Study Guide 2024-2025

MSc "ANALYSIS AND DESIGN OF STRUCTURES"

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

CONTENTS

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

Established in 1836 as the "School of Arts", the National Technical University of Athens (NTUA) has evolved in tandem with the formation of the Modern Greek State. Undergoing significant transformations in 1887 and 1917, NTUA aligned itself with the educational standards of the Continental European engineering system. This adaptation included a strong theoretical foundation for studies and a standard five-year program. The diploma conferred by NTUA is considered equivalent to a "Master of Science" (M.Sc.) or "Master of Engineering" (M.Eng) degree in the Anglo-Saxon education system.

In accordance with the constitutional framework defined by Law 1268/82, NTUA, both physically and legally, is dedicated to providing high-quality higher education and advancing sciences and technology. Through a unified approach to studies and research, NTUA, symbolized by Prometheus-Bearer of Fire, places human values at the forefront, emphasizing the quality of life and the protection of democratic rights and achievements.

In pursuit of its strategic goal to maintain and enhance its distinguished position as an academic institution internationally, NTUA fulfills its mission by fostering the personal and social virtues of educators, researchers, and students:

a. Developing skills for independent access to knowledge, synthesis, research, communication, collaboration and personnel and project management.

b. Cultivating well-rounded personalities that not only possess up-to-date scientific and technological knowledge but also know how to stand as scientists and exist as conscientious, responsible citizens.

c. Providing an undivided and effective contribution to addressing the scientific, technological, social, cultural and needs of development in general, prioritizing both national and international priorities.

SCHOOL OF CIVIL ENGINEERING

SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering (C.E.) at the National Technical University of Athens (NTUA) stands as the oldest engineering school in Greece, holding the foundational position for all other Schools within the university. Throughout its extensive history, the School of Civil Engineering has played a paramount role in the scientific, technological and economic advancement of the nation. Whether during turbulent or tranquil periods in Greek history from the 19th century to the present day, the graduates of the C.E. have consistently served as a stable reference point and a cornerstone for the construction and reconstruction of the country and its infrastructure.

The impact of the School's graduates extends beyond the national borders, with many leaving their mark on the global scientific and technological landscape. Both the faculty and students actively contribute to the global production of new knowledge. Due to the consistently high quality of work at both undergraduate and postgraduate levels, the C.E. School has consistently ranked among the top institutions internationally. For instance, it is ranked among the top 50 globally and holds the 14th position among European Civil Engineering Schools according to QS Organization. Additionally, it is globally positioned at 7th according to the ShanghaiRanking.

In accordance with QS Organization (2019), the School of Civil Engineering at NTUA is recognized among the top 50 globally, securing the 14th position in Europe. The ranking criteria encompass academic reputation (40% weight), employer reputation and the employability of graduates (30%), along with the recognition of the School's research work (30%). Notably, the C.E. School is the sole representative from Greece to consistently maintain a position in the top 50 for five consecutive years.

The C.E. School includes four sections, each functioning as a unit for the production and dissemination of science and technology.

The Structural Engineering Department conducts scientific research in theoretical and experimental statics, dynamics, structural stability analysis, formation and computation of metallic constructions, constructions of reinforced and prestressed concrete, seismic technology and relevant computer applications. Additionally, the section engages in programming and project management of technical projects from conception to delivery, operation and maintenance. The section encompasses five laboratories: the Reinforced Concrete Laboratory, the Steel Structures' Laboratory, the Earthquake Engineering Laboratory, the Structural Analysis and Antiseismic Research Laboratory and the Construction Equipment and Project Management Laboratory.

The Water Resources and Environmental Engineering Department focuses on the comprehensive study, both quantitatively and qualitatively, of the aquatic environment and its correlation with Civil Engineering projects. It encompasses educational and research activities in Hydraulic Engineering, Hydrology, Water Resources, Hydraulic Structures, Environmental and Health Technology, Coastal Hydraulics and Port Engineering, as well as Energy and Hydropower Projects. The Department comprises four Laboratories: the Applied Hydraulics Laboratory, the Harbour Works Laboratory, the Sanitary Engineering Laboratory and the Hydrology and Water Resources Laboratory.

The Department of Transportation Planning and Engineering covers, from an educational and research perspective, the transportation of people and goods through all available means of transport. It spans

from the research and general design stages to feasibility studies, application studies, construction, and operation. The Department also involves the design of pavement materials and the construction and maintenance of road and airport pavements. It consists of three Laboratories: the Traffic Engineering Laboratory, the Pavement Engineering Laboratory, and the Railway and Transport Laboratory.

The Department of Geotechnical Engineering covers a broad spectrum, including the study of soil behavior under static and dynamic loading conditions, the behavior of rocks and geological formations, seismic behavior of underground structures, coastal retaining walls and bridge foundations. It also includes the computation, design and construction of foundations for engineering projects, as well as the protection and restoration of the geo-environment. The Department oversees two Laboratories: the Soil Mechanics Laboratory and the Foundations Engineering Laboratory.

The School of Civil Engineering operates a Computer Laboratory equipped with facilities for both undergraduate and postgraduate students.

The C.E. School employs 45 professors and lecturers, along with an equal number of laboratory, technical and administrative staff members. The Departments, Laboratories and Postgraduate Programmes of the C.E. School are active in education and research, involving diploma and postgraduate theses, doctoral dissertations and national, European and international research projects. These efforts are supported by research personnel. The School's educational and research needs are met within approximately 40,000 square meters of space, including unique heavy Laboratories.

COLLABORATING SCHOOLS

COLLABORATING SCHOOLS

The Postgraduate Course of Studies "Analysis and Design of Structures" operates under the auspices of the School of Civil Engineering at the National Technical University of Athens (NTUA), in collaboration with the Schools of Applied Mathematics and Physical Sciences, Electrical and Computer Engineering, and Mining and Metallurgical Engineering at NTUA.

School of Applied Mathematics and Physical Sciences

The School of Applied Mathematics and Physical Sciences is the most populous faculty at NTUA, comprising four Departments: (a) the Mathematics Department, (b) the Physics Department, (c) the Mechanics Department and (d) the Humanities, Social Sciences and Law Department. This Postgraduate Programme involves the Mechanics and Mathematics Departments.

The Mechanics Department at the School of Applied Mathematics and Physical Sciences and the Strengthening of Materials Laboratory have been actively engaged in both research and teaching in the field of Applied and Theoretical Mechanics. Specifically, the Mechanics Department has a longstanding collaboration with the School of Civil Engineering, contributing to the engineering undergraduate and laboratory courses as well. In terms of research, the Mechanics Department has made significant contributions to areas such as Materials Engineering, including steel, geotechnical and composite/polymeric materials, fracture mechanics theories and experimental work using destructive and non-destructive methods.

The Mathematics Department plays a crucial role, as mathematics has always been a fundamental tool in technology and a cornerstone discipline, as evidenced by its mention in the founding decree of NTUA in 1836 and subsequent relevant decrees. The Mathematics Department covers teaching and research in various areas of mathematics, including Functional Analysis, Differential Equations and more.

School of Electrical and Computer Engineering

Through a legislative decree in 1917, the existing Higher School of Mechanical Engineers underwent a transformation, becoming the Higher School of Mechanical and Electrical Engineers. The relentless scientific and technological advancements necessitated their subsequent separation, which was duly carried out in 1975. With the application of law governing higher education in Greece, in 1982, the Faculty of Electrical Engineering was renamed to "Department of Electrical Engineering". Subsequently, in May 1991, the Department of Electrical Engineers was renamed to "School of Electrical and Computer Engineering". With this legislative act the field of Computer Engineering and Information technology, which the Department has been dealing with for years, was formally recognized. Approximately a decade ago, a comprehensive renaming initiative rebranded all Departments of NTUA as Schools.

Since 1993, a progressively implemented curriculum has been in place, offering four specializations:
1. Electronics and Systems
2. Information Technology
3. Communications

4. Energy

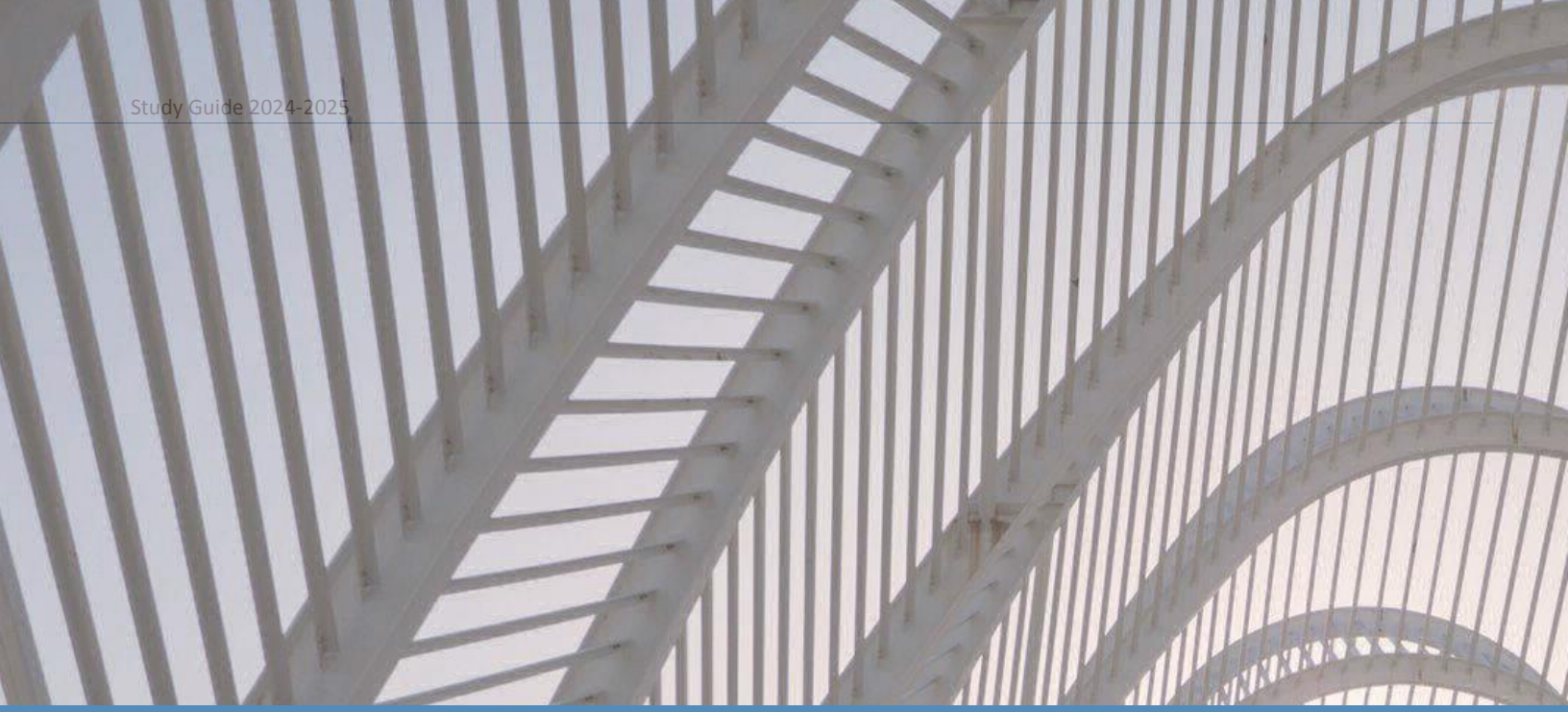
The existing Laboratories have been completely modernized, while new laboratories were also established. All the Laboratories are connected via a network that allows their full utilization.

School of Mining and Metallurgical Engineering

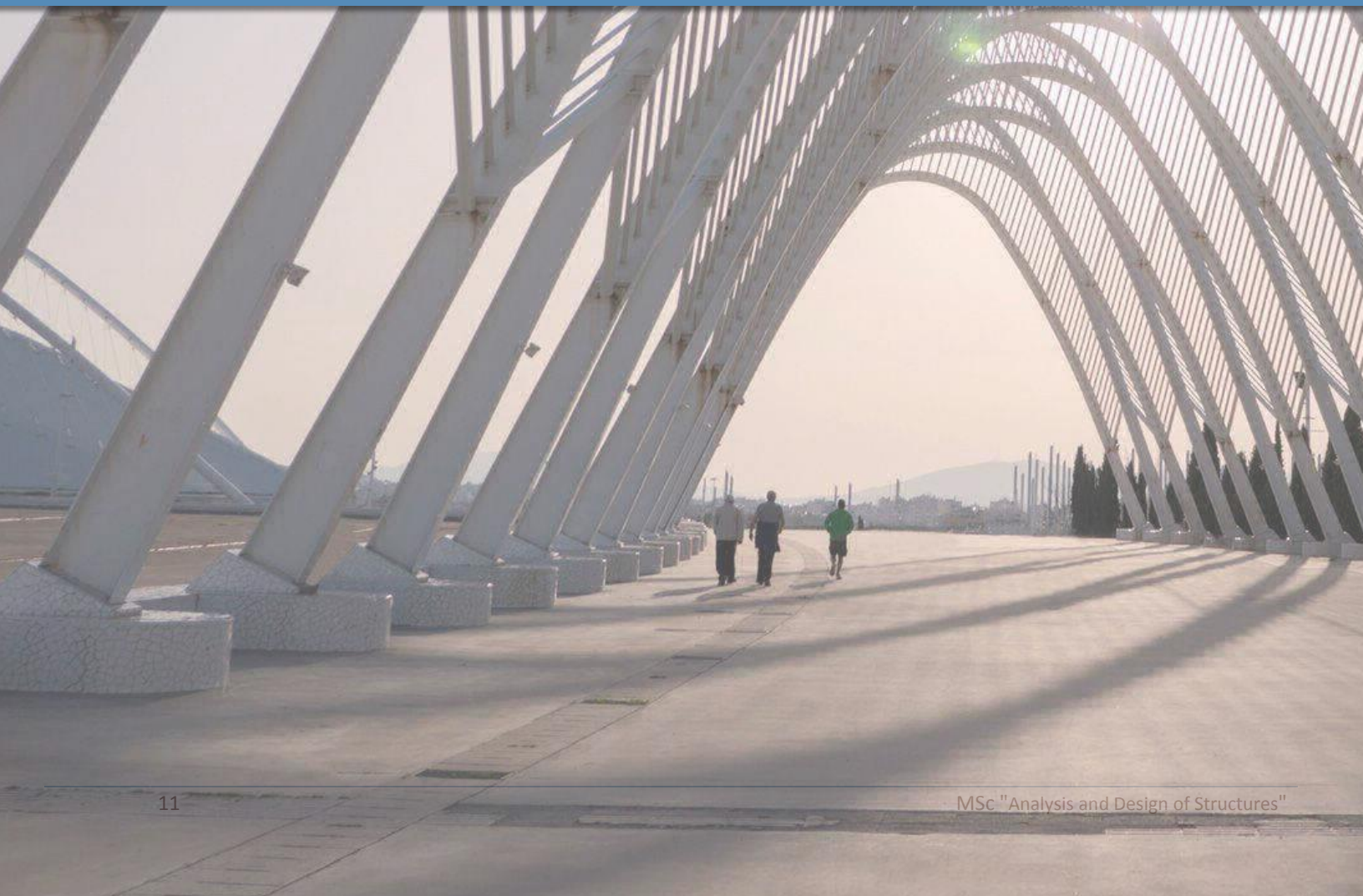
The School of Mining and Metallurgical Engineering at the National Technical University of Athens (NTUA) has been operating since the academic year 1945-46, initially established as the School of Mining and Metallurgical Engineers within the Higher School of Chemical Engineers at NTUA During the academic year 1975-76, the Department was separated from the School of Chemical Engineering and formed an independent school under the name “School of Mining and Metallurgical Engineering”.

This academic institution consists of three Departments: the Geological Sciences Department, the Mining Engineering Department and the Metallurgy & Materials Technology Department. The Postgraduate Course of Studies collaborates with the Mining Engineering and the Metallurgy & Materials Technology Department. The Department of Mining focuses on delivering courses related to mineral resource exploration, exploitation and geological project construction. It encompasses four Laboratories: Laboratory of Laboratory of Excavation Engineering, Laboratory of Mining Engineering and Environmental Mining, Laboratory of Hydrocarbons’ Exploitation & Applied Geophysics and Laboratory of Tunneling Engineering.

On the other hand, the Metallurgical and Materials Technology Department focuses in courses related to processing of ores and industrial minerals, metallurgical and materials production, metals and non-metal materials processing and the environmental protection from all these activities. It also conducts research pertaining to these topics. This Department features the following Laboratories: a) Laboratory of Mineral Processing, b) Laboratory of Metallurgy, c) Laboratory of Physical Metallurgy, d) Laboratory of Environmental Protection Science and Engineering in Metallurgy & Materials Technology, e) Laboratory of Computer-Aided Materials Processing – Rheology and Design for Polymers and Composites.



MSc "ANALYSIS AND DESIGN OF STRUCTURES"



MSc "ANALYSIS AND DESIGN OF STRUCTURES"

INTRODUCTION

The Postgraduate Programme ***"Analysis and Design of Structures"*** covers a wide range of topics related to the analysis and design of structures with an emphasis on Civil Engineering projects.

The MSc ADS provides advanced training and specialization in many subjects that include theoretical engineering and its implementations, the anti-seismic design of structures, special topics of reinforced concrete structures, the design of metal and composite structures as well as geotechnical projects implementations. The Postgraduate Programme also provides a wide range of knowledge in modern computational methods of analysis and design.

The Programme awards a high-level and internationally recognized postgraduate diploma that advances the scientific knowledge and responds to current and future technological needs. The MSc ADS provides scientists with broad knowledge in the design and analysis of structures aiming to staff the construction industry with personnel having specialized skills.

Finally, the ***MSc "Analysis and Design of Structures"*** provides the necessary scientific background for those who choose to continue to a Doctoral level.

The Programme offers classes in two scientific fields, in Direction ***A: "Structural Engineering"*** and in Direction ***B: "Analysis and Design of Earthquake Resistant Structures"***.

The ***MSc Programme "Analysis and Design of Structures"*** has been included in the internationalization project of NTUA's postgraduate studies [the project "Support of internationalization actions of the postgraduate studies of the National Technical University of Athens" is co-financed by Greece and the European Union (European Social Fund) through the Operational Programme "Human Resources Development, Education and Lifelong Learning"], with the aim to promote both the studies opportunities for international students and the research and educational activities of NTUA. In this context, the Programme is **offered fully in the English language**.

GENERAL INFORMATION

Goals of the MSc ADS

a) To specialize civil engineers in the modern methods and techniques of the interdisciplinary approach, cooperation and research in the field of analysis and design of structures to cover the growing needs of Greece's public and private sector, as well as European or other countries' in the scientific areas of the Programme.

b) To in-depth train scientists to become capable of producing new knowledge in research centers and university institutions at home and abroad. The programme emphasizes on modern methods of analysis as well as on the design of structural projects based on the New Greek Regulations and Eurocodes.

Learning Outcomes

The curriculum of the MSc "Analysis and Design of Structures" is designed so that upon completion, graduates will have gained the following specialized scientific and technical skills. Specifically, graduates of the MSc ADS will be able to:

- Have an advanced understanding of the scope of Structural Engineering and the requirements and challenges (technological, scientific) posed by modern infrastructure projects in terms of their analysis and design and the constantly evolving technological field regarding construction projects.
- Apply advanced methods for analyzing and evaluating the behavior of materials and structures aiming to the safe design under static and dynamic loads.
- Apply advanced methods for the design of resilient, functional, and sustainable structural systems.
- Analyze and synthesize research topics as well as relevant scientific literature to support specific Structural Engineering objectives.
- Solve complex interdisciplinary problems, often combining methods in an innovative way.
- Have competence in technical terms both in writing and orally and use specialized data analysis tools to communicate results.
- Manage and plan their personal time to achieve specific technological and scientific goals either individually or as part of a technical team.
- Recognize scientific innovation and creativity and accomplish research goals in a scientifically sound manner.
- Gain skills compatible with the modern information society and the use of specialized software programs.

STRUCTURE

Degree Awarded

The ADS Programme leads to an MSc degree in the area of Analysis and Design of Structures, after the completion of the postgraduate course of study.
The programme offers classes in two scientific fields, in:
***Direction A**: "Structural Engineering" and in*
***Direction B**: "Analysis and Design of Earthquake Resistant Structures"*.

Duration of Studies

The minimum duration of studies for the acquisition of the Postgraduate Studies Diploma is three (3) semesters and the maximum two (2) years, including the completion of the postgraduate thesis. Extensions are generally not permitted. However, in special cases and upon a justified request from the student, the Course of Studies Committee (CSC) may grant the necessary extension for reasons of force majeure.

Postgraduate students have the option of suspending their studies, which cannot exceed a total of two academic semesters, following a reasoned request to the Course of Studies Committee. The semesters of suspension of student status are not counted towards the prescribed maximum duration of enrollment.

Postgraduate students who exceed the maximum study time from their first enrollment in the programme without having completed their educational obligations are automatically deregistered from the programme. Deregistered students are informed by the Secretariat and exit the program with a certificate of attendance for the courses they attended and successfully passed.

Part-time study is allowed in the ADS according to the existing provisions, following a decision of the Course of Studies Committee after a justified request from the student. The duration of studies in this case does not exceed twice the full-time enrollment.

European Credit Transfer and Accumulation System (ECTS)

Each semester lasts 13 weeks. ECTS credits of each course reflect or correspond to the workload required from the student for the successful completion of the course. ECTS is based on the total workload of the student and is not limited to course hours.

The ADS Programme is equivalent to 90 ECTS. 60 ECTS credits equal studies of two semesters (30+30), while the rest 30 ECTS equal to the postgraduate thesis.

Language

The MSc Programme “Analysis and Design of Structures” has been included at the internationalization project of NTUA postgraduate studies [the project “Support of internationalization actions of the postgraduate studies of the National Technical University of Athens” is co-financed by Greece and the European Union (European Social Fund) through the Operational Programme “Human Resources Development, Education and Lifelong Learning”], with the aim to promote the studies opportunities for international students, along with the research and educational activities of NTUA.

In this context, the Programme is offered fully in the English language.

Tuition Fees

According to the NTUA’s Senate decision, the ADS Programme does not charge tuition fees for EU students.

For non-EU students, tuition fees of 500€ euros per semester of study are applicable.

PROGRAMME ADMINISTRATION

The Interdepartmental Postgraduate Programme "Analysis and Design of Structures" runs under the administration of the School of Civil Engineering and with the participation of the Schools of Applied Mathematics and Physical Science, Electrical and Computer Engineering and Mining and Metallurgical Engineering of the National Technical University of Athens (NTUA).

ADS Director - 2022-2024 Term
Evangelos Sapountzakis, Professor (School of CE)

The Programme is directed by the Course of Studies Committee (CSC) consists of nine faculty members from the collaborating schools, who have been elected for a two (2) year term by each School's General Assembly. The Director of the Programme presides over the Course of Studies Committee.

Course of Studies Committee (CSC) - 2022-2024 Term
Evangelos Sapountzakis, Professor (School of CE)
Charalampos Gantes, Professor (School of CE)
Christos Zeris, Professor (School of CE)
Nikos Lagaros, Professor (School of CE)
Charalampos Mouzakis, Associate Professor (School of CE)
Achilleas Papadimitriou, Associate Professor (School of CE)
Athanasios Voulodimos, Associate Professor (School of ECE)
Pavlos Nomikos, Professor (School of MME)
Panagiotis Tsopelas, Professor (School of AMPE)

The Coordination Committee oversees and coordinates the operation of the Programme. It consists of 5 faculty members -instructors of the Programme- who are elected by the Course of Studies Committee (CSC) for a two (2) year term. The Director of the Programme presides over the Coordination Committee.

Coordination Committee - 2022-2024 Term
Evangelos Sapountzakis, Professor (School of CE)
Nikolaos Lagaros, Professor (School of CE)
Charalampos Mouzakis, Associate Professor (School of CE)
Achilleas Papadimitriou, Associate Professor (School of CE)
Athanasios Voulodimos, Associate Professor (School of ECE)

ADS Past Directors
1998-2004 Antonios Kounadis, Professor (School of CE)
2004-2015 Manolis Papadrakakis, Professor (School of CE)
2015-2019 Vlasis Koumousis, Professor (School of CE)
2019-2022 Evangelos Sapountzakis, Professor (School of CE)

INSTRUCTORS

Name	Rank	School
Antoniou Andreas	Laboratory Teaching Staff	Civil Engineering
Badogiannis Efstratios	Associate Professor	Civil Engineering
Bouckovalas George	Retired faculty member	Civil Engineering
Diamantopoulos Spyridon		Civil Engineering
Ermopoulos John	Professor Emeritus	Civil Engineering
Exadaktylos Georgios	Professor	Applied Mathematical and Physical Sciences Mechanics
Fragiadakis Michalis	Associate Professor	Civil Engineering
Fourlaris George	Professor	Mining and Metallurgical Engineering
Gantes Charalampos	Professor	Civil Engineering
Georgiannou Vasiliki	Professor	Civil Engineering
Giannakopoulos Antonios	Professor	Applied Mathematical and Physical Science
Gourgiotis Panagiotis	Associate Professor	Applied Mathematical and Physical Science
Katsikadelis Ioannis	Professor Emeritus	Civil Engineering
Kavvadas Michail	Professor Emeritus	Civil Engineering
Kotsovos Michael	Retired faculty member	Civil Engineering
Koumousis Vlassis	Professor Emeritus	Civil Engineering
Ktenidou Olga		
Lagaros Nikolaos	Professor	Civil Engineering
Marinos Vassilis	Assistant Professor	Civil Engineering
Mouzakis Charalampos	Associate Professor	Civil Engineering
Nerantzaki Maria	Associate Professor	Civil Engineering
Pantouvakis John Paris	Professor	Civil Engineering
Papadimitriou Achileas	Associate Professor	Civil Engineering
Papadopoulos Vissarion	Professor	Civil Engineering
Psycharis Ioannis	Professor Emeritus	Civil Engineering
Sapountzakis Evangelos	Professor	Civil Engineering
Saroglou Charalampos	Laboratory Teaching Staff	Civil Engineering
Sextos Anastasios	Associate Professor	Civil Engineering
Spiliopoulos Kostas	Retired faculty member	Civil Engineering
Spyrakos Constantine	Professor Emeritus	Civil Engineering
Stamou Georgios	Professor	Electrical & Computer Engineering
Stafylopatis Andreas-Georgios	Professor	Electrical & Computer Engineering
Stavridis Leonidas	Professor Emeritus	Civil Engineering

Name	Rank	School
Thanopoulos Pavlos	Assistant Professor	Civil Engineering
Toumpakari Eleni		
Trezos Konstantinos	Retired faculty member	Civil Engineering
Triantafyllou Savvas	Associate Professor	Civil Engineering
Tsiatas Georgios	Associate Professor	Applied Mathematical and Physical Science
Tzouveli Paraskevi	Laboratory Teaching Staff	Electrical & Computer Engineering
Vamvatsikos Dimitrios	Associate Professor	Civil Engineering
Vayas Ioannis	Professor Emeritus	Civil Engineering
Vintzilaiou Elisabeth	Professor Emeritus	Civil Engineering
Vougioukas Emmanouil	Assistant Professor	Civil Engineering
Voulodimos Athanasios	Assistant Professor	Electrical & Computer Engineering
Zervos Antonios	Assistant Professor	Civil Engineering

STUDENTS ADMISSION

Prospective Students

The postgraduate course of studies admits graduates of the Civil Engineering and other NTUA Schools or of Polytechnic Schools in Greece or abroad, graduates of other Departments/Faculties of science and technical Universities, University degree holders in the field of engineering from accredited Engineering Schools with duration of 4 or 5 years, internationally recognized and equivalent to NTUA. Candidates must have sufficient knowledge of the English language. Students that will be graduating in upcoming September's period are also eligible to attend.

Apart from civil engineers, engineers who graduate from all other Science Schools in Greece or abroad can be admitted to the MSc, provided that they attend additional structural and geotechnical courses offered by the undergraduate course of studies of the NTUA's Civil Engineering School.

The attendance of these courses lasts up to 2 semesters. If the candidates fail in the additional courses, they cannot enroll in the postgraduate Programme. These semesters are not accounted in the maximum duration of studies.

Entry Requirements

For the selection of postgraduate students certain criteria will be taken into consideration such as the overall diploma grade, the grades of the thesis and the grades in relevant to the Master's Programme undergraduate courses, IT knowledge, research and work experience, letters of recommendation, and the candidate's overall profile (awards, distinctions, general ranking).

The CSC specifies annually the application of these criteria, including the level of language proficiency, the definition of additional criteria or the conduct of examinations or interviews, which will be taken into consideration for the students' selection.

Admission Procedures

A call for admission in the "Analysis and Design of Structures" Programme is published on an annual basis. The call specifies the available positions, the deadlines for submitting the required files, the categories of candidates and the required supporting documents. The call is published on the websites of the MSc and NTUA.

Candidacy files are submitted to the Programme's secretariat online, according to the instructions given in the call. Senior students may also be admitted in the Programme under the condition that their studies will be completed within the academic year prior to their enrolment.

The CSC evaluates each candidacy taking also into account the legislation and sets up the list with the candidates' ranking. The candidates who rank up to the maximum number of offered positions get

admitted in the Programme. In case there are more than one candidates ranking in the last position, the Programme admits them all.

The selected candidates are announced on the MSc website and are informed by the secretariat.

The selected candidates have to enroll in the program at the beginning of the winter semester of studies, according to the instructions given by the secretariat.

STUDIES

To obtain the Postgraduate Diploma, students must attend and be successfully examined at 10 courses, five (5) in the winter and five (5) in the spring semester, as well as develop a Postgraduate Thesis.

The ADS Programme is equivalent to 90 ECTS. 60 ECTS credits equal studies of two semesters (30+30), while the rest 30 ECTS equal to the postgraduate thesis.

Programme of Studies

The MSc "Analysis and Design of Structures" spans two (2) semesters of courses, followed by one (1) semester dedicated to the development of the Postgraduate's Thesis.

To obtain the Postgraduate Diploma, students must attend and be successfully examined at 10 courses, five (5) in the winter and five (5) in the spring semester, as well as develop a Postgraduate Thesis. Four (4) out of these ten (10) courses should be selected among the ones offered in the chosen direction, three (3) should be selected among the ones from the Geotechnical category, and three (3) among the Analysis category.

Students can enroll in additional courses (upon their interest) among all offered courses. The maximum number of additional courses is four (4) with the limitation that only up to three (3) courses may be from the non-selected direction. The marks acquired in the additional courses are not counted for the overall diploma grade.

Enrollment - Attendance

The enrollment in each semester, during the periods that are announced, is mandatory regardless if the postgraduate students have fulfilled the course requirements and are developing their Postgraduate Thesis.

Postgraduate students may enroll in up to six (6) courses per semester.

The students who have fulfilled the Programme's requirements (5 courses from the winter and 5 courses from the spring semester) have the option to enroll in additional courses up to the total number of 14 throughout their studies.

Postgraduate students have the option to apply to the CSC for exception of courses offered by another recognized Postgraduate Programme which they have already successfully attended; this application must be accompanied by the recommendation of the respective instructors.

If it is deemed necessary for the students' further academic training to attend and be examined in courses offered by other NTUA's Postgraduate Programmes, this option is also offered by applying to the CSC with the recommendation of their academic advisors.

Courses that do not meet the minimum number of five (5) enrolled students are suspended for the semester, upon mutual agreement of the instructors.

Each semester lasts for 13 weeks. Attendance in courses is mandatory, with a maximum allowable number of three (3) absences per course. Participation in related educational activities, such as weekly exercises, assignments, exams etc., is also compulsory.

Postgraduate students who have not reached the required number of attendances in a course have the right to retake it (or an equivalent one designated by the CSC) during the next and final academic year of study. If students have been successfully examined in a course, it is not allowed to retake it.

Examinations and Grading System

Examinations take place at the end of each semester and they last two weeks according to the academic calendar of NTUA and more specific CSC decisions. Only postgraduate students who have not exceeded the maximum number of absences per course are eligible to participate in the exams. The results are issued by the instructors within two weeks after the examinations and are announced by the secretariat.

Re-sitting of exams is scheduled every September upon CSC decision. Each student is allowed to be examined to a maximum number of 4 courses, 2 from the winter and 2 from the spring semester. When the mark is over the base of five (5), no re-examination is allowed. In order to participate in the September's exams students need to apply for it after the spring semester has ended.

The grading system is on a 1-10 scale without fractional part and with the base of five (5). The mark comes from the final written exam plus the exercises, projects or other assignments given during the semester.

Postgraduate Thesis

After completing the second semester of the first year of studies, postgraduate students can select the subject and supervisor for their Postgraduate Diploma Thesis, provided that they have successfully passed 80% of the required ten (10) courses by then.

Upon the student's application, which includes the proposed title of the thesis, the suggested supervisor and an abstract of the proposed thesis, the Course of Studies Committee appoints the supervisor and establishes a three-member Examination Committee for approval. The Examination Committee consists of the supervisor and members of the same discipline as the thesis' objective; these members may also come from other Schools or Institutions.

The list of approved postgraduate theses, as determined by the examination committee, is published on the official website of the Postgraduate Programme.

The postgraduate thesis is written in English. Writing and formatting requirements are specified by the Course of Studies Committee. The thesis must include an extensive abstract in both Greek and English.

After the presentation and examination of the thesis, postgraduate students are obligated to submit online their thesis to the Central Library of the National Technical University of Athens.

The assessment of the Postgraduate Thesis is conducted by the three-member examination committee using uniform criteria established by the CSC. The passing grade for the thesis is 5.5 on a 0-10 scale and it may include fractional parts.

Graduation - Master's Degree

For the Postgraduate Studies Diploma (MSc) to be awarded, a cumulative grade in both postgraduate courses and the Thesis and also a total of 90 ECTS credits are required, according to the Programme's academic requirements.

The overall grade of the MSc is derived as the weighted average of the grades of the postgraduate courses and the postgraduate thesis, where the latter is considered equivalent to the teaching units of one (1) semester of courses (Sum of grades of ten (10) courses and five times the grade of the postgraduate thesis divided by 15).

In case the student succeeds in more than 10 courses, then the ones with the highest mark are counted for the overall Master's Degree grade, provided that the conditions specified in the programme of studies are met. If there are mandatory courses assigned to the student, they are counted for the overall grade even if they are not the ones with the highest mark.

Graduating students are required to submit to the Secretariat of the Programme:
a) Certificates from the Library of NTUA confirming:
i) the online submission of the postgraduate thesis and
ii) that graduating students don't have any obligation towards the Library
b) A copy of the cover page of the postgraduate thesis and,
c) An abstract both in greek and in english of the Postgraduate Thesis.

The graduation periods for the MSc "ADS" Programme are in February, in June and in October. A list containing the Programme's graduates is compiled once a year and a ceremony for the award of Diplomas is organized by the coordinating School.

COURSES

GROUP OF SUBJECTS

StrEn

Direction A:
STRUCTURAL ENGINEERING

Ref. No.	COURSE
101	Advanced Concrete Technology
102	Design Models for Aseismic Repair and Strengthening
103	Design of Steel Buildings
104	Recent Advances in RC Design Models
105	Reliability of Structures
106	Steel Structures for Marine Applications
107	Advanced Mechanics of Mansory
108	Design of Cable and Membrane Structures
109	Design of Technical Projects II
110	Information systems in Construction Management
111	Engineering Materials

ADERS

Direction B:
ANALYSIS AND DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Code	COURSE
201	Nonlinear Analysis of Frame Structures and Applications in Seismic Engineering
202	Novel Methods for Seismic Isolation and Response Control of Structures
203	Signal Processing in Earthquake Engineering
204	Engineering Seismology
205	Experimental Earthquake Engineering
206	Pathology and Design of Structures under Seismic Actions
207	Special Topics in Earthquake Engineering
208	Structural intervention on Cultural Heritage Structures

Geo

GEOTECHNICAL COURSES

Code	COURSE
301	Computational Geomechanics
302	Geotechnical Engineering in Design of Structures
303	Ground Investigation Methods
304	Computational Methods in the Analysis of Underground Structures
305	Seismic Design of Surface and Underground Geotechnical Structures

Ana

ANALYSIS COURSES

Code	COURSE
401	Advanced Plastic Analysis of Framed Structures
402	Advanced Structural Dynamics
403	Applied Structural Analysis of Framed and Shell Structures
404	Design of Technical Projects I
405	Theory of Shells
406	Machine Learning
407	Mechanics of a Continuous Medium
408	Boundary Elements
409	Load-carrying Behavior and Design of Structural Systems
410	Non Linear Finite Element Analysis of Structures
411	Stochastic Finite Elements
412	Structural Optimization
413	Applied Elasticity
414	Plasticity and Fracture of Materials

SYLLABUS

STREN 101. Advanced Concrete Technology

Instructor	E. Badogiannis
School	CV
Semester	winter
Hours	3
ECTS	6

Introduction : Concrete materials, Cement, types and production methods. Selection of the cement. Aggregates properties and their influence on concrete performance. Water, additive materials, admixtures. Fresh concrete. Strength (Compressive, tensile) resistance to cyclic loading, fatigue, strength under uniaxial, biaxial and triaxial loading. Factors affecting the strength of concrete. Durability of concrete and design, Corrosion of reinforcement, Service life of RC structures. Shrinkange, Elasticity, Creep. High performance concrete. Mixing, transportation, casting, compaction, curing. Special concretes. In lab and in situ quality control. Concrete standards and regulations.

STREN

102. Design Models for Aseismic Repair and Strengthening

Instructor	E. Vintzilaiou
School	CV
Semester	winter
Hours	3
ECTS	6

Short historical review / Inspection / Measurements
Assessment of available bearing capacity
The logic of the intervention-categories and criteria
Design actions and partial safety factors
Constitutive laws of force transfer mechanisms across interfaces (Triaxial compression, Friction, Pullout, Dowel action)/Shear capacity of interfaces
The target of redesign (performance levels and critical behavior values)
Available plastic rotation
Theory and redesign applications (using steel or FRPs): Increase of bending capacity/increase of shear capacity/inadequate overlap length/increase of local ductility/infill shear walls/new shear walls.

STREN

103. Design of Steel Buildings

Instructors	D. Vamvatsikos, I. Vayas
School	CV
Semester	winter
Hours	3
ECTS	6

Design of singly story steel buildings,
Design of singly story steel buildings,
Dissipative Structural systems for Seismic Resistance,
Loads on Buildings.

STREN

104. Recent Advances in RC Design Models

Instructors	E. Vougioukas, M. Kotsovos
School	CV
Semester	winter
Hours	3
ECTS	6

Concrete behaviour: Strength, stress-strain behaviour under short-term loading, cracking, failure mechanism.
Behaviour of structural concrete elements: Modes of failure, causes of failure, physical model of element behaviour.
Design of structural concrete elements: Compressive force path method, earthquake-resistant design, application of the method for the design of beams, columns, structural walls, slabs, frames, etc

STREN

105. Reliability of Structures

Instructor	C. Trezos
School	CV
Semester	winter
Hours	3
ECTS	6

Introduction, probabilistic vs deterministic design of structures. Basic notions on probabilities. Central limit theorem. Distributions. Estimation of parameters. Maximum likelihood. Transformations. Regression analysis. Return period. Monte Carlo simulation (independent and correlated variables). Probabilistic models of resistances. Probabilistic models of actions (wind, snow, earthquake, self-weight). Combination of actions. Time varying actions, fatigue. Stochastic processes. Probability of failure, Level II method. Safety index. Reliability of serial and parallel systems. Bayes theorem, updating prior information reliability of existing structures. Code format, partial safety factors. Probabilistic design of special structures. Conformity criteria.

STREN

106. Steel Structures for Marine Applications

Instructors	Ch. Gantes, P. Thanopoulos
School	CV
Semester	winter
Hours	3
ECTS	6

The course consists of three parts.
The course introducing the students to issues pertaining to the behavior, analysis and design of marine and offshore structures, with emphasis on steel structures.
The course covers issues of configuration of structural systems for various types of steel structures for marine applications (jetties for loading/unloading, offshore platforms, offshore wind turbines), optimum member sections, types of connections between members, relation between selection of structural system and method of erection, numerical modeling issues (software selection, types of elements, mesh density, modeling of connections), analysis methods (static vs. dynamic, linear vs. nonlinear, interpretation of results), dimensioning (concept of limit state design verifications, design criteria, failure criteria, member verifications, buckling lengths, connection verifications,fatigue), construction drawings (general layout, assembly, part and erection drawings).

STREN

107. Advanced Mechanics of Mansory

Instructor	E. Vintzilaiou
School	CV
Semester	spring
Hours	3
ECTS	6

Technology of old and modern masonry.
Behaviour of masonry in compression, in tension, in shear
(Out-of-plane) Buckling and bending of plain, confined and reinforced masonry
The Mechanics of tie-beams (timber or RC)
Behaviour of interfaces within masonry. Mechanisms of load transfer (friction between mortar and stone or brick, pullout/push-in, dowel action)
Methods of analysis of masonry structures
In situ assessment of mechanical properties of historic masonry
Pathology of masonry structures
Assessment of residual properties of masonry
Intervention materials and techniques
Design and redesign models for masonry

STREN

108. Design of Cable and Membrane Structures

Instructor	Ch. Gantes
School	CV
Semester	spring
Hours	3
ECTS	6

The course introducing the students to issues pertaining to the behavior, analysis and design of tension structures.
The objectives of the course are multiple: (a) to understand the peculiarities of behavior and analysis of such structures, due to their lack of compressive, shear and bending stiffness, and their resulting flexibility to transverse loads, which leads them to nonlinear behavior, (b) to present their significant advantages for covering large spans, either in roofs or in bridges, (c) to address technological issues regarding their materials of construction, connections, the importance and ways of application of pretension and the erection methods, and (d) to be introduced to design methods of structures including cables and membranes: individual cables, guyed towers, suspended and cable-stayed bridges, cable roofs, cable nets, prestressed and air-supported membranes.

STREN

109. Design of Technical Projects II

Instructor	J. Ermopoulos
School	CV
Semester	spring
Hours	3
ECTS	6

Planning of development projects. Procedures for design, construction, and supervision. Total quality and environmental planning. Bridge axis alignment, selection, and arrangement of spans. Structural morphology and systems of concrete and steel bridges. Design actions in highway, railway, and pedestrian bridges. Cable suspended bridges, aerodynamic considerations. Special topics on steel bridges (Orthotropic deck, Fatigue etc.). Bearing and expansion joints. Design of bridge piers and abutments, protection against scouring. Design methods of concrete bridges (slab bridges, T-beam girders, box girders). Aseismic design of bridges. Design for environmental effects. Modern construction methods.

STREN

110. Information Systems in Construction Management

Instructor	J-P. Pantouvakis
School	CV
Semester	spring
Hours	3
ECTS	6

Overview of information systems in construction management. Review of construction management as an information processing system (techniques, procedures, Books of Knowledge (BoKs), Contract types). Review of time scheduling methodologies (MPM, linear methods, simulation, critical chain, monte carlo), Use of commercial systems (Primavera, MS-Project, Excel, 4D systems). Information Systems Analysis and Design Techniques (Data bases, Systems Analysis, Systems Design). IT & telecommunications applications in construction management (PDA's, wearable computers, wireless & satellite networks, project websites, e-site, e-construction, document control systems).

STREN

111. Engineering Materials

Instructor	G. Fourlaris
School	MMM
Semester	spring
Hours	3
ECTS	6

Classes of materials: Metals and alloys, ceramics, polymers and composite materials. Technological evolution and trends, properties and cost comparison, main applications.
Structure-properties relationships: Nature of chemical bonding, crystal structure and imperfections, dislocations. Solidification of metals. Mechanical properties and their dependence on the microstructure. Hardness, tensile strength, ductility, toughness, strain hardening, recovery and recrystallization. Fracture mechanisms, elements of fractography. Impact strength, transition from ductile to brittle fracture.
Other properties: Fatigue and fretting fatigue. Creep. Wear resistance. Corrosion and high temperature oxidation. Protection against corrosion (coatings, anodic and cathodic protection).
Study of some common alloys: Iron and steel, cast iron, aluminium and light alloys, copper alloys.
Production and processing methods and their relation to mechanical properties: Casting, hot and cold forming, powder metallurgy. Defects, inclusions, texture and anisotropy.
Welding: Welding methods, welding joints, welding defects and non destructive methods.
Construction steels: Plain carbon and low-alloy steels. High elastic limit steels, dual phase steels, controlled rolling and microalloyed steels. Stainless steels. Steels for low temperature applications.
Reinforced concrete steels: Types and relevant mechanical properties. Resistance to high temperatures. Weldability and welding techniques..

ADERS

201. Nonlinear Analysis of Frame Structures and Applications in Seismic Engineering

Instructors	M. Fragiadakis, S. Diamantopoulos
School	CV
Semester	winter
Hours	3
ECTS	6

1st Part: Introduction – algorithms for solving non-linear problems
Introduction and types of non-linear problems,
Introduction to algorithms for solving non-linear problems (full and modified Newton-Raphson method, method failures),
Non-linear methods for exceeding limit points (pure incremental solution, displacement control, arc-length),
Solvers and structure of a non-linear analysis code.
2nd Part: Geometric non-linearity
Geometrically non-linear mesh element
Kinematic relations of a beam in the plane (corotational theory)
Geometrically non-linear beam element
Application to solving buckling problems of structures.
3rd Part: Introduction to material non-linearity
Introduction to non-linear simulations for the inelastic analysis of structures
Comparison of the step-by-step method with the Newton-Raphson method
Uniaxial constitutive laws in terms of stress-strains (σ-ε): (a) bilinear s-e relation, (b) kinematic, isotropic and mixed hardening, (c) constitutive relations for steel and concrete
Phenomenological simulations in terms of torque-rotation (M-ϕ) (Clough-Johnston, Takeda models, stiffness and strength reduction)
Cross-sectional analysis: (a) moment-axial interaction plots, (b) curvature moment plots
Lumped plasticity
Fiber elements displacement & force elements
Spatial frames - torsion
Simulation of shear
Simulation of diaphragm
4th unit: Non-linear dynamic analysis and applications
The Newmark method for nonlinear dynamic problems
The mass matrix (lumped, consistent mass matrix)
Formulation of damping matrix (The problem of spurious moments in the case of models of concentrated plasticity).
Convergence and accuracy of non-linear dynamic problems
Non-linear dynamic analysis using seismic records.

ADERS

202. Novel Methods for Seismic Isolation and Response Control of Structures

Instructor	A. Sextos
School	CV
Semester	winter
Hours	3
ECTS	6

1. Introduction to seismic isolation (recap from UG course). Development of Seismic Isolation Worldwide. Theoretical Basis of Seismic Isolation. Seismic response of Seismic Isolated Hospitals during the Feb. 6th, 2023 Turkey earthquake sequence.
2. Isolation System Components (recap from UG course). Mechanical Characteristics and Numerical Modeling of Isolators. Advanced FEM aspects. Software example: Seismostruct.
3. Code Provisions for Seismic Isolation. Review of new generation North America, Asian and European Seismic Codes.
4. Ground Motion Selection for Seismically Isolated systems. Design Earthquake Ground Motion Selection and Scaling for SI.
5. Design of a new SI building. Worked Example: Stavros Niarchos Foundation complex (Library and Opera buildings).
6. Design of a SI bridge. Worked example: Egnatia Highway overpass.
7. Redesign and seismic upgrade of existing R/C buildings with SI. Worked example: Multi-storey R/C building including cost/benefit comparison with conventional redesign.
8. Redesign and seismic upgrade of existing URM buildings with SI. Worked Example: Rehabilitation of the Theological School of Chalki using multiple layer SI.
9. Geotechnical and Low-Cost Seismic Isolation methods for low-income regions. Worked Example: A school building in Nepal founded on PVC-sand-PVC sliding foundation system.
10. In class tutorial
11. Novel control methods. Novel passive, semi-active, active and hybrid mass dampers for buildings in seismic regions. Limitations of control systems.
12. Coupled seismic isolation and control systems. Coupled systems of geotechnical seismic isolation and active damping. Case study: Rion-Antirion bridge.
13. Use of TMDs in seismic regions. Tuned mass damper inerter systems for control of buildings subjected to earthquake ground motions. Challenges and limitations.

ADERS

203. Signal Processing in Earthquake Engineering

Instructor	M. Fragiadakis
School	CV
Semester	winter
Hours	3
ECTS	6

The course consists of three parts.
1) Introduction to signal analysis. Autocorrelation and crosscorrelation. Analysis in the frequency domain, Fourier transform and power spectra. Wavelet theory and applications. Transfer functions.
2) Ground motion time histories, analysis, correction and filtering. Intensity measures, energy and pulse-like content. Signal rotation for the extraction of mean values and directivity azimuth. Synthetic and semisynthetic accelerograms.
3) Characteristics of structural dynamic response time histories. Elastic and inelastic response of single degree of freedom systems. Deterministic methods for the evaluation of structural dynamic characteristics and their transformation. Application of wavelets. Design based evaluation. Probabilistic methods based on fragility curves.
Homework problems including a small project based on the analysis of structural response time histories under severe ground motion are used to cover all topics.

ADERS

204. Engineering Seismology

Instructors	D. Vamvatsikos, A. Sextos, O. Ktenidou
School	CV
Semester	spring
Hours	3
ECTS	6

The lesson of Engineering Seismology presents the following subjects dealing with the estimation of earthquake hazard and loss assessment.
Presentation of regional seismicity, fault description and earthquake source mechanism.
Characteristics and effects of near field ground motions.
New generation attenuation relationships.
Evaluation of seismic hazard.
Site effects on ground motion.
Artificial accelerograms and simulation of near field pulses.
Selection of seismic records for design.
Review of earthquake loss assessment methods.
Presentation of loss assessment HAZUS methodology.
Displacement based loss assessment methods.

ADERS

205. Experimental Earthquake Engineering

Instructor	Ch. Mouzakis
School	CV
Semester	spring
Hours	3
ECTS	6

Accelerometers, Electromycynsimeters, Other sensors, Data collection systems, Experiments on scale structures, Experiments using the seismic simulator, experiments with the pseudodynamic method, Analysis of recordings a) in the time domain, b) in the frequency field, Measurements of dynamic characteristics of buildings.

ADERS

206. Pathology and Design of Structures under Seismic Actions

Instructor	C. Spyrakos
School	CV
Semester	spring
Hours	3
ECTS	6

Typical damage to structures from earthquakes and their interpretation. Correlating them with the seismic motion-excitation and the characteristics of the structure. Analysis of the function of the basic structural elements and structural members according to the materials composed of. Correlation of the function of these elements with damping and stiffness. Influence of the position and function of the various members on the final seismic behavior of the structures. Criteria for selecting position, type and operation of the various structural members. Simulation of structures, depending on the material, the function of the member and the geometry of the structure.

ADERS

207. Special Topics in Earthquake Engineering

Instructors	C. Spyrakos, I. Psycharis
School	CV
Semester	spring
Hours	3
ECTS	6

Principles of seismic design of special structures (e.g. bridges, tanks, dams).
Criteria for the selection of the appropriate structural model.
Displacement based seismic design.
Dynamic soil-structure interaction / methods of analysis and applications.
Dynamic structure-water interaction / methods of analysis and applications to representative systems (dams, tanks).
Principles of seismic design of structures with base isolation / applications.
Seismic assessment of existing structures.
Retrofit and strengthening of structures / methods of analysis and applications.

ADERS

208. Structural Intervention on Cultural Heritage Structures

Instructors	M. Fragiadakis, C. Spyrakos, E. Toumpakari, I. Psycharis
School	CV
Semester	spring
Hours	3
ECTS	6

1. Masonry monuments (dry connection)

This type of monuments include classical-Hellenistic monuments (temples, towers, fortifications, etc.) as well as some prehistoric ones (the most emblematic vaulted tombs), Ottoman (minarets) or more recent ones (parts of monuments, e.g. porches, as well as burial monuments). This module spans 4-5 lessons and includes:

(a) Typology, structural analysis and routine pathology;

(b) Theoretical approach to structural behavior, methods of analysis, controls etc.,

(c) Planning and dimensioning interventions with reference to principles and regulatory framework, and

(d) Examples of analyzes and interventions.

2. Masonry monuments (with mortars)

This type of monuments includes Roman, Byzantine, post-Byzantine, Ottoman and newer monuments. This module spans 6-7 lessons and includes:

(a) Typology of common and special structures, analysis, common pathology and reference to the principles and regulatory framework (materials and typical structures, causes and development of damage, categorization of structures, institutional framework and legislation),

(b) Methods of investigating an existing situation;

(c) Theoretical approach to structural behavior, simulation and analysis methods (masonry mechanics, simulation methods and linear analysis methods, inelastic static analysis, local mechanisms),

(d) Planning and dimensioning of interventions,

(e) Examples of analyzes and interventions.

3. Supporting lectures (1 or 2 lectures)

(a) Protection of monuments in practice, in the context of the Archaeological Service and the Ministry of the Interior: history of the protection, preservation and restoration of monuments in Greece,

(b) Building materials, materials of historical constructions and repair materials (reference to stones & bricks, emphasis on mortars & grouts): brief historical review, methods of analysis and characterization of materials, pathology, determination of repair and reinforcement material requirements (performances), design.

4. Guest speaker lecture

It will concern various relevant topics related to the protection of monuments, such as: archaeology, material science, modern methods of recording, security of museum exhibits, etc. In this way, students will obtain an overview on the expertise of other specialties involved in the protection of monuments and archaeological sites.

GEO

301. Computational Geomechanics

Instructor	A. Zervos
School	CV
Semester	winter
Hours	3
ECTS	6

1. Introduction to plasticity. Yield function, plastic potential, loading/unloading.
2. The Tresca and von Mises models and their application in modelling undrained clay.
3. The Mohr-Coulomb and Drucker-Prager models, and their application in modelling drained soil behaviour.
4. Integration of the constitutive relations.
5. The concept of critical state. Modified Cam-Clay and its application in modelling soil behaviour.
6. Formulation and solution of seepage problems using finite element analysis.
7. Formulation and solution of transient, coupled pore pressure-deformation (consolidation) problems using finite element analysis.

GEO

302. Geotechnical Engineering in Design of Structures

Instructors	V. Georgiannou, A. Zervos
School	CV
Semester	winter
Hours	3
ECTS	6

The topics of seepage, compression and consolidation are examined briefly and are related to engineering practice and to current research work. By using an extended case study of the Tower of Pisa as a theme, the concepts can be applied to different soils and the long-term settlement of soil can be assessed. The major challenges facing designers of multi-propped deep excavations, particularly in crowded urban areas are examined. Embedded retaining walls such as secant bored pile walls and diaphragm walls used in the construction of deep sections of retained cuttings and cut-and-cover tunnels in road schemes and excavations in urban cities are studied with emphasis on the stress transfer and deformation mechanisms around diaphragm walls. The study of retaining systems is extended to include reinforced soil retaining walls and/or steepened embankments, as a relatively new cost effective method of construction which reduces embankment width and land-take and is environmentally acceptable. The classic preliminary design methods, including Eurocode 7, are presented both for retaining walls and reinforced soil. By using case studies (e.g. Egnatia Motorway) the Codes of practice are applied through analytical programs. The earthquake loading is assessed for conventional retaining walls, reinforced soil walls and bridge abutments.

GEO

303. Ground Investigation Methods

Instructors	V. Marinos, Ch. Saroglou, A. Antoniou
School	CV
Semester	winter
Hours	3
ECTS	6

General principles and methods of ground investigation. Geological maps and sections. Interpretation of aerial photographs. Sampling drilling for geotechnical purposes, description of samples, preparation of geotechnical sections. In-situ tests for geotechnical purposes (cross-hole, permeability, standard penetration, static penetration, determination of in-situ stresses, direct shear, pressometer and dilatometer tests). Geotechnical monitoring methods for the design and construction of civil engineering works. Fundamentals of the geophysical methods (seismic, electrical and other) with applications in the design and construction of engineering projects.

GEO

304. Computational Methods in the Analysis of Underground Structures

Instructors	M. Kavvadas
School	CV
Semester	spring
Hours	3
ECTS	6

Elasto-plastic stress and deformation analysis around circular tunnels. Derivation of elasto-plastic convergence-confinement curves. Analysis of tunnel end-effects (Panet curves). Principles of numerical methods for the analysis of underground structures (modeling of the 3-D problem in 2-D) - rockmass loosening methods (methods of deconfinement and stiffness reduction). Numerical analyses of the excavation and temporary support (staged excavation, temporary support measures) using Finite Element programs (application using the computer program RS2). Analysis of the loading on the permanent support of tunnels. Analysis of face stability and face reinforcement techniques..

GEO

305. Seismic Design of Surface and Underground Geotechnical Structures

Instructors	A. Papadimitriou, G. Bouckovalas
School	CV
Semester	spring
Hours	3
ECTS	6

This post-graduate course has the following themes:
1. Introduction to Geotechnical Earthquake Engineering. Basic elements of engineering seismology, with emphasis on strong ground motion.
2. Single degree of freedom structural vibration with base excitation, elastic response spectra.
3. Seismic wave (P, S, Rayleigh, Love) propagation in homogeneous and inhomogeneous soil.
4. Seismic design of underground tunnels and pipelines against seismic waves and permanent ground displacements.
5. Soil amplification (or de-amplification) of seismic ground motion with analytical and numerical methods. Practice with dedicated software.
6. Seismic design of retaining walls with the Mononobe-Okabe method (pseudo-static design) and with Richards-Elms (allowable displacements),
7. Topography effects and seismic design of soil and rock slopes.
8. Liquefaction, with emphasis on assessment methods and on its effects on Civil Engineering works. Description of ground improvement methods and methods for mitigating the effects of liquefaction.

ANA

401. Advanced Plastic Analysis of Framed Structures

Instructor	K. Spiliopoulos
School	CV
Semester	winter
Hours	3
ECTS	6

Introduction to the plastic design of structures. Redistribution of forces. Ductility. Relation with the Codes of Practice. Step-by-step 1st order elastoplastic analysis of frames. Principle of virtual work. Lower and upper bound theorems of plastic collapse. Safe moment distribution. Collapse mechanisms. Holonomic and non-holonomic behaviour. Mathematical programming. Kuhn-Tucker conditions. Linear programming. Simplex method. Mesh and nodal description. Static-kinematic duality. Flow rule. Stable materials. Rigid plastic behaviour. Alternative linear programs of limit analysis. Uniqueness of limit load. Automatic limit load evaluation. Optimal plastic design. Automatic optimal plastic design using linear programming. Variable loading. Alternating plasticity. Incremental collapse. Shakedown. Residual stress. Melan's theorem. Mesh-unsafe shakedown linear program and automatic shakedown load evaluation. Relation between limit and shakedown load. Elastoplastic analysis with 2nd order effects. Large displacements. Geometric non-linear elasto-plastic stiffness matrix. Arc-length method. Comparison of limit loads with and without 2nd order effects. Merchant-Rankine formula. Inelastic dynamic analysis of MDOF systems. Seismic response of buildings. Ductility ratios. Pounding of buildings. Reference to approximate static methods (pushover, etc.). Practice with commercial packages (SAP, Abaqus, etc.).

Scope

The course aims to the in-depth understanding of the inelastic behaviour of framed structures since plasticity is the basis of all today's Codes of Practice. Emphasis is also put on the mathematical framework and the computational techniques of plastic analysis. In this way the course addresses both the practicing engineer and the researcher.

ANA

402. Advanced Structural Dynamics

Instructors	M. Nerantzaki, I. Katsikadelis
School	CV
Semester	winter
Hours	3
ECTS	6

Dynamic loads and dynamic models of structures. Methods of derivation of equations of motions for structural systems (Equilibrium of forces, principle of virtual displacements, Hamilton's, principle, Langrage equations). Damping (viscous, Coulomb, structural). Discretization of continuous systems. Free and forced vibrations of SDOF systems. The finite element method for beam structures. (plane and space trusses and frames). Rigid bodies in elastic structures. Axial constraints. Free vibrations of MDOF systems. Modal damping, proportional damping. Numerical evaluation of eigenfrequencies and mode shapes. Partially restrained structures. Forced vibrations of MDOF systems. The method of modal superposition. Modal participation, static correction method. Reduction of degrees of freedom (kinematic constraints, Ritz vectors). Support excitation. Response spectrum analysis (ABSSUM, CQC, SRSS). Nonlinear response of structures Numerical solution of the equations of motion in time domain. Dynamic analysis of multi-storey buildings. Base isolation. Applications to civil engineering structures.

ANA

403. Applied Structural Analysis of Framed and Shell Structures

Instructor	E. Sapountzakis
School	CV
Semester	winter
Hours	3
ECTS	6

The displacement vector of a particle of a body. Components of strain of a particle of a body. Implications of the assumption of small deformation. Traction and components of stress acting on a plane of a particle of a body. Proof of the tensorial property of the components of stress. Properties of the strain and stress tensors. Components of displacements for a general rigid body motion of a particle. The compatibility equations. Equations of equilibrium. Stress-strain relations. Formulation and solution of boundary value problems using the linear theory of elasticity. The principle of Saint-Venant. Prismatic bodies subjected to pure tension. Prismatic bodies subjected to pure bending. Plane stain and plane stress problems in elasticity. Fundamental assumptions of the theories of mechanics of materials for line members. Internal actions on a cross-section of line members. The boundary value problems in the theories of mechanics of materials for line members. The boundary value problem for computing the axial component of translation and the internal force in a member made from an isotropic linearly elastic material subjected to axial centroidal forces and to a uniform change in temperature. The boundary value problem for computing the angle of twist and the internal torsional moment in members made from an isotropic linearly elastic material subjected to torsional moments. Primary and secondary warping functions. Warping normal stresses. The classical theory of beams. Solution of the boundary value problem for computing the transverse components of translation and the internal actions in prismatic beams made from isotropic linearly elastic material. The Timoshenko theory of beams. A displacement and a stress function solution to transverse shear loading of beams. Computation of the shearing components of stress in beams subjected to bending without twisting. Shear center. Theory of plates. Buckling of elastic structures. Nonlinear theory of elasticity.

ANA

404. Design of Technical Projects I

Instructors	E. Sapountzakis, L. Stavridis
School	CV
Semester	winter
Hours	3
ECTS	6

Presentation of major bridge projects. Design principles, methods of construction. Design of bridges.
Static and dynamic models of bridge structures. Slab and continuous body structures.
Static and dynamic models of bridge structures. Slab and beam structures, box shaped bridges.
The grid model for the analysis of bridge structures.
Support of bridge structures and its modelling. Oblique and curved bridges.
Torsional parameters of elements for the analysis of framed structures.
Introduction to thin walled beams. Comparison between open and closed sections.
Analysis of warping due to torsion. Stress state due to the warping restrain.
The concept of bimoment and its relation to the stress state. The basic equation of torsional behavior and its practical treatment through the analogy with the laterally loaded tensioned beam.
Box-girder bridges. Rectilinear girders under eccentric traffic loading.
Stress-state due to the deformability of cross-section profile under eccentric loading.
Curved box-girders in bridge design. Determination of longitudinal bending and torsional state-of-stress. Lateral response of section walls.
Influence of prestressing on the curved girders of bridges. Reducing the torsional response through prestressing

ANA

405. Theory of Shells

Instructor	V. Koumousis
School	CV
Semester	winter
Hours	3
ECTS	6

Introduction to shell structures. An historical overview. Basic elements of differential geometry. Space curves, parametric representation. Surfaces as grid of families of space curves. First fundamental form. Applications. Assumptions of thin shell theories. Stress resultants per unit length. Equilibrium Equations. The general initial and boundary value problem of theory of shells. Statical indeterminacy of the general problem. Membrane theory assumptions. Cylindrical shells. General solution for the statically determinate problem. Strains and displacements. Applications. Use of symbolic language i.e. Maple or Mathematica for the solution of cylindrical shells for various loading cases and support conditions. Membrane theory of conical shells. Equilibrium equations. General solution. Applications. Use of symbolic language i.e. Maple or Mathematica for the solution of conical shells for various loading cases and support conditions. Membrane theory of Shells of revolution. Equilibrium equations. General solution for axisymmetric loading cases. Spherical Shell. Hyperbolic shells. Applications for open or closed spherical shells. Shells of revolution for arbitrary loading. Fourier series solution, symmetric and antisymmetric cases. Differential geometry notion of curvature. Second fundamental form. Gauss-Godazzi conditions. Bending theory of cylindrical shells. Axisymmetric loading. Beam on elastic foundation type of solution. Donnell theory. Applications for cylindrical shells with different boundary conditions. Comparison with numerical solutions with finite element method. Design provisions of Eurocode 3 for steel thin shell structures.

ANA

406. Mechanics of a Continuous Medium

Instructor	A. Giannakopoulos
School	AMPS
Semester	winter
Hours	3
ECTS	6

Tensor analysis. The Rayleigh transport theorem. The deformation gradient. The polar decomposition theorem. Rotations and stretches. Lagrangian and Eulerian description of deformation metrics. Mass conservation. Conservation of linear momentum. Conservation of angular momentum. The stress tensors: Cauchy, 1st and 2nd Piola-Kirchhoff. Objective deformation measures. The velocity gradient tensor. Decomposition to strain rate and spin. Principal stretches and principal directions. Invariants of symmetric tensors. Orthogonal tensors. Equilibrium equations and the Virtual Work theorem. Constitutive equations in elasticity and fluid mechanics. Anisotropy. Hyperelasticity. Internal constrains: incompressibility, inextensibility. The first thermodynamic theorem. The second thermodynamic theorem. Objective stress rates. Objective deformation rates. Mechanical power and work conjugate stresses and deformation tensors. Jump conditions and discontinuities. Problems of large deformation elasticity. Problems of fluid mechanics.

ANA

407. Machine Learning

Instructors	A.G. Stafylopatis, G. Stamou, A. Voulodimos, P. Tzouveli
School	ECE
Semester	winter
Hours	3
ECTS	6

Neural network models (Perceptron, multilayer backpropagation NDs, radial basis function NDs, feedback NDs, self-organizing neural networks). Neural learning. Use of neural networks in function approximation / visualization, identification of static and dynamic systems and automatic control. Fuzzy sets and fuzzy logic. Unclear reasoning. Fuzzy relational equations. Use of fuzzy logic and reasoning in decision making and systems identification / control. Neurofuzzy systems. Special applications of neural and fuzzy systems in building and construction problems.

ANA

408. Boundary Elements

Instructors	M. Nerantzaki, I. Katsikadelis
School	CV
Semester	spring
Hours	3
ECTS	6

Introduction. Boundary Elements and Finite Elements. Historical development of the BEM. Preliminary Mathematical Concepts. The Gauss-Green theorem. The divergence theorem of Gauss. Green's second identity. The Dirac delta function. The BEM for Potential Problems in Two Dimensions. Fundamental solution. The direct BEM for the Laplace and the Poisson equation. Transformation of the domain integrals to boundary integrals. The BEM for potential problems in anisotropic bodies. Numerical Implementation of the BEM. The BEM with constant boundary elements. The Dual Reciprocity Method for Poisson's equation. Computer program for solving the Laplace equation with constant boundary elements. Domains with multiple boundaries. The method of subdomains. Boundary Element Technology. Linear elements. Higher order elements. Near-singular integrals. Applications. Torsion of non-circular bars. Deflection of elastic membranes. Bending of simply supported plates. Heat transfer problems. Fluid flow problems. The BEM for Two-Dimensional Elastostatic Problems. Equations of plane elasticity. Betti's reciprocal identity. Fundamental solution. Integral representation of the solution. Boundary integral equations. Numerical solution of the boundary integral equations. Body forces. Computer program for solving the plane elastostatic problem with constant boundary elements. Applications.

ANA

409. Load-carrying Behavior and Design of Structural Systems

Instructor	L. Stavridis
School	CV
Semester	spring
Hours	3
ECTS	6

Structural behavior and design of steel and reinforced concrete beams
Structural behavior and design of prestressed concrete beams. The treatment of prestressing
Structural behavior of one-story and multistory frames. Gravity loads, Horizontal loads, Lateral stiffness. Juxtaposition of shearing and bending behavior.
The influence of deformations on the structural behavior of beams (Second order theory)
The influence of deformations on the structural behavior of frames (Second order theory)
Structural behavior and design of arches and arch-beam systems
Load-carrying behavior and design of cable prestressed structures
Main characteristics of the structural behavior of grids
Specific topics on the structural action, behavior and design of reinforced and prestressed concrete slabs

ANA

410. Non Linear Finite Analysis of Structures

Instructors	V. Papadopoulos, K. Spiliopoulos
School	CV
Semester	spring
Hours	3
ECTS	6

Issues of continuum mechanics and basic tensor analysis. Introduction to nonlinear analysis. Incremental equations of motion, Green Lagrange strain tensor. Cauchy stress tensor, Piola Kirchhoff stresses, Incremental total and updated Lagrangian formulations. Principle of Virtual work in a non-linear setting. Linearization of non-linear equations of motion and incremental - iterative solution methods. Newton-Raphson algorithm. Path following techniques. Arc-Length. Geometric Non linearity. Finite element method for geometric non – linear problems: Truss and Cable elements, Plane Strain and plane stress elements, Three-dimensional solid elements, Structural elements: beam and general shell elements. Material nonlinearity. Problem statement. Elastoplastic problem in one dimension. Isotropic and Kinematic Hardening. J2 Plasticity. Deviatoric stress. Deviatoric strain. Yield surface. Von Mises & Tresca Yield criteria. Drucker's postulate. Maximum dissipation principle. Associated and non-associated flow rules. Perfect plasticity. Radial return algorithm. Algorithms for isotropic, kinematic and combined hardening. Algorithmic tangent operator. Finite element method for materially nonlinear problems. Implementation using MSOLVE and Commercial Software.

ANA

411. Stochastic Finite Elements

Instructor	V. Papadopoulos
School	CV
Semester	spring
Hours	3
ECTS	6

Scope: The course aims at the investigation of the effect of uncertain parameters (material and geometric properties, loading) on structural response variability.
Introduction: Random variables, cumulative distribution function, probability density function, statistical moments (mean value, variance, skewness and kurtosis), covariance. Stochastic processes and fields: Definition, stationary stochastic processes, ergodicity, analysis in the frequency domain-Fourier transform: autocorrelation and spectral density functions, Gaussian stochastic processes. Representation/discretization of stochastic processes and fields using (i) Point discretization methods: midpoint, integration and nodal point methods (ii) Average discretization methods: local average and weighted integral methods (iii) Spectral representation method: simulation of stationary Gaussian stochastic processes and fields. Formulation and solution of the stochastic problem: Stochastic virtual work principle, formulation of the stochastic stiffness matrix using the local average and weighted integral methods, solution by Taylor, Neumann series expansion and by Monte Carlo simulation. Applications: Computer applications on framed structures and 2D elasticity problems: investigation of the effect of several stochastic field parameters (probability distribution, correlation length and autocorrelation function) on structural response variability.

ANA

412. Structural Optimization

Instructors	N. Lagaros, S. Triantafyllou, V. Koumousis
School	CV
Semester	spring
Hours	3
ECTS	6

Basic concepts. Design variables, objectives and constraints. Optimal sizing, shape and topology design problems for skeletal and 2D structures. Continuous and discrete optimal design problems. Methods of mathematical programming. Linear programming problem, simplex method and interior point methods. Nonlinear programming. Approximate methods of solution. Duality principle. Optimality criteria methods, fully stresses design and redesign formulas. Applications with Excel, Fortran and Matlab. Sensitivity analysis, approximate methods. Accuracy and reliability of sensitivity analysis methods. Sensitivity analysis of skeletal and 2D structures analyzed with the finite element method. Direct method of sensitivity analysis. Adjoint method. Applications by using the finite element method computer program NASTRAN. Discrete optimization problems. Some basic problems of integer programming. Dynamic programming, simple applications. Genetic algorithms- evolutionary optimization algorithms. Applications to structural design problems.

ANA

413. Applied Elasticity

Instructors	G. Exadaktylos, P. Gourgiotis
School	AMPS
Semester	spring
Hours	3
ECTS	6

Elements of Tensor Analysis. Traction. Stress Tensor. Balance Laws. Equations of Motion and Equations of Equilibrium. Symmetry of Stress Tensor. Strains and Rotations. Equations of Compatibility. Constitutive Elasticity Equations. Strain Energy. Generalized Hooke's Law. Anisotropy – Isotropy. Navier-Cauchy Equations and Beltrami-Michell Equations. Boundary Conditions. Boundary Value Problems. Two-Dimensional Problems. Plane Strain and Plane Stress. Airy's Stress Function. Exact Theory of Torsion. Prandtl's Stress Function. Stress-Concentration Problems. Williams' Technique. Self-Similar Problems. Flamant-Boussinesq and Kelvin Problems. Contact Problems. Energy Theorems and Methods. Uniqueness Theorem. Principle of Superposition. Rayleigh-Ritz Method. Several Generalizations. Elasticity and Thermodynamics. Wave Propagation. Viscoelasticity. Thermoelasticity. Elements of Fracture Mechanics. Griffith's Theory – Applications in the Design of Structures.

ANA

414. Plasticity and Fracture of Materials

Instructor	A. Giannakopoulos
School	AMPS
Semester	spring
Hours	3
ECTS	6

A. Plasticity of Materials
A.1 Introduction
A.2 Limit analysis - reminders
A.3 Absolutely solid-perfect plastic body
A.4 Elastoplastic analysis
A.5 Rate effects
A.6 Special issues
A.7 Thermodynamics
A.9 Large plastic deformation and rotation
A.8 Cyclic plasticity and low cycle fatigue
B. Breakage of Materials
B.1 Small and large cracks
B.2 Crack analysis with linear elasticity
B.3 Analysis of cracks with nonlinear elasticity and plasticity
B.4 Diffuse micro-cracking and damage parameter

MSc "ANALYSIS AND DESIGN OF STRUCTURES"

NATIONAL TECHNICAL UNIVERSITY OF ATHENS