the rational design of new drugs.

Lecturers: A. Detsi (Coordinator), F. Tsopelas
Laboratory: A. Detsi, F. Tsopelas
Laboratory Teaching Staff: L.-A Tsakanika, Th. Lymperopoulou, Z. Katsanevaki

DIRECTION: MATERIALS

SPECIALIZATION: OPERATIONAL AND MULTIPLE SCALE MATERIALS

Metallic Materials Science and Engineering (5174)

[Course ID Sheet]

The aim of the course is to introduce students to the fundamental principles, structure, properties of metals and their alloys, as well as to the treatments/processes applied to obtain the desired properties according to their final application. The main aims of the course are the student to: - Understand the connection of the structure and properties of these materials, as well as relate them to the process / treatment applied and their applications as finished products, - To know the latest techniques and methods of characterization of these materials, - To develop skills in selecting a suitable metallic material and refining it according to material applications.

Lecturers: C. Charitidis (Coordinator), K. Kollia
Laboratory: C. Charitidis, K. Kollia, E. Pavlatou
Laboratory Teaching Staff: P. Gyftou, P. Papandreopoulos, E. Rakanta

Construction and Ceramic Materials (5295)

[Course ID Sheet]

The aim of the course is the specialization in concepts and methods of Science and Engineering of construction materials and ceramics, which enable the characterization, control, design, selection, protection and management, applied to the scale of real systems and conditions of their operating environment, with sustainability. Content: Categories of construction materials. classification and use criteria, based on the structure / property / technical relationship by material category, quality control, selection and design of materials, methodology, techniques and methods for characterization and control of materials.

Lecturer: A. Bakolas (Coordinator)
Laboratory: A. Bakolas
Laboratory Teaching Staff: A. Delegou, V. Dritsa, A. Konstanti, K. Lampropoulos, M. Karoglou, E. Daflou, E. Rakanta

SPECIALIZATION: POLYMERS AND COMPOSITE MATERIALS

Composite Materials (5257)

[Course ID Sheet]

Within the framework of this course will be presented the basic concepts and definitions of composite materials, production techniques and their fields of application. Contents: 1. Overview of composite materials 2. Enforcement material, 3. Matrix material, 4. The role of interface, 5. Metallic and ceramic matrix composites, 6. Polymeric matrix composites, 7. Non-conventional composites.

Lecturers: Ch. Argirusis (Coordinator), L. Zoumpoulakis
Laboratory: L. Zoumpoulakis
Laboratory Teaching Staff: P. Georgiou, S. Soulis
Technical Laboratory Staff: E. Kanellopoulou

Polymer Production Engineering (5154)

[Course ID Sheet]

The aim of the course is to extend the knowledge of the student on the polymerization processes, including bio-based and/or biodegradable polymers along with recycling/upcycling approaches. At the end of the course, the student should be able to: i) define the appropriate polymerization mechanism and technique for a given monomer, ii) understand the relationships between polymerization parameters and polymer properties, iii) calculate the molecular weight of a polymer based on the most common relevant characterization techniques, iv) describe quantitatively basic polymerization processes, v) describe alternative polymerization techniques for the production of environmentally friendly polymers, vi) define plastic management solutions in respect to circular economy and suggest recycling/upcycling technologies for different types of plastic waste.

Lecturer: S. Vouyiouka (Coordinator)
Laboratory: S. Vouyiouka, P. Tarantili
Laboratory Teaching Staff: M. Komiotou, D. Korres, D. Koullas, S. Mai, E. Barabouti
Technical Teaching Staff: Y. Zannikou

10th SEMESTER

SPECIALIZATION COURSES

DIRECTION: PROCESS DESIGN

SPECIALIZATION: PROCESS ENGINEERING

Advanced Process Control (5309)

[Course ID Sheet]

The course aims to familiarize students with a range of modern methodologies applied in the simulation, analysis and adjustment of multi-variable processes and systems with emphasis on the use of computers.

Lecturer: Ch. Sarimveis (Coordinator)
Laboratory: F. Doganis (Laboratory Teaching Staff), A. Nikolakopoulos (Laboratory Teaching Staff)

SPECIALIZATION: ECONOMICS AND BUSINESS ADMINISTRATION

Project Management (5308)

[Course ID Sheet]

The course aims to provide knowledge and develop the appropriate skills to successfully manage projects and programs. Projects and programs include the design and implementation of a set of complex activities that consume resources within an agreed timeframe, an estimated and acceptable budget, and the necessary technical specifications and requirements. In addition, project planning, organization and management are nowadays a key occupation of a modern Engineer. Organizations and businesses increasingly work on projects in conjunction with the development of networks (which extend their boundaries). Projects and networks coexist with their conventional organizational structures/functions and the range of products and services they produce and offer.

Lecturer: A. Tsakanikas (Coordinator)
Laboratory: A. Protogerou (Laboratory Teaching Staff)

DIRECTION: ENVIRONMENT – ENERGY

SPECIALISATION: ENVIRONMENT

Dispersion of Pollutants (5301)

[Course ID Sheet]

Analysis of the environment as a receiver of pollution. Mechanisms and Processes in Nature. Dispersion of pollutants in the atmosphere. Calculations of air pollutants dispersion from various sources. Air dispersion computational models. Applications of atmosphere dispersion modeling software. Pollutants dispersion in water and soil. Water Pollution Transfer: Fully Mixed Systems. Systems not fully mixed. Conventional pollutants, dissolved oxygen, pathogens, toxic compounds. Transport of pollutants in water: Rivers. Streeter-Phelps models. Water Pollution Transfer:

Lakes. Eutrophication. Soil pollutants transportation: Groundwater. Pollution and transport of dissolved pollutants. Unsaturated zone.

Lecturers: M. Kavousanakis (Coordinator), G. Kokkoris
Laboratory: M. Kavousanakis, K. Papadopoulou (Laboratory Teaching Staff)

SPECIALIZATION: ENERGY

Sustainable Management of Energy Systems (5170)

[Course ID Sheet]

The aim of the course is to familiarize students with the basic principles and general methods of energy saving. The objectives of the course are: (a) development of basic energy and energy analysis tools for physical and chemical processes, their application to power generation and the steam system (generation, distribution, use, saving, cogeneration), (b) study of basic systems of co-production (c) industrial freezing and air conditioning; (d) the use of renewable energy resources in industry. Course content includes: Energy Needs in Industry-Principles of Energy Optimization/Energy and Thermodynamics/Basic and Complex Power Generation Cycles/Energy/Energy Analysis of Heat Transfer Systems/Steam Generation Systems/Cogeneration/Cooling.

Lecturer: E. Voutsas (Coordinator)
Laboratory: V. Louli (Laboratory Teaching Staff)

DIRECTION: FOOD-BIOTECHNOLOGY

SPECIALIZATION: FOOD SCIENCE AND TECHOLOGY

Design of the Food Industries - Quality and Safety Assurance of Foods (5310)

[Course ID Sheet]

This course provides the knowledge necessary for the design and operation of the food industries, as well as for the control and assurance of food quality and safety and is a cutting-edge field for a Chemical Engineer. The course aims to gain knowledge on issues regarding food factory design, the structure / operation of the food industry, quality parameters and risks related to food safety, as well as ensuring their quality and safety through systems (ISO 9001, HACCP). The familiarity with the above topics is complemented by properly designed laboratory exercises, themes and computational exercises. Course content includes: Food Industry, Food Quality, Hazard Analysis - HACCP, Food Industry Design.

Lecturer: M. Giannakourou (Coordinator)
Laboratory: P. Taoukis, M. Giannakourou
Laboratory Teaching Staff: V. Giannou, E. Dermesonlouoglou, D. Tsimogiannis

SPECIALIZATION: BIOTECHNOLOGY

Environmental Biotechnology (5175)

[Course ID Sheet]

The course aims to familiarize students with the bio-processes that aim both at environmental protection of ecosystems from pollution and the exploitation of liquid gases and solid wastes in the production of high value-added products, as well as the design and optimization of these biological systems. The course content is about the description of ecosystems, organic stabilization of organic substrates, organic waste stabilization bioreactors, natural wastewater treatment ecosystems, biological nitrogen removal and microbial production of high value-added products.

Lecturers: D. Mamma (Coordinator), An. Vlysidis
Laboratory: G. Lyberatos, An. Vlysidis, D. Mamma, E. Topakas
Laboratory Teaching Staff: D. Koullas, K. Papadopoulou, L. Karaoglanoglou, E. Nikolaivits

DIRECTION: MATERIALS

SPECIALIZATION: OPERATIONAL AND MULTIPLE SCALE MATERIALS

Nanomaterials and Nanotechnology (5302)

[Course ID Sheet]

The aim of the course is to introduce students to the basic concepts and phenomena that govern the nano-scale. Emphasis is placed on the categorization of materials, based on their properties and on their characterization by advanced techniques. The course is highly lab-based and focuses on nanomaterial synthesis methods, taking into account current applications and social implications.

Lectures: C. Charitidis (Coordinator), K. Kordatos
Laboratory: K. Kordatos, E. Pavlatou, C. Charitidis
Laboratory Teaching Staff: P. Georgiou, P. Gyftou, A. Karamperi
Technical Laboratory Staff: E. Kanellopoulou

SPECIALIZATION: POLYMERS AND COMPOSITE MATERIALS

Polymers Processing (5306)

[Course ID Sheet]

The aim of the course is to expand and deepen students' knowledge regarding the procedures of polymers processing (modification and formulation), which aim to produce final products with pre-designed, desirable properties.

Lecturer: P. Tarantili (Coordinator)
Laboratory: S. Vouyiouka, P. Tarantili
Laboratory Teaching Staff: M. Komiotou, D. Korres, S. Mai, E. Barabouti, P. Schinas

8. POSTGRADUATE STUDIES – DOCTORAL STUDIES

8.1 Postgraduate Studies

The Departmental or Inter-Departmental Postgraduate Courses, are leading to the respective "Post Graduate Specialization Diploma", with a minimum duration of 17 months. After the acquisition of the "Post Graduate Specialization Diploma", the student can proceed towards submitting a Doctorate Thesis.

The Postgraduate Courses offered by the School of Chemical Engineering are:

-Materials Science and Engineering, Director: C. Charitidis, Professor

-Computational Mechanics, Director: Ch. Sarimveis, Professor

-Protection of Monuments, Sites and Complexes - Direction B, Director: A. Moropoulou, Professor

Programs offered by other Departments and in which the School of Chemical Engineering participates:

- Automation Systems, School of Mechanical Engineering NTUA
- Athens Postgraduate Program in Business Administration, School of Mechanical Engineering NTUA
- Energy Production and Management, School of Electrical and Computer Engineering NTUA
- Protection of Monuments, Sites and Complexes, School of Architecture Engineering NTUA
- Environment and Development, School of Rural and Surveying Engineering NTUA
- Mathematical Modeling in Modern Technologies and Economics, School of Applied Mathematics and Physics NTUA
- Chemistry Education and New Educational Technologies, Department of Chemistry, University of Athens
- Microsystems and Nanodevices, School of Applied Mathematics and Physics NTUA

8.2. Doctoral Studies

The doctoral dissertation in the School of Chemical Engineering NTUA is done in accordance with the Doctoral Studies Regulation of the School (Issue B '2811 / 16.07.2018, No. 26460). Doctoral Studies (DScs) aim at preparing and empowering young researchers who have the ability to promote scientific knowledge by autonomously producing research results in the science and technology of Chemical Engineering as well as in interfaces with other scientific areas.

Doctoral Studies lead to the award of a Ph.D. and Doctor of Engineering degree, for those who are PhDs or otherwise a PhD in NTUA. The Doctoral Program is organized within the School, united for all Departments. Doctoral studies are offered free of charge. Candidate PhDs have up to five (5) full academic years from their first enrollment all the

rights and benefits for PhD candidates as provided by their respective regulations, scholarships or other.

Applications for a doctoral thesis are submitted to the Secretariat of the School. Candidates are selected up to twice per academic year. The maximum number of doctoral candidates per selection period for each School is decided by the General Assembly.

The positions of the new doctoral candidates, with a description of the broader subject area of each post, are publicized by the School and are announced. The selection of new doctoral candidates ends with the final approval by the General Assembly, which takes place in April and October.

Right to apply for doctoral dissertation have the Graduate Diploma holders (BScs) who have the same or related subject to the doctoral dissertation and the NTUA and postgraduate diplomas (5 year diplomas) with the right to apply for doctoral thesis level (Master). In exceptional cases (such as, for example, if the candidate has a high quality publication or patent), he or she may be accepted as a doctoral candidate and not a BMI or Master.

Graduates of ATEIs, ASPETEs or equivalent schools may be accepted as PhD candidates only if they hold BSc degrees. Graduates from ATEI, ASPETE or equivalent schools, if elected, are required by the relevant decision of the General Assembly of their respective School to successfully attend the specified undergraduate or postgraduate courses in order to be awarded a doctorate degree.

Applications are evaluated by the relevant three-member Selection Committee in which the doctoral dissertation will be prepared. The General Assembly of the School, taking into account the Memorandum of the Selection Committee, approves or rejects the candidate's application. The General Assembly additionally appoints the Supervising Professor (SP) as well as the Three-member Advisory Committee of the PhD candidate, of which the Supervisor is a member. The three-member advisory committee, in collaboration with the doctoral candidate, determines the topic of the doctoral dissertation and its provisional title in Greek and English, which is validated by the School's General Assembly and communicated to the Department. Once every academic year and in the month of September, each doctoral candidate presents orally and submits, in writing, through the Protocol of the School Secretariat, a detailed memo to the Advisory Committee on the progress of the doctoral dissertation. The memorandum, along with any additional comments from the supervisor or advisory committee, is in the position of a progress report. Progress reports are submitted by the Supervisor at the School Secretariat in October of each year, are recorded in the candidate's individual file and are indicated on the list of active doctoral candidates.

The time for obtaining a Doctorate (PhD) may not be less than three (3) full calendar years from the date of appointment of the Three-member Advisory Committee. The prerequisite for obtaining a Doctorate is the attendance and successful examination in three (3) to six (6) semesters of the Graduate Program of the School of Chemical Engineering. This includes undergraduate and postgraduate courses at the School of Chemical Engineering or other NTUA Schools or other ATEIs, which are approved by the School's General Assembly. For those graduates of NTUA or other equivalent Chemical Engineering Schools of Greece or abroad (Master's level) the number of these compulsory courses is three (3). For the Diploma Engineers of other NTUA Schools or Graduate Departments of other HEIs and holders of Postgraduate Degrees related to the

subject of their Doctoral thesis, the number of compulsory courses is five (5).

The thesis is evaluated by a seven-member selection committee, which is appointed by a decision of the General Assembly, following the recommendation of the three-member advisory committee. A prerequisite for the final thesis evaluation is that the candidate doctorate has presented evidence of his/her work with at least two (2) publications in reputable international peer-reviewed journals.

Detailed information on the process of preparation of the PhD is given in the NTUA Doctoral Regulation.