NATIONAL TECHNICAL UNIVERSITY OF ATHENS

DEPARTMENT OF RURAL AND SURVEYING ENGINEERING

A comprehensive guide

ATHENS

1999-2000

*This **Guide** aims at providing students with information concerning studies at the Department of Rural and Surveying Engineering in particular, and their life at the National Technical University of Athens in general.*

*A special effort takes place every year to update this **Guide** and make each edition more comprehensive and complete. This is an on-going process.*

The National Technical University of Athens

The ***National Technical University of Athens*** (NTUA) is one of Greece's higher education establishments.

It dates back to 1836 when the *Royal School of Arts* was founded and started operating on Sundays and holidays. The first reformation took place in 1843: the *School* switched over to daily operation, and its aim was defined as the teaching of industrial and 'fine' arts. A second major change occurred in 1863 with the introduction of theoretical and applied education for managers and technicians in building construction, metal industry, joinery, sculpture, painting, ceramics, tanning, soap manufacturing, etc. In 1887, the *School* was upgraded to a higher education establishment for Building Construction Engineers, Architects and Mechanical Engineers. Since then the evolution of NTUA has moved hand-in-hand with the technical and financial development of Greece.

The last radical reformation in the organization and administration of NTUA took place in 1917 when a special bill gave to the NTUA a new structure and established the Schools of Civil, Mechanical & Electrical, Chemical and Surveying Engineers as well as the School of Architecture.

The current legal framework for higher education came into effect in 1982. In accordance with this, NTUA is divided into 9 **Departments**, as follows:

1. Department of ***Civil*** Engineering
2. Department of ***Mechanical*** Engineering
3. Department of ***Electrical*** Engineering
4. Department of ***Architecture***
5. Department of ***Chemical*** Engineering
6. Department of ***Rural & Surveying*** Engineering
7. Department of ***Mineral & Metallurgic*** Engineering
8. Department of ***Naval Architecture & Marine*** Engineering
9. Department of ***General*** Studies with Physics Faculty Mathematics.

As prescribed by law, each Department is administered by a *General Assembly* consisting of **the Teaching and Research Personnel** (TRP: Professors, Associate Professors, Assistant Professors and Lecturers) and the representative of the **Scientific and Teaching Personnel** (STP: Assistants and Research Associates), the **Administrative and Technical Personnel** (ATP) and the **Students**. Certain matters of minor importance are handled by an *Executive Board*.

A Special Electorate elects a professor or associate professor as *President* of the Department and another member of the same rank as *Deputy President.*

Each Department is subdivided into **Sections** covering scientific areas. Sections are also administered by General Assemblies which are similar to the Department's assembly. The head of a Section, called *Director*, is elected amongst professors and associate Professors by the Section's general assembly.

Finally, there may be further subdivisions in the shape of **Laboratories** which deal with specific scientific subjects. Each Laboratory is headed by a professor an associate professor or an assistant professor but administratively it belongs to a Section or directly to the Department.
NTUA's general administration is effected by the **Senate** which consists of the Presidents of the Departments, one TRP member from each Department, representatives of STP, the Special Research Personnel (SRP), representatives of ATP, the administration staff and

the students. The Senate is headed by the *Rector* and two *Vice Rectors* who are professors or associate professors elected by a special electorate comprising all NTUA staff and students.

The Department of Rural & Surveying Engineering

The **Department of Rural and Surveying Engineering** was founded in 1917 as *'Higher School of Surveying Engineering'*. Initially, three years of study were required to obtain a diploma, but in 1930 this was increased to four years and the title was changed to *'Higher School of Rural and Surveying Engineering'*

The leading personality of the *School of Rural and Surveying Engineering* as well as the inspirer of the changes that occurred in 1930 was Professor **Demetrios Lambadarios**. Prof. Lambadarios was a member of the *Academy of Athens,* Rector of NTUA during the years 1928 to 1933 and Dean of the School for many years. Today, the Department's building in Zographou campus carries his name.

In 1974, the School's curriculum was extended to five years, and in 1982 the School's title was changed to *'Department of Rural and Surveying Engineering'*. At the same time, Prof. Dionyssios Balodimos became the Department's first President. The list of Department heads since the introduction of the new scheme is the following :

Academic Year	*President*	*Deputy President*
1983-84	D. Balodimos	---
1984-86	D. Balodimos	---
1986-88	D. Balodimos	E. Marketos
1988-90	C. Koutsopoulos	G. Veis
1990-92	H. Billiris	C. Koutsopoulos
1992-94	H. Billiris	G. Veis
1994-96	D. Balodimos	G. Veis
1996-98	D. Balodimos	H. Billiris
1998-00	A. Balodimou	A. Georgopoulos

In accordance with a decision of the general assembly taken on 26 April 1983, the Department was divided into three sections:

1. Section of ***Topography***

   Dealing with the development of measurement methods and techniques, and their application in topographic, photogrammetric, hydrographic, geodetic and geophysical surveys.

2. Section of ***Geography and Regional Planning***

   Dealing with the analysis, elaboration and interpretation of qualitative and quantitative entities in geographical space, and their inter-relationship and variation process in investigating problems of regional planning.

3. Section of ***Infrastructure Works and Rural Development***.

   Dealing with planning and construction which contribute to the development of rural areas.

Department of Topography

Director : Associate Professor K. Papazisi

Faculty Members

Professors

D.-D. Balodimos
A.-M. Balodimou
H. Billiris
D. Rokos

Associate Professors.

D. Argialas
A. Georgopoulos
K. Papazisi
D. Paradissis
M. Doufexopoulou

Assistant Professors.

E. Doukakis
L. Tsoulos
H. Zentelis
M. Kavouras
R. Korakitis
H. Mitsakaki
V. Nakos
D. Stathas
V. Filippakopoulou
G. Karras

Lecturers

P. Gerontopoulos
H. Ioannidis
V. Barbaroussi

Faculty Assistant

Assistants

S. Giokas
V. Kyriakou
A. Tsagari
E. Staboulouglou

Scientific Collaborator

O. Arabatzi
G. Georgopoulos
S. Dogouris
G. Makris
Th. Matsikari
D. Pournaras
E. Telioni

Administrative and Technical Personnel

B. Andronis
Ch. Dogouri
V. Karathanasi
J. Missas
S. Stergiou
P. Tsanos
M. Fragou
M. Antepli
D. Mimiyannis
K. Paganis
J. Georgis
M. Tsolakis
G. Psaraftis

Other Personnel

K. Vasili-Kalomira
E. Dimopoulou
J. Karabelas
P. Milas
G. Pantazis
Ch. Potsiou
A. Tsoutsoura
H. Iosifidis
H. Vlachos
A. Zissopoulos
E. Lambrou
A. Bithas
A. Papagianni
F. Rikaniadi-Poulou
S. Felekis

Candidates for Dr's Degree

J. Andritsos
I. Vassiliadis
E. Giakoumaki
E. Zaharis
S. Karamitsos
I. Katsieris
P. Kolokousis
A. Mavromati
È. Michailidou
E. Panagiotopoulou
E. Roussos
K. Sakelariou
A. Skopeliti
L. Stamou
A. Sokratidou
E. Tournas
A. Hroni
D. Katsigiorgis
O. Mavrantza
A. Lambropoulos
G. Manousakis
B. Andronis
I. Kostopoulos
H. Kakarounas
A. Antonopoulos
E. Galanou
H. Gomoza
D. Katsigiorgi
T. Kokkas
K. Logothetis
G. Miliaresis
V. Pagounis
G. Panopoulos
J. Papamavros
A. Sioulis
J. Spyrakos
K. Stefanakis
N. Tzelepis
J. Houhoulas
M. Farsaris
E. Lefakis
K. Daniilidis
D. Skarlatos
H. Tsiligiris
A. Marinou
S. Likoudis
B. Dimopoulos

Department of Geography and Regional Planning
Director : Professor K. Koutsopoulos

Faculty Members

Professors

K. Kassios
K. Koutsopoulos
M. Yaoutzi

Associate Professors

A. Siolas

Faculty Assistant

Scientific Collaborators

A. Lagoudaki

Administrative and Technical Personnel

A. Pashalidou

Other Personnel

A. Dara
D. Dimitriou
D. Papakonstantinou
D. Stamou
G. Fotis

Candidate Doctors

K. Akrivos
I. Andritsakis
G. Ahilleos
D. Vasilarou
Z. Vasiliadou
A. Gioutsou
S. Dasaklis
M. Diamantopoulos
A. Kyriazi
M. Peppa
N. Papaioanou
S. Sirkou
F. Stefani
M. Trantas
E. Hadjinikolaou
E. Dimitrakopoulou
S. Haralambous
M. Lamprou
A. Siskos
G. Halaris
N. Athanasopoulou
M. Frantzi
K. Kanellopoulou
O. Akinyosoye.
D. Kostandara

Department of Infrastructure Works and Rural Development.
Director : Associate Professor B. Psarianos

Faculty Members

Professors
G. Tsakiris

Associate Professors
V. Psarianos

Assistant Professors
A. Vlastos
A. Mandoglou
M. Kontaratos*
H. Giounis
M. Sakellariou

Lecturers
A. Aga
A. Kaltsounis
S. Giakoumakis
J. Theodoraki

Faculty Assistants

Assistants
H. Stamos

Scientific Collaborators
Th. Katsanos
S. Sassanis
S. Papakonstantinou

Administrative and Technical Personnel
A. Liaramantzas
A. Tsanaka
A. Touloupi
J. Dionyssopoulos

Candidate Doctors

S. Kozanis
E. Liapis
R. Maragoudaki
S. Mavromatis
G. Doulis
P. Sklavounos
Th. Karagiannis
D. Apostolopoulou
V. Paslis
K. Papazoglou
B. Kourou
K. Makarounis
D. Mavridis
M. Barbopoulos
G. Ekonomou
M. Ferentinou
A. Migardou
D. Lagadianos
I. Hatzidouros

* to be appointed

Laboratories

The following Laboratories operate within the Department's Sections:

1. Section of Topography

- Laboratory of ***Higher Geodesy*** (*Director*: Prof. H. Billiris)
- Laboratory of ***General Geodesy*** (*Director*: Prof. D. Balodimos)
- Laboratory of ***Remote Sensing*** (*Director*: Prof. D. Rokos)
- Laboratory of ***Photogrammetry*** (*Director*: Assoc. Prof. A. Georgopoulos)
- Laboratory of ***Cartography*** (*Director*: Ass.Prof. L. Tsoulos)
- ***Dionyssos Satellite Tracking Station*** (*Director*: Assoc.Prof. D. Paradissis)

2. Section of Geography and Regional Planning

- Laboratory of ***Geography*** (*Director*: Prof. K. Koutsopoulos)
- Laboratory of ***Physical Geography & Environmental Impact***

3. Section of Infrastructure works and Rural Development.

- Laboratory of ***Reclamation works and water recourses management***. (*Director*: Prof. G. Tsakiris)
- Laboratory of ***Structural Mechanics and Technical Works*** (*Director*: Ass. Prof. M.Sakellariou)
- Laboratory of Transportation ***Engineering*** *(Director. Assoc. Prof. V. Psarianos**)***

Library

The Department's Geodetic Library is situated on the first floor of Lambadarios building. It is one of NTUA's first specialist libraries. The Library is open every working day, 9.45 to 13.45 hrs, during which students and staff may study and borrow books. Students are encouraged to make extensive use of the Library.
Librarians : M. Liapa, I. Hatzidimitriou

Geoinformatics Centre

This Centre was established to support research activity, both at undergraduate and postgraduate level, by students and staff dealing with collection, processing and interpretation of geographic information. The Centre is open every day, 9.00 to 17.00 hrs.

Scientific Supervisor : L. Tsoulos

- S. Andonakos
- B. Pagounis

Facilities

The Department is serviced by the following facilities:

- Computer Center
- Small unit for printing and photocopying (B. Kostorizos)
- Small technical unit
- Student restaurant
- Building caretaking
- Secretariat

Secretary : E. Koliou
Deputy Secretary : M. Moraitou

M. Konstantinidou
A. Fotou-Aloupi-
Th. Kremizi
F. Rikaniadi-Poulou
K. Papanikolaou
A. Katakou

♦ *Operation and Development Office :*

Head of the Office : N. Kaffes

T. Antaki
K. Vasili-Kalomira
X. Vlahos
A. Dara
D. Dimitriou
E. Dimopoulou
O. Zaharou
L. Zahos
A. Zisopoulos
S. Zorbas
X. Iosifidis
I. Karabelas
E. Lambrou
M. Mazarakos
P. Milas
A. Bithas
G. Pantazis
A. Papagiani
D. Papakonstantinou
X. Potsiou
D. Stamou
A. Stratigea
A. Tsoutsoura
S. Felekis
G. Fotis

Curriculum

The Department's curriculum is based on the scientific and technical activities of Rural and Surveying Engineers, Greece's production and development goals, as well as future prospects in those areas.

The curriculum aims at providing students with the necessary scientific and technological education that will enable them to perform satisfactorily in a specific area of Rural and Surveying Engineering.

To succeed in his future goal, a graduate should be in position to comprehend technical developments in his own scientific field, cooperate constructively with fellow engineers, and indeed contribute to scientific development.

The Department's curriculum also aims at preparing interested students for post-graduate studies.

Rural and Surveying Engineering activities may be divided into the following areas of specialization:

1. Collection, processing and presentation of space and environmental elements (determination of position on the earth's surface, survey, cartography)
2. Space analysis and organization
3. Transportation engineering
4. Reclamation and other hydraulic works
5. Construction and technical works

The wide range covered by these subjects leads to the necessity for considerable *specialization* of the curriculum. It should be stressed, however, that at present, such specialization does not appear to conform to prevailing professional conditions in Greece.

The Department's curriculum aims at reaching a compromise between what appears to be two 'contradictory' tendencies. This is accomplished by recognizing specialized educational areas, and by dividing courses into *mandatory* and *elective*.

Mandatory are the courses required to lead the student into mastering the basic background in Rural & Surveying Engineering and prepare him for specialization in a certain field.

Elective are the courses dealing with specialized subjects and topics in an area chosen by the student, and providing the required knowledge for further studies and scientific research.

In accordance with the NTUA's educational system, studies last five years. Each year is divided into two *semesters*: the **winter** semester (September to January) and the **spring** semester (February to June). Out of ten semesters, the first nine are devoted to courses and practical exercise, while students spend the last one preparing their diploma thesis.

Under the new curriculum introduced in academic year 1998-99, 57 courses are required in total for the completion of studies: 37 mandatory (including a foreign language) and 20 elective, to be taken from a palette of 84 available courses.

The opportunity of selecting courses is established as early as from the first semester and special effort has been made in order to provide equal selection ability in all fields. Care is taken so that each semester should have no more than 7 courses, totalling 30 teaching hours.

The required 57 courses are distributed as follows:

Semester	*Courses*	*Total*
1st – 4th	7	28
5th – 8th	6	24
9th	4	4
Mandatory summer course		1
	Total	**57**

Furthermore, out of the same courses:

- 37 are mandatory (Table 1)
- 6 belong to the *Basic Topographic Circle* (BTC) (Table 2,3)
- 6 belong to the specialization direction (Table 4-11)
- 2 are to be chosen from the following courses (Table 12)
  - Fundamentals of Economic Science
  - Business Administration
  - Elements of Law & Engineering Legislation
- 1 is to be chosen from the following courses (Table 12)
  - Philosophy of Science
  - Spatial Sociology
  - History of Civilization
- 5 may be chosen at large from the remaining courses

Students attending the 9th semester need to take a practical course, in the area of their specialization. It has been ascertained that students experience difficulties in technical write up and that the first project they face in their studies is the diploma thesis, thus, special practical courses have been introduced in the curriculum, demanding collective work in one or more scientific areas.

The educational centre of gravity for Rural & Surveying Engineers lies in topography. To stress this, a *Basic Topographic Circle* (BTC) has been introduced between mandatory and specialization courses. The *Circle* itself is mandatory for all students, and consists of six courses (Table 2). At least three of them should be picked up from the palette of six courses of table 2 which are oriented in modern technological surveying applications, while the rest out of a more general group of courses listed in table 3 as well as from the remaining courses of table 2.

Students have four specialization areas to choose from:

1. Topography (tables 4,5).
2. Regional-urban planning and development (6,7).
3. Water resources (8,9).
4. Traffic engineering (10,11).

There are six primary courses in each specialization area, of which at least three are to be chosen from a group of six courses (listed in tables 4,6,8,10) and the rest (necessarily including a practical course) from a group of courses listed in tables 5,7,9,11). There are also courses corresponding to one or more specializations.

In selecting courses, students may seek advice from the Consultants-TRP members above :

- Aga E. Lecturer
- Giaoutzi M. Professor
- Doukakis E. Assistant Proffesor
- Karras G. Lecturer
- Kassios K. Proffesor
- Mandoglou A. Assistant Proffesor
- Mitsakaki H. Assistant Proffesor
- Nakos V. Assistant Proffesor
- Rokos D. Proffesor
- Sakelariou M. Assistant Proffesor
- Stathas D. Assistant Proffesor
- Psarianos V. Associate Proffesor

1st SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
9.2.14.1.1.6.	1. Analysis I.	5
9.2.80.1.1.6.	2. Descriptive and Higher Geometry.	5
6.1.91.1.1.6	3. Introduction to Computer Programming.	4
7.3.20.1.1.6.	4. General Geology.	4
6.1.01.1.1.6.	5. Technical and Topographical design and Drawing.	4
6.1.02.1.1.6.	6. Introduction to Geodesy.	4
	Total teaching hours	***26***

II. Optional Courses (one course may be selected)

Code	*Courses*	*Hours*
9.1.31.1.2.6.	1. Principles of Economic Science.	2
9.1.42.1.2.6.	2. Philosophy of Science.	2

III. Non credit courses.

Courses	*Hours*
1. Foreign Language and Technical Terminology.	2

2nd SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
9.2.19.2.1.6.	1. Analysis II.	5
9.2.72.2.1.6.	2. Probability Theory and Statistics.	4
9.4.61.2.1.6.	3. Physics I.	5
6.1.92.2.1.6.	4. Computer Programming Applications.	4
6.2.01.2.1.6.	5. Physical Geography and Environment.	4
6.1.03.2.1.6.	6. General Cartography.	4
	Total teaching hours	***26***

II. Optional courses (one course may be selected)

Code	*Courses*	*Hours*
9.1.22.2.2.6.	1. Urban Sociology.	2
9.1.51.2.2.6.	2. History of Culture.	2
5.1.23.2.2.6.	3. Chemistry.	3

III. Non credit courses.

Courses	*Hours*
1. Foreign Language and Technical Terminology.	2

3rd SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
9.2.25.3.1.6.	1. Differential Equations.	4
9.4.02.3.1.6.	2. Physics II.	5
6.1.04.3.1.6.	3. Principles of Geoinformation and G.I.S.	4
6.1.05.3.1.6.	4. GEODESY-Geodetic instruments and Measuring methods.	4
6.3.01.3.1.6.	5. Engineering Mechanics – Statics.	4
	Total teaching hours	***21***

II. Optional courses (two courses may be selected)

Code	*Courses*	*Hours*
9.1.32.6.2.6.	1. Business Administration.	3
1.2.53.3.2.6.	2. Ecology.	2
	3. Construction Materials I.	4
	4. Social Geography.	2
9.2.82.3.2.6.	5. Descriptive and Higher Geometry.	3

III. Non credit courses.

Courses	*Hours*
1. Foreign Language and Technical Terminology.	2

4th SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
9.2.44.4.1.6.	1. Numerical Analysis.	4
9.2.30.4.1.6.	2. Differential Geometry.	4
	3. Foreign Language and Technical Terminology.	2
6.1.06.4.1.6.	4. Geodesy (Land surveying).	5
6.1.07.4.1.6.	5. Photointerpretation-Remote sensing.	5
6.3.02.4.1.6.	6. Structural Mechanics-Strength of Materials.	6
	Total teaching hours	***26***

II. Optional courses (one course may be selected)

Code	*Courses*	*Hours*
9.4.63.4.2.6.	1. Applied Optics.	4
6.2.02.4.2.6.	2. Urban Land and Social Processes.	2
6.3.03.4.2.6.	3. Introduction to Geotechnics.	3
	4. Construction Materials II.	3

III. Summer Mandatory courses.

Code	*Courses*	*Hours*
6.1.08.4.2.6.	1. Field course in Geodesy I.	

5th SEMESTER
COURSES

II. Mandatory courses.

Code	*Courses*	*Hours*
6.1.09.5.1.6.	1. Theory of errors and Adjustments I.	4
6.1.10.5.1.6.	2. Photogrammetry I.	5
6.1.11.5.1.6.	3. Higher Geodesy.	4
6.3.04.5.1.6.	4. Highway Engineering I (Geometric Design).	4
6.3.05.5.1.6.	5. Fluid Mechanics and Applied Hydraulics.	5
	Total teaching hours	***22***

II. Optional courses (one course may be selected)

Code	*Courses*	*Hours*
6.1.12.5.2.6.	1. Remote Sensing Digital Image Analysis.	4
6.1.13.5.2.6.	2. Special Topics in Remote Sensing.	4
6.1.14.5.2.6.	3. Analytical Cartography.	4
6.2.03.5.2.6.	4. Applications of G.I.S.	4
6.2.04.5.2.6.	5. Urban Geography.	4
2.1.19.5.2.6.	6. Operational Research.	3
6.3.06.5.2.6.	7. Building Construction.	4
6.3.07.5.2.6.	8. Structural Mechanics-Special Topics.	4

6th SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
6.2.05.6.1.6.	1. Geography and Spatial Analysis.	4
6.3.08.6.1.6.	2. Transportation Infrastructure Design-Economic aspects.	3
6.3.09.6.1.6.	3. Reinforced Concrete.	4
	Total teaching hours	***11***

II. Optional courses (three courses may be selected)

Code	*Courses*	*Hours*
6.1.15.6.2.6.	1. Special Subjects of Geodesy.	4
6.1.16.6.2.6.	2. Photogrammetry II.	4
6.1.11.6.2.6	3. Introduction to the Legal System and Elements of Technical Legislation.	3
6.1.17.6.2.6.	4. Geodetic Astronomy.	4
6.1.18.6.2.6.	5. Thematic Cartography.	4
6.1.19.6.2.6.	6. Photographic Data Acquisition.	3
6.1.20.6.2.6.	7. Reference Systems and Geodetic Projections.	3
6.2.06.6.2.6.	8. Settlements' networks.	3
6.2.07.6.2.6.	9. Methods and Models in Spatial Planning.	4
6.3.10.6.2.6.	10. Architecture.	4
6.3.11.6.2.6.	11. Open-Channel Flow and Hydraulic Structures.	3
1.5.14.6.2.6.	12. Construction equipment-Construction site organisation.	3

III. Summer optional courses.

Code	*Courses*
6.1.21.6.2.6.	Field course in Geodesy II.

7th SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
6.1.22.7.1.6.	1. Cadastre.	4
6.2.08.7.1.6.	2. Urban Planning.	4
6.3.12.7.1.6.	3. Engineering Hydrology.	4
	Total teaching hours	***12***

II. Optional courses (three courses may be selected)

Code	*Courses*	*Hours*
6.1.23.7.2.6.	1. Geodetic Satellite Positioning.	4
6.1.24.7.2.6.	2. Digital Cartography.	4
6.1.25.7.2.6.	3. Photogrammetry III.	4
6.1.26.7.2.6.	4. Radiometry and Microwave Remote Sensing.	4
6.1.27.7.2.6.	5. Hydrography and elements of Oceanography.	3
6.1.28.7.2.6.	6. Introduction to the study of the Earth's gravity Field.	3
6.3.13.7.2.6.	7. Economic Geography.	4
6.3.14.7.2.6.	8. Soil Mechanics and Foundations.	4
6.3.15.7.2.6.	9. Highway Engineering II (Traffic flow).	3
6.3.16.7.2.6.	10. Railroad Engineering.	3
6.3.17.7.2.6.	11. Matrix Analysis of Structures.	4

8th SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
6.2.9.8.1.6.	1. Regional Planning.	3
6.3.18.8.1.6.	2. Hydraulic Works.	4
	Total teaching hours	***7***

II. Optional courses (four courses may be selected)

Code	*Courses*	*Hours*
6.1.29.8.2.6.	1. Cadastre and Land Information Systems.	4
6.1.30.8.2.6.	2. Marine Geodesy.	4
6.1.31.8.2.6.	3. Theory of errors and Adjustements II.	4
6.1.32.8.2.6.	4. Metrology.	2
6.1.33.8.2.6.	5. Photogrammetry IV.	3
6.1.34.8.2.6.	6. Navigation.	3
6.1.35.8.2.6.	7. Goephysical Prospecting – Gravimetry.	3
6.2.10.8.2.6.	8. Environmental Impact Assessment from Projects and Programs.	4
6.2.11.8.2.6.	9. Sustainable use of Natural Resources.	4
6.3.19.8.2.6.	10. Groundwater Hydrology.	3
6.3.20.8.2.6.	11. Reclamation Works.	3
6.3.21.8.2.6.	12. Highway Engineering III (Intersection design and operation.	3
6.3.22.8.2.6.	13. Transportation systems.	3
6.3.23.8.2.6.	14. Rural Settlements.	4
6.3.24.8.2.6.	15. Coastal Zone Management.	3
6.3.25.8.2.6.	16. Design of Engineering Structures.	4
1.1.53.8.2.6.	17. Design of Steel Structures.	4

III. Summer optional courses.

Code	*Courses*
6.1.36.8.2.6.	Summer Field Course in Photogrammetry.
6.1.37.8.2.6.	Summer Field Course in Photointerpretation and Remote Sensing.
6.1.38.8.2.6.	Summer Field Exercises in Higher and Satellite Geodesy.

9th SEMESTER
COURSES

I. Mandatory courses.

Code	*Courses*	*Hours*
6.1.39.9.2.6.	1. Engineering Geodesy. – Case studies.	4
6.1.40.9.2.6.	2. Surveying and Documenting of Monuments.	4
6.1.41.9.2.6.	3. Special Applications of Photointerpretation and Remote Sensing.	4
6.2.12.9.2.6.	4. Environmental Planning – Case studies.	4
6.2.13.9.2.6.	5. Highway Engineering Project.	4
6.3.26.9.2.6.	6. Integration Development Project.	4
6.3.27.9.2.6.	7. Water resources management.	4
6.3.28.9.2.6.	8. Design of reclamation work systems.	4

II. Optional courses (four courses may be selected)

Code	*Courses*	*Hours*
6.1.42.9.2.6.	1. Satellite Geodesy.	4
6.1.43.9.2.6.	2. Real Estate Valuation and Land Management.	4
6.1.44.9.2.6.	3. Cadastre and Land Policy.	3
6.2.14.9.2.6.	4. Applications of Regional Planning.	4
6.2.15.9.2.6.	5. Applications of Urban Planning.	4
6.3.29.9.2.6.	6. Rural Constructions and Open Spaces.	4
6.3.30.9.2.6.	7. River Engineering.	3
6.3.31.8.2.6.	8. Highway Engineering IV (Construction Elements)	3
1.2.59.9.2.6.	9. Sanitary Engineering and Environment.	3

MANDATORY COURSES.

table 1.

	Courses	***Semester***
1. General	Analysis I.	1o
	Analysis II.	2o
	Differential Geometry.	4o
	Descriptive and Higher Geometry.	1o
	Differential Equations.	3o
	Probability Theory and Statistics.	2o
	Numerical Analysis.	4o
	Physics I.	2o
	Physics II.	3o
	General Geology.	1o
	Introduction to Computer Programming.	1o
	Computer Programming Applications.	2o
	Foreign Language and Technical Terminology.	4o
2. General courses of the Department	Technical and Topographical Design and Drawing	1o
	Principles of Geoinformation and G.I.S.	3o
	Theory of Errors and Adjustments I.	5o
Section I.	Introduction to Geodesy.	1o
	Geodesy – Geodetic Instruments and Measuring Methods.	3o
	Geodesy (Land Surveying).	4o
	Higher Geodesy	5o
	Geodesy (Land Surveying).	4o
	Photointerpretation – Remote Sensing.	4o
	Photogrammetry I.	5o
	General Cartography.	2o
	Cadastre.	7o
Section II.	Physical Geography and Environment.	2o
	Geography and Spatial Analysis.	6o
	Regional Planning.	8o
	Urban Planning.	7o
Section III.	Engineering Mechanics – Statics.	3o
	Structural Mechanics – Strength of Materials.	4o
	Reinforced Concrete.	6o
	Fluid Mechanics and Applied Hydraulics.	5o
	Engineering Hydrology.	7o
	Hydraulic Works.	8o
	Highway Engineering I. (Geometric Design).	5o
	Transportation Infrastructure Design – Economic aspects.	6o

OPTIONAL COURSES.
Basic Topographic Cycle.

table 2

Courses	***Semesters***
1. Remote Sensing Digital Image Analysis.	5o
2. Special Subjects of Geodesy.	6o
3. Photogrammetry II.	6o
4. Geodetic Satellite Positioning.	7o
5. Digital Cartography.	7o
6. Cadastre and Land Information Systems.	8o

table 3

Courses	***Semester***
1. Applied Optics.	4o
2. Analytical Cartography.	5o
3. Special Topics in Remote Sensing.	5o
4. Descriptive and Higher Geometry.	3o
5. Geodetic Astronomy.	6o
6. Photographic Data Acquisition.	6o
7. Thematic Cartography.	6o
8. Reference Systems and Geodetic Projections.	6o
9. Radiometry and Microwave Remote Sensing.	7o
10. Hydrography and Elements of Oceanography.	7o
11. Introduction to the study of the Earth's Gravity Field.	7o
12. Photogrammetry III.	7o
13. Metrology.	8o
14. Geophysical Prospecting – Gravimetry.	8o
15. Photogrammetry IV.	8o
16. Navigation.	8o
17. Marine Geodesy.	8o
18. Theory of Errors and Adjustements II.	8o
19. Real Estate Valuation and Land Management.	9o
20. Satellite Geodesy.	9o
21. Cadastre and Land Policy.	9o
22. Special Subject of Geodesy.	6o
23. Summer Field Exercises in Higher and Satellite Geodesy.	8o
24. Summer Field Course in Photogrammetry.	8o
25. Summer Field Course in Photointerpretation and Remote Sensing.	8o
Practical Courses	***Semester***
1. Surveying and Documenting of Monuments.	9o
2. Special Applications of Photointerpretation and Remote Sensing.	9o
3. Engineering Geodesy.	9o

SPECIALIZATION IN TOPOGRAPHY

Table 4

Courses	***Semester***
1. Special Topics in Remote Sensing.	5o
2. Thematic Cartography.	6o
3. Reference Systems and Geodetic Projections.	6o
4. Photogrammetry III.	7o
5. Marine Geodesy.	8o
6. Theory of Errors and Adjustments II.	8o

Table 5

Courses	***Semester***
1. Applied Optics.	4o
2. Analytical Cartography.	5o
3. Remote Sensing Digital Image Analysis.	5o
4. Special Subjects of Geodesy.	6o
5. Photogrammetry II.	6o
6. Descriptive and Higher Geometry.	3o
7. Geodetic Astronomy.	6o
8. Photographic Data Acquisition.	6o
9. Geodetic Satellite Positioning.	7o
10. Radiometry and Microwave Remote Sensing.	7o
11. Digital Cartography.	7o
12. Hydrography and Elements of Oceanography.	7o
13. Introduction to the study of the Earth's Gravity Field.	7o
14. Metrology.	8o
15. Geophysical Prospecting – Gravimetry.	8o
16. Photogrammetry IV.	8o
17. Cadastre and Land Information Systems.	8o
18. Navigation.	8o
19. Real Estate Valuation and Land Management.	9o
20. Satellite Geodesy.	9o
21. Cadastre and Land Policy.	9o
22. Special Subjects of Geodesy.	6o
23. Summer Field Course in Higher and Satellite Geodesy.	8o
24. Summer Field Course in Photogrammetry.	8o
25. Summer Field Course in Photointerpretation and Remote Sensing.	8o
Practical courses	***Semester***
1. Surveying and Documenting of Monuments.	9o
2. Special Applications of Photointerpretation and Remote Sensing.	9o
3. Engineering Geodesy.	9o

SPECIALIZATION IN REGIONAL – URBAN PLANNING AND DEVELOPMENT

table 6

Courses	***Semester***
1. Urban Geography	5o
2. Applications of G.I.S.	5o
3. Economic Geography.	7o
4. Environmental Impact Assessments from Projects and Programs.	8o
5. Applications of Urban Planning.	9o
6. Applications of Regional Planning.	9o

OPTIONAL COURSES
REGIONAL – URBAN PLANNING AND DEVELOPMENT

table 7

Courses	***Semester***
1. Social Geography.	3o
2. Urban Land and Social Processes.	4o
3. Settlement's Networks.	6o
4. Methods and Models in Spatial Planning.	6o
5. Sustainable use of Natural Resources.	8o
6. Transportation Systems.	8o
7. Cadastre and Land Information Systems.	8o
8. Real Estate Valuation and Land Management.	9o
9. Cadastre and Land Policy.	9o
10. Analytical Cartography.	5o
11. Thematic Cartography.	6o
12. Architecture.	6o
Practical courses	***Semester***
1. Integration Development Project.	9o
2. Environmental Planning.	9o

SPECIALIZATION IN WATER RESOURCES.

Table 8

Courses	***Semester***
1. Building Construction.	5o
2. Open Channel Flow and Hydraulic Structures.	6o
3. Soil Mechanics and Foundations.	7o
4. Ground Water Hydrology.	8o
5. Reclamation Works.	8o
6. River Engineering.	9o

OPTIONAL COURSES OF WATER RESOURCES.

table 9

Courses	***Semester***
1. Ecology.	3o
2. Construction Materials I.	3o
3. Introduction to Geotechnics.	4o
4. Construction Materials II.	4o
5. Structural Mechanics – Special Topics.	5o
6. Architecture.	6o
7. Matrix Analysis of Structures.	7o
8. Rural Settlements.	8o
9. Coastal Zone Management.	8o
10. Highway Engineering III. (Intersection design and operation).	8o
11. Environmental Impact Assessment from Projects and Programs.	8o
12. Sanitary Engineering and Environment.	9o
13. Rural Constructions and Open Spaces.	9o
Practical courses	**Semester**
1. Water Resources Management.	9o
2. Design of Reclamation Work Systems.	9o

SPECIALIZATION IN TRAFFIC ENGINEERING.

table 10

Courses	Semester
1. Building Construction.	5o
2. Soil Mechanics and Foundations.	7o
3. Highway Engineering II (Traffic flow).	7o
4. Railroad Engineering.	7o
5. Highway Engineering III (Intersection Design and operation).	8o
6. Transportation Systems.	8o

OPTIONAL COURSES OF TRAFFIC ENGINEERING

Table 11

Courses	Semester
1. Ecology.	3o
2. Construction Materials I.	3o
3. Introduction to Geotechnics.	4o
4. Construction Materials II.	4o
5. Structural Mechanics – Special Topics.	5o
6. Architecture.	6o
7. Construction equipment – Construction site organisation.	6o
8. Matrix Analysis of Structures.	7o
9. Design of Steel Structures.	8o
10. Rural Settlements.	8o
11. Highway Engineering III (Intersection design and operation).	8o
12. Environmental Impact Assessment from Projects and Programs.	8o
13. Rural Constructions and Open Spaces.	9o
Practical courses	**Semester**
1. Highway Engineering Project.	9o

OTHER OPTIONAL COURSES

table 12.

Courses	Semesters
1. Principles of Economic Science.	1o
2. Philosophy of Science.	1o
3. Urban Sociology.	2o
4. History of Culture.	2o
5. Chemistry.	2o
6. Business Administration.	3o
7. Operational Research.	5o
8. Introduction to the Legal System and Elements of Technical Legislation.	6o

- ***Technical and Topographical Design and Drawing.***
  Mandatory course in the 1st semester.

  Description of drawing instruments. Principles of drawing. Legends. Definition of scale. Geometrical traces. Representation of the building space.. Design of a simple geometrical solid on the ground : floor plan, sections, elevations, axonometrics. Design of open, covered and enclosed buildings :site plan, floor plan, sections and elevations, in scales: 1/200, 1/100, 1/50. Topographic design and the general rules of graphic design. The different scales of topographic design as related to the graphic accuracy. Constructing the grid, the layout and the legend. Portraying technical constructions. Drawing procedures in portraying the horizontal details. Portraying the land-surface form, contouring. System of horizontal coordinates. Cadastral and city-plan diagrams. The design of intersections and sections.

- ***Analysis I***
  Mandatory course in the 1st semester.

  Real-valued functions of a real variable. Sequences and Series. Limits, continuity, derivatives and differential functions. Study of functions with derivatives. Definite integral. Indefinite integral Rules of integration. Applications of integration. Taylor's series. Linear spaces. Basics and dimension of a linear space. Linear spaces with scalar product. Matrices, Linear transformation and their matrices Determinants. The inverse of a square matrix. Linear system. Vectors Equations of lines and planes. Cross product. Eigenvalues and eigenvectors. Diagonalizable matrices. Cayley-Hamilton theorem.

- ***Introduction to Geodesy***
  Mandatory course in the 1st semester.

  Introduction and historical review. Shape and size of the earth. Reference surfaces. Introduction to geodetic observations and methods. Geometry of the sphere and the ellipsoid (basic concepts, ρ, N,r). Geodetic coordinates (φ,λ). Arc length. Coordinate systems in two and three dimensions. Basic concepts and determination of reference systems: Astronomic, terrestrial, geodetic system. Topocentric and Geocentric systems. Determination of CGRS '87. Introduction to map projections. Difference between topographic plane coordinates and projection plane coordinates. Basic computations in the plane and the sphere. Significant digits. Applications. Hatt and Mercator projection used in CGRS '87. Reductions due to projection. Reference systems transformations. Transformation in the plane (x,y) . Translation, rotation and scale.

- ***Descriptive and Higher Geometry.***
  Mandatory course in the 1st semester.

  The projective space, plane and line. Cross ratio. The principle of duality. Projective transformations of the line and the plane. The central and parallel homology in the plane. Exercises.

Introduction to the Descriptive Geometry. The system with two projection planes. Representation of a point, line and plane. Intersection of a plane with a line or a plane. Methods for solving problems. Representation of a polyhedron and its intersection with a line or a plane. Development of a polyhedron. Exercises. Applications.

The system with one projection plane and the elevations. Representation of a point, line and plane. Intersection of a plane with a line or a plane. Representation of a polyhedron and its intersection with a line or a plane. Exercises. Applications.

Introduction to the perspectivity. The perspective image of a plane polygon. The perspective image of a polyhedron. Exercises. Applications.

- ***General Geology.***
  Mandatory course in the 1st semester.

Endogenic dynamic geology. Earth's consist, temperature, isostasy. Endogenic energy, theory of tectonic plates. Tectonic processes, tectonic events. Earthquakes. Geological structure effect to the seismicity of the Greek area. Igneous processes. Volcanism. Minerals and rocks coming from the magma. Metamorphism, metamorphic rocks. Exogenic dynamic geology. Weathering, erosion denudation. Water action, water tables. Karst and fluvial cycle of erosion. Coasts and costs evolution, changes and protection of the coasts.

- ***Introduction to computer programming***
  Mandatory course in the 1st semester.

Short history of computers and programming. Evolution of computer architecture and main components of computer hardware (CPU, RAM, ROM, ALU, system bus, I/O, hardware, software). Principles of operating systems and Application software. Binary system and internal representation of numbers in computers. Principles of programming, algorithms and flow-charts. Evolution of computer languages. Programming in structured BASIC (QuickBASIC). The environment and editor of QB. Data types and their characteristics (arithmetic, alphanumeric and logical constants or variables). Arithmetic, relational and logical operators and expressions. Declaring and using array variables. Syntax and usage of commands in QB. Input / output of data from the console. Control-flow structures (decision structures, looping structures) and corresponding commands.

- ***Principles of Economic Science.***
  Optional course in the 1st semester.

Political Economy aims to acquaint students with the basic notions of contemporary economic science, giving special gravity to macroeconomic analysis. By the completion of the course, the students shall be capable to understanding and analyse the statistical data of the national and international economy, as well as to investigate the relations and mechanisms that determine the immediately detectable economic phenomena. At the same time, students shall also be capable to form a scientific opinion on economic policy.
The course extends to the following major areas:

- The National Income Accounts
  Gross National Product and Net National Product. Calculating the GNP. Real and Nominal GNP. Price Indexes. Factor Shares in National Income. Outlays and Components of Demand. The Basic Macroeconomic Identities. Balance Sheets.
- Equilibrium Output
  The Consumption Function and Aggregate Demand. The Consumption-Income Relationship. The Multiplier. The Government Sector. Budget, Taxes, Government Purchases, Transfers.
- Money, Interest and Income
  The Goods Market and the IS Curve. The Assets Market and the LM Curve. Equilibrium in the Goods and Assets Market. Monetary Policy. Fiscal Policy. Growding Out and Policy Mix.
- International Linkages
  The Balance of Payments. Exchange Rates. Market Equilibrium and the Balance of Trade. Capital Mobility. International Integration and the European Union.
- Aggregate Supply and Demand
  The Classical Supply Curve. The Keynesian Supply Curve. The Aggregate Demand Schedule. Monetary and Fiscal Policy under alternative Supply Assumptions. The Quantity Theory of Money. The Market-Clearing Approach.
- Long-term Growth and Productivity
  Sources of Growth. The Production Function. Empirical Estimates of the Sources of Growth. Output Growth and Supply-Side Economies. Limits to Growth. Technical Progress. Growth and Development of the Greek Economy after World War II.

♦ ***Philosophy of Science***
Optional course in the 1st semester.

Distinction between analytic and synthetic judgements (truths of reason and truths of fact) in Leibniz. Application of this distinction by D. Hume. To the analysis of causality. Kant's reply to Hume: Synthetic judgements a priori. The Conventionalist interpretation of the distinction. Quines criticism of analyticity. Contextualism and the idea of Incommonsurability of conceptual changes. Criticism of Contectualism by means of the analytic-synthetic distinction.

♦ ***Urban Sociology.***
Optional course in the 2nd semester.

Theoretical approach of urban space, urban versus rural life, urbanisation in Greece, social theories about urban space, processes of urbanisation, social integration in urban space, symbolism and urban space. The actual social structure of urban spaces (urban housing, working areas, leisure activities, churches and cemeteries). Components of the economic system and urbanism. The development and the protection of urban space. The future of cities.

♦ ***History of Culture***
Optional course in the 2nd semester.

Distinctive elements of the phenomenon of science and their interaction. Refutation of geocentric conceptions by Copernicum and Galileo, and the turn to objectivity.

The Newtonian synthesis. The class the twentieth century: Relativity and Quantum Mechanics.

- ***Physics I***
  Mandatory course in the 2nd semester.

  Kinematics of the point mass. Statics. Dynamics. Work, energy. Principles of conservation. The dynamics of a system of particles. Rotational motion. Gravitation. Central forces. Special theory of relativity. Elasticity. Oscillations. Mechanical waves. Sound. Thermodynamics: first and second law of thermodynamics.

- ***Physical Geography and Environment.***
  Mandatory course in the 2nd semester.

  The lesson provides scientific knowledge concerning the natural environment and its relationship with the human activities. Its aims are to examine and evaluate the elements of the natural environment, their structure and spatial distribution and the changes which man caused to the nature.
  In this lesson the approach of Physical Geography is an opportunity to synthesize and integrate Biogeography and Geography in order to explain the spatial dimension of the natural systems (air, water, soils, climates) and the earth-human relationships.
  The lesson also provides practicing in special issues which improve the overall learning process.

- ***Probability Theory and Statistics***
  Mandatory course in the 2nd semester.

  Descriptive statistics. Concept, rules and properties of probability. Conditional probability, independence of events, Bayes theorem. Distributions of random variables. Expected value and variance. Basic distributions and applications. Bivariate distributions, independence of random variables. Central limit theorem. Sampling distributions. Point estimation, confidence intervals and statistical hypothesis testing. Linear model: estimation and testing of parameters, coefficient of determination, prediction. X^2 – goodness of fit test, probability plotting. Contingency tables. Applications using computer packages.

- ***General Cartography***
  Mandatory course in the 2nd semester.

  Introduction (cartography and earth sciences, the concept of cartography, principles of cartography, map definition, map classification). History of cartography. Cartographic data (nature of cartographic data, data sources-data acquisition, data analysis). Elements of mathematical cartography (physical earth surface and projection on plane, principles of maps projections, study of map distortions, basic map projections). Cartographic visualisation. The concept of color in cartography. Cartographic generalisation. Topographic relief presentation. Map composition. Name placement. Map production. Measurements from maps (length, angle, area, volumes, accuracy issues). Greek cartographic publications and organisations.

- ***Chemistry***
  Optional course in the 2nd semester.

  Introduction to chemical principles. Atomic theory. Classification of elements and Periodicity. States of matter. Solid State Chemistry. Properties of solution and colloids. Principles and applications of chemical kinetics and chemical equilibrium. Water chemistry. Atmospheric chemistry. Soil chemistry. Heavy metals. Materials (fertilizers, cementitious mixtures, etc.). Fuels.

- ***Analysis II***
  Mandatory course in the 2nd semester.

  Function of several real variables. The space R. Limits and continuity. Partial derivatives Differentiability and differential of a function. Taylor's theorem. Local maxima and minima. Implicit function. Integral calculus (double, triple, line and surface integrals, Applications). Vector analysis (vector field theory, Green's Gauss', Stokes' theorems and applications. Elementary complex functions. Differentiation and integration. Cauchy's Theorem. Power series and Laurent's series. Basic theorems. Residues of a function. Conformal mappings. Linear-fractional mappings.

- ***Computer programming applications***
  Mandatory course in the 2nd semester.

  Advanced structured programming. More control-flow commands (SELECT CASE, WHILE, DO-LOOP etc.). Modules and procedures (subroutines and functions): definitions, calling of procedures, differences between subroutines and functions. Dynamic and static variables. Sharing variables between procedures. Passing arguments by value or by reference. File input / output. Sequential and random-access files. Working with data files and databases. String processing. Principles of computer graphics. Pixels and coordinate systems. Drawing points, lines and basic shapes. Elementary topographic applications.

- ***Engineering Mechanics-Statics***
  Mandatory course in the 3rd semester.

  Introduction: Force, Moment, Composition of forces, Funicular polygon, Moment and Couple. Equilibrium: Resultant, Equilibrium Conditions. Center of gravity, Centroids of lines, surfaces and volumes, Pappus theorem. Friction, applications. Structures, Loads, Supports, Reactions. Trusses, simple and complex trusses, Analytical and graphical methods of solution, method of sections. Plane Beams, Bending moments, shearing forces, Axial forces. Diagrams of internal forces, Simply supported beam, Cantilever, Hinged beam. Frames, Three-hinged arch. Cables. Principle of Virtual Work.

- ***Principles of GeoInformation and GIS***
  Mandatory course in the 3rd semester.

  The course introduces the students to the basic elements of Geospatial information and Geographic Information Systems (GIS). The course consists of two Parts (A & B), which progress simultaneously.

Part A is designed in such way to familiarize the students with concepts of space and to provide elementary knowledge of GIS use and development, including data models, data collection, data structures, data representation and cartographic principles. Part B introduces the technical issues of GIS regarding object oriented and relational models, spatial database design, spatial analysis and decision making. During the course the students practice with GIS software, conducting a series of exercises that constitute a semester project.

- ***Construction Materials I.***
  Optional course in the 3rd semester.

Introduction (General properties-Measurement techniques)-Mortar-Cement-Thermal protection. Methods and Materials-Moisture protection-Methods and Materials for vapor barriers-Laboratory and classroom exercises.

- ***Physics II***
  Mandatory course in the 3rd semester.

Electric charge. Electrostatic field. Capacitors. Electric current. Magnetic field. Magnetic dipoles. Interaction of electric current with a magnetic field. Induction, self-induction, alternating currents. Electrical oscillations. Matter in an electric or a magnetic field. Maxwell's equations. Electromagnetic waves.

Waves: characteristics of waves. The nature and propagation of light. Photons, electrons and atoms. The structure of the atom.

- ***Projective Geometry.***
  Optional course in the 3rd semester.

The central and parallel homology. Solving problems in space with the use of homology. Quadric surfaces and conic sections. The perspective transformation as central homology and its properties. The perspective image of a plane and a solid (curvilinear) figure. Exercises. Applications.

- ***Differential Equations.***
  Mandatory course in the 3rd semester.

First Order D. E.: Separable Variables, Exact Equations, Integrating Factor, Linear Equations, Bernoulli and Riccati Equations, Homogeneous Equations, Lagrange and Clairaut Equations, Orthogonal Trajectories
Qualitative Theory: Existence and Uniqueness Theorems (Picard and Peano)
Linear Equations: Basics, Fundamental Theorems for homogeneous equations, Homogeneous Equations with Constant Coefficients, Nonhomogeneous equations: Undetermined Coefficients Method (Euler) Variation of Parameters Method (Lagrange).
Series Solutions: Series and Sequences of Functions, Series Solutions near and regular singular point: Frobenius Theory, Bessel Equations and Functions.
Systems and D.E.: Basic notions, Elimination Methods, Fundamental Theorems for Homogeneous Systems with Constant Coefficients, **Nonhomogeneous Systems:** Undetermined Coefficients Method, Variation of Parameters Method (Lagrange).

Laplace Transform: Basic notions, Properties, Heaviside function, Convolution, Inverse Laplace Transform, Applications for D.E. and Systems.

- ***Social Geography.***
  Optional course in the 3rd semester.

  The Social Geography course combines a theoretical approach dealing with the scope of social geography in urban studies and social science. It is also completed with exercises of regional analysis based on data of statistical services. Most particularly in the theoretical level it deals with subjects such as : Definitions of terms : "urban, urbanism, urbanization". The sociological tradition and Social Geography : Classical German urban sociology. The Chicago School. Spatial definitions of social geography studies. Locational Analyses and studies of systems of cities towns and regions. Regional analysis. Location quotient, Christaller's theory of the emergence of an urban hierarchy.

- ***Business Administration.***
  Optional course in the 3rd semester.

  Basic meanings of production-exchanges-prices and money.
  Types of management of the market, competition and entrepreneurial goals.
  Principles of programming and forecasting techniques. The contents of management.
  Basic principles and functions of management. Analysis and evaluation of technical projects. The interval-external business environment. The interconnection of strategic targets and business planning. Analysis of entrepreneurial risks taking. Growth incentives.

- ***Ecology.***
  Optional course in the 3rd semester.

  Basic ecological concepts: organization at the level of organisms, populations and ecosystems. Flow of energy-circulation of chemical substances. Land and water ecosystems. Mathematical models. Humans and the environment. Alternations of environment and environmental consequences. Water pollution, atmospheric pollution and car noise. Technologies and policies for pollution control. Special topics and engineering applications.

- ***Geodesy (Geodetic Instruments and Measuring Methods)***
  Mandatory course in the 3rd semester.

  Theory of observations-Elementary error theory-Propagation of errors-Significant figures. Definitions of geodetic elements (directions, angles, distances, height differences). Instruments and methods for direction and angle measurements-Corrections and reductions. Instruments, systems and methods for distance measurements-Corrections and reductions. Instruments and methods for the determination of height differences. Elements of G.P.S. positioning.

- ***Field Course in Geodesy I***
  Summer Optional course in the 4th semester.

  Summer field course based on geodetic subjects taught up to the 4th semester. Students' practice includes: establishment and measurements of a network and a traverse, detail surveying, setting out of a road axis and measurements for its longitudinal section and cross sections. Written or oral examination with the delivery of the final technical report and drawings. The course takes place in Zografou Campus or in the greater Athens area.

- ***Urban Land and Social Processes***
  Optional course in the 4th semester.

  This course focuses on the relation between land use and land values. In the first part, it elaborates on mechanisms of land use development with emphasis on factors affecting land values. It also elaborates on land value assessment methods. In the second part the focus is placed on land use development and its impacts on spatial dynamics. Different theoretical approaches will also be presented in the third part, on issues of land policy and their impacts together with case studies from different countries.

- ***Structural Mechanics – Strength of Materials.***
  Mandatory course in the 4th semester.

  Mechanical properties of materials. Stress, strain, elasticity, plasticity, superposition. Tension. Compression, Poisson's ratio. Three dimensional and plane stress, Mohr's circle. Moments of inertia. Symmetric bending, unsymmetric bending. Shear, shear center. Torsion. Eccentric loading of short columns, core, neutral zone. Differential equation of elastic line. Strain energy, Castgliano's theorem, principle of vitrual work. Statically indeterminate beams, method of superposition, theorem of three moments. Thermal stresses. Long columns, Euler's formula, "ω" coefficients. Combined loadings. Tresca , v. Mises, Mohr criteria Coulob's equations. Laboratory test: Behavior and mechanical properties of materials. Testing methods. Experiments. Stress-strain measurements. Experimental stress analysis. Methods of research. Materials. Models. Techniques.

- ***Numerical Analysis***
  Mandatory course in the 4th semester.

  Introduction in **Matlab** and **Mathematica**, basic concepts and tools.
  Linear Systems. Explicit methods (Gauss, Factorization). Iterative methods (Jacobi, Gauss-Seidel, SOR). Power method for the calculation of the eigenvalues. Applications in Matlab and Mathematica.
  Interpolation and Polynomial Approximation. Polynomials of Taylor, Lagrange, Newton. Hermite and Spline Interpolation. Applications in Matlab and Mathematica.
  Non Linear Equations. Methods of Bisection, Regula Falsi. Iterative methods of Fixed-Point, Newton-Raphson, Secant and Schroder. Newton method for non linear systems. Applications in Matlab and Mathematica.

Numerical Differentiation and Integration. Approximation of Derivatives of several order, Simple formulas of Numerical Integration, Composite Trapezoidal and Simpson's Rule, Newton-Cotes Integration, Gauss Integration, Integration in an infinite interval. Applications in Matlab and Mathematica.
Differential Equations. Initial value problem, errors in numerical methods. One-step methods (Taylor, Runge-Kutta). Construction of Runge-Kutta methods. Multistep methods (Adams, Predictor-Corrector). Applications in Matlab and Mathematica.
Approximation Theory. Discrete Least-Squares Approximation (polynomial, exponential). Least-Squares function approximation, Least-Squares with orthogonal polynomials. Applications in Matlab and Mathematica.
Boundary Value Problems. Approximation of Partial Derivatives. Linear Shooting Method, Finite-Difference Method, Galerkin Method with Finite Elements. Applications in Matlab and Mathematica.

- ***Photointerpretation - Remote Sensing***
  Mandatory course in the 4th semester.

Introduction. Basic concepts and Philosophy of Photointerpretation and Remote Sensing.
Basics from physics and mathematics. Electromagnetic radiation. Sensors and images.
Photointerpretation and Remote Sensing instruments and measurements.
Satellite Remote Sensing Programs and operational applications. Possibilities and constraints. Prospects.
Photointerpretation and Remote Sensing analogue and digital methods and techniques for Earth Observation and Monitoring by airborne and satellite systems.
Applications in the scientific/technical and professional fields of the Rural and Surveying Engineer.
Remote Sensing and GIS Integration Applications for Land and Environment Inventories, Mapping and Monitoring.

- ***Introduction to Geotechnics***
  Optional course in the 4th semester.

Geological environment: Plate tectonics, Seismicity, Structure, In situ stresses, Surface processes, Hydrological conditions. Geotechnical description of rocks and soils: Rock structure-rock material, Discontinuities, Stereographical projection, Mechanical properties, Classification systems. Structure of soils-Classification, Mechanical properties. Site investigation-maps, photointerpretation, In situ probes. Applications of Geotechnical Engineering-Slopes, Underground Constructions-Tunneling, Applications in Highway Engineering and Hydraulic Structures.

- ***Applied Optics***
  Optional course in the 4th semester.

Geometrical optics (reflection, refraction, lenses, mirrors, prisms). Optical instruments (eye, photographic camera, telescopes, resolving power of optical instruments). Sources of light and detectors of optical radiation (radiometry and photometry, black body, emission photodiodes, detectors). Wave optics (superposition, interference, diffraction, wave coherence). Interferometry, interferometric techniques. Holography and Fourier optics.

The laser (principles of operation, representative types of lasers). Electromagnetic and polarisation effects. Optical waveguides, optical fibre measurements, transmission of information with optical fibres, optical communication. Integrated optics, optical memories, optical transistors, optical computers. Atmospheric optics, pollution detection in the atmosphere, LIDAR. Infrared photography, imaging and observation. I^2 image detectors. Imaging and observation with I^2 devices. Thermal imaging, thermal observation. Laser telemetry (IDM modulated beam, pulse echo, interferometric). Presentation of information by optical means (cathode-ray tubes, screens, television, imaging devices, etc.). Satellite telecommunications, measurement of solar ultraviolet radiation, hydrographic applications of the LIDAR, monitoring of climate changes etc.

- ***Geodesy (Land Surveying)***
  Mandatory course in the 4th semester.

Geodetic Networks-Horizontal and Vertical Control Networks-State and local Coordinate Systems. Triangulation-Intersection, Resection. Traversing (high accuracy traverses and networks)-Urban traverse networks. Topographical surveys-Topographical diagrams (by using modern technology): Field work, computations and plotting-Profiling and cross sectioning-Earth work computations. Setting out of straight lines and basic curves-Setting out of roads-Urban applications.

- ***Differential Geometry.***

A. Mandatory course in the 4th semester.

Curves: The concept of a curve, are length, target line, osculating plane, principal normal, curvature, moving trihedron, torsion, formulae of Frenet, contact, osculating sphere, involutes and evolutes.
Surfaces: The concept of a surface, curves on a surface, tangent plane, first fundamental form, normal vector to a surface, area in surfaces, second fundamental form, arbitrary and normal section of a surface, Mesnier's theorems, elliptic, parabolic and hyperbolic point of a surface, principal curvatures, lines of curvature. Gaussian and mean curvature. Duping indicatrix, geodesic curvature, geodesics, geodesic polar coordinates theorems of Gauss-Bonnet.
Mappings: Isometric mapping, stenographic and Mercator projection, equiereal mappings, mappings of Lambert, Sanson and Bone.

- ***Construction Materials II.***
  Optional course in the 4th semester.

Asphalt-Latex and Elastomeric materials-Damproofing-Materials for surface protection layers-Colours-Welding materials-Walls and Partitions-Stones-Marbles-Artificial blocks and tiles-Wood-Glass-Other materials-Cement waterproofing bed-Concrete-Iron-Steel-other metals-Noise protection. Methods, materials-Laboratory, and classroom exercises.

- ***French Language and Technical Terminology***
  Non credit course in the 1st, 2nd, 3rd, 4th semester.

The aim of the two-year French Language course is to cover basic issues of the language grammar and intermediate vocabulary and to enable the students to consult technical bibliography and to use the technical language.

It comprises two distinct cycles:
a. 1st – 3rd semester:
Everyday language combined with technical terminology:
Details study and translation of technical texts which can also be of some practical use.
Language problems, classified in broad structure units, are examined: question, negation, articles, pronouns, prepositions, conjunction, common adverbs etc.
Examples with their translation and clarifications are given.
b. 4th semester:
The syllabus includes the gradual enrichment of the vocabulary on technical terminology through authentic technical texts of the students' major and comprehension as well as translation practice of such texts. The cycle is mandatory.

- ***English Language and Technical Terminology***
  Non credit course in the 1st, 2nd, 3rd and 4th semester.

The aim of the two-year English language course is to cover basic issues of the grammar and vocabulary on an intermediate level and to enable students to consult technical bibliography and use the technical language.
It comprises two distinct cycles:
1st –3rd semester: The syllabus covers the teaching of the current language in reading, listening and writing as well as basic issues of the grammar and syntactical structure for the intermediate students. Students who hold specific competence certificates can be exempted from this cycle.
4th semester: The syllabus includes gradual enrichment of the vocabulary on technical terminology through authentic technical texts of the students' major as well as comprehension and translation practice of such texts. This cycle is mandatory.

- ***Italian Language***
  Non credit course in the 1st, 2nd, 3rd and 4th semester.

The aim of the two-year foreign Language course is to cover basic issues of the Language grammar and Intermediate rocabory and syntactical structure for intermediate students (for 1st, 2nd, 3rd semester), to enable student to consult technical bibliography and use the technical language (4th semester).

- ***German Language***
  Non credit course in the 1st, 2nd, 3rd and 4th semester.

Foreign Language and Technical Terminology : German

The aim of the Two-year Foreign Language Course is to cover basic issues of the Language and Intermediate vocabulary and to Enable students to consult technical bibliography and use the technical Language.

- ***Special Topics of Remote Sensing***
  Optional course in the 5th semester.

  Advanced topics of airborne and satellite analogue and digital Remote Sensing methods and techniques.
  Advanced topics of Recognition, Analysis, Interpretation, Processing and Evaluation of remotely sensed imagery.
  Digital Image Processing Systems and Software for educational, research and professional use.
  Interdisciplinarity of Remote Sensing methodologies and Integrated Surveys.
  Introduction to Integrated Land, Development and Environment Information Systems.
  Remote Sensing applications in Natural Resources Inventories, Land Use/Cover Monitoring and Mapping.

- ***Remote Sensing Digital Image Analysis.***
  Optional course in the 5th semester.

  Computational Image Interpretation. Image Histogram. Contrast enhancement and stretching, linear histogram stretching, histogram equalisation, histogram saturation. Display alternatives, colour processing. Filters, edge enhancement, high pass filtering, smoothing, low pass filtering, gradient, Laplacian. Spatial registration, geometric manipulation, coordinate transformation, interpolation. Feature extraction : spectral rationing, principal component analysis, vegetation indeces. Mathematical concepts for image classification, discriminant functions, Bayes theory, Density slicing. Supervised training and classification : parallelepiped, table look-up, decision tree, minimum distance, maximum likelihood. Unsupervised training and clustering, Algorithms : Kmeans, ISODATA. Postclassification processing. Classification accuracy. Data merging, Geographic information systems. Change detection. Applications. Introduction to computer vision.

- ***Operational Research.***
  Optional course in the 5th semester.

  Subject and Methodology: Development, nature and definition of OR, basic characteristics, methodology, categories of problems.
  Allocation Problems-Linear Programming (LP): The allocation problem, formulation of the general LP model, Simplex method, duality theory, sensitivity analysis, transportation problem, assignment problem decomposition principle.
  Non-linear Programming: Introduction, Uncostrained and con-strained optimization algorithms.
  Dynamic Programming: Introduction, one-dimensional processes and applications.
  Investment Analysis: Investment problems, discounting (and compounding) Preparation stages of an Investment plan. Investment selection criteria, Investment planning. Cost-benefit analysis.

- ***Building Construction***
  Optional course in the 5th semester.

  Preparation work of the soil. Work required for the structural systems, (foundation, bearing structure, floors, walls, roofing systems). Other building systems (painting, flooring, metal work, marble, coloring.

Waterproofing, thermal insulation, noise insulation. Explanation of building solutions, alternatives and setting of priorities. Reference to vernacular techniques. Workshop: design and drafting of building details of a simple building (open, covered and enclosed): building structure and insulations, roofing and disposal of rain water, circulation (ramps, stairs), Geometrical traces. scales: 1/20, 1/10, 1/5,…

- **Structural Mechanics – Special Topics.**
  Optional course in the 5th semester.

  Elastic analysis: Fundamental methods of indeterminate Stuctures. The Force Method. Primary Structure. Compatibility equations. Deflections of Structures: Moment-area theorems, Castigliano's 2nd theorem. Principle of virtual work. The Displacement Method. Kinematics of Elastic structures, structures with and without sidesway. Fixed-end actions. Equilibrium equations. Moment Distribution Method. Member stiffness factor, distribution factor, carry-over moment, thermal effects, support yielding.

  Plastic Analysis: Elastoplastic materials. Indeterminate problems in tension and compression. Plastic torsion. Plastic shear. Plastic buckling of columns. Plastic design of beams and frames. Collapse mechanisms. Limit load.

- ***Photogrammetry I***
  Mandatory course in the 5th semester.

  Introduction to the photogrammetric process-Photogrammetry and Surveying. Applications and subdivision of Photogrammetry. Data collection-Geometry of the camera. Measurement and corrections of image-coordinates-Interior orientation. Photogrammetric cameras. Image and space coordinate systems. Exterior orientation. Collinearity equation. Monoplotting. Parallax and elevation determination. Geometry of stereopair-General principles of photogrammetric instruments. Stereoplotting instruments. Relative and absolute orientation. General principles of analytical and digital instruments, DTM's, orthophotos and aerialtriangulation.

- ***Fluid Mechanics and Applied Hydraulics.***
  Mandatory course in the 5th semester.

  Basic characteristic properties of fluids. Hydrostatics. Kinematics. Fundamental equations of fluid mechanics. General equations for conservation of mass, momentum, and energy. Real and ideal fluids. One-dimensional equation of conservation of mass, momentum and energy. Laminar flow in pipes. Boundary layer theory. Coefficient of friction. Darcy-Weisbach equation and Moody diagram. Basic principles and applications in steady flow in closed conduits under pressure. Introduction to uniform flow in open channels. Specific energy. Characterization of flow regarding criticality. Froude number.

- ***Theory of Errors & Adjustments I***
  Mandatory course in the 5th semester.

  Introduction to adjustment theory, principle of Least Squares. Statistical concepts. Estimation of a single variable from direct measurements (equally and unequally weighted).

Multidimensional variables. Variance-Covariance propagation. Bivariate normal distribution, error ellipse.
Least Squares adjustments by the methods of observation and condition equations. Estimation of Variance-Covariance matrices.
Geodetic applications.

- ***Higher Geodesy.***
  Mandatory course in the 5th semester.

Introduction. Reference surfaces. Shape and size of the Earth. Geometry of the ellipsoid.
Reference systems. Geodetic Datum. Datum transformations.
Geodetic networks for horizontal and vertical control. 3D networks.
The influence of the atmosphere on geodetic measurements.
Field work. Instruments and measurement methods for first order networks.
Deflection of the vertical. Astrogeodetic methods.
First order levelling, accuracies and computations. Dynamic theory of heights.
Corrections and reductions of geodetic measurements on the reference surface.
Computations on the ellipsoid for positioning.
Elements of map projections. Distortions.

- ***Analytical Cartography***
  Optional course in the 5th semester.

Introduction. Physical earth surface-geoid-ellipsoid. Geographical co-ordinates. Plane co-ordinates. Principles of map projections. Study of map distortions. Study of map projections (cylindric, conic, azimuthal). Greek cartographic systems. Transformations between cartographic systems. Measurements from maps-cartometry (measurements of length-area, error analysis, data reduction, statistical sampling and cartography). Interpolation methods (one-dimensional interpolation, two-dimensional interpolation, digital terain models, data smoothing, hill shading algorithms). Geometrical transformations. Polygon transformations. Data structure transformations. Line simplification algorithms.

- ***Urban Geography***
  Optional course in the 5th semester.

The town's system: the procedure of urbanism, the towns' interactions. Towns' hierarchy and areas of influence. Towns of the periphery.
The town system: Elements that constitute the urban areα, urban evolution and urban transports. Land uses, town limits and formal definitions.
The problems of urban space. Transportation, transports, habitation in town, social problems.

- ***Highway Engineering I (Geometric Design)***
  Mandatory course in the 5th semester.

Introduction. Geometric configuration of a roadway. Tractive and braking forces of vehicles. Vehicle cornering. Pavement friction. Geometric design elements of horizontal alignment. Direction diagram of an alignment.

Limiting values of horizontal design elements. Design speed. Operating speed. Speed limit. Climbing speed of a heavy vehicle, travel time and fuel consumption. Safety criteria.

Design elements of the vertical alignment and limiting values. Superelevation rates and superelevation runoff. Stopping and passing sight distance. Administrative and functional classification of roads. Cross section elements. Design elements of cross sections. Typical cross sections. Approximate and accurate methods for calculating earth volumes. Corresponding sections. Accuracy of volume calculation. Mass haul diagram and use of linear optimization. Land acquisition. Estimated construction cost.

- ***Applications of G.I.S.***
  Optional course in the 5th semester.

  G.I.S. are presented as part of a comprehensive spatial approach, thus the concepts of spatial analysis, G.I.S. and planning as they relate and affect each other are introduced, Emphasis however is given in presenting and then applying the three basic components of G.I.S., namely building a data base, performing geographical analysis and presenting the results of the analysis. Four projects are completed in class to familiarize the students with the application of G.I.S.

- ***Construction equipment & Construction site organisation***
  Optional course in the 6th semester.

  Construction equipment. Excavators. Production of crushed stone aggregate. Concrete Production. Calculation of the hourly production.of machinery. Calculation of the unit cost in technical works.

- ***Geography and Spatial Analysis.***
  Mandatory course in the 6th semester.

  This course introduces the students to the principles of human geography and the basic methods of spatial analysis and is divided into three interrelated parts. The first part examines the basic components of human geography: population, environment and resources. The second part introduces the methodological principles applied in human geography and the last part presents the most commonly used methods such as regression, factor analysis and location-allocation methods.

- ***Introduction to the legal system and elements of technical legislation.***
  Optional course in the 6th semester.

  This course is divided in two parts. The first one constitutes an introduction to law and the legal system in general, whereas the second part focuses on technical legislation with specific attention being paid to urban and public procurement law, as well as to the construction regulation.

More in detail :

a) Law and the legal system

The aim of this part of the course is to give students lacking a legal background a general overview of the legal system and the operation of legal rules and to focus on essential legal issues arising in fields such as : public law (constitutional and administrative law), private law (contracts, torts, and land law), corporate law

(commercial transactions, securities, e.t.c.) and labour law (work accidents, constructor liability, e.t.c.)

b) Technical legislation

This second part of the course focuses on issues directly accruing from the theory and practice of technical legislation.
- Public procurement : national legislation on public procurement (types of tenders, conclusion, execution and termination of contracts, resolution for non execution), EC legislation and implementing measures
■ Urban law : aim and sources of urban law, substantive matters, interaction with environmental protection and with the preservation of the architectural heritage and tradition.

♦ ***Photographic Data Acquisition***
Optional course in the 6th semester.

Introduction to the photographic techniques. Historical development of photography and application areas. Presentation of conventional photographic cameras and of special application cameras. Description of metric and semi-metric cameras. Photographic camera calibration for mensuration purposes. Reference to digital cameras and camcorders. Structural and functional description of the photographic camera with special emphasis on the photographic lens. Light as electromagnetic radiation and as a photography tool. Introduction to lighting theory and the functionality and role of the light meters. Light sensitive surfaces and photographic films. Elements of photographic optics. Photographic camera accessories. Organization of the photographic darkroom and black-and-white film development.

♦ ***Open-Channel Flow & Hydraulic Structures***
Optional course in the 6th semester.

Introduction. Saint-Venant equations. Uniform flow. Non-uniform gradually varied flow: Computation of flow profiles. Hydraulic jump. Hydraulic structures: transitions, spillways, gates, drop structures, stilling basins, culverts, bridge piers.

♦ ***Methods and Models in Spatial Planning***
Optional course in the 6th semester.

The course on Planning Methods consists of: Introduction to Planning Concepts. Systems Theory and Use of Models. Population Analysis and Forecasting-Models and Techniques. Economic Activities Urban and Regional Planning. Models and Techniques in Spatial Analysis.

Techniques and Methods of Spatial Impact Assessment. Methods of Quantitative and Qualitative Analysis (Multi-Criteria Analysis). Computer Applications

- ***Reinforced Concrete.***
  Mandatory course in the 6th semester.

  Materials and components. Properties and strength of concrete, properties and strength of steel. Ultimate strength design. Uniaxial and biaxial bending of orthogonal cross sections. CEB tables and diagrams.

  Interaction diagrams. T-beams, CEB tables. One-way slabs. Bond, anchorage length. shear, web reinforcement. Torsion, torsional design. 2nd order deformations, buckling of columns. Shear in flat slabs. Deflections, limits of deflections.Cracks, limits of cracks.

- ***Architecture.***
  Optional ourse in the 6th semester.

  Theoretical approach of architecture. Design primer for the Greek environment, fundamentals of climate and comfort. Building regulations and standards. Dimensional co-ordination. Critical position in Greek architecture by examining the ideas upon drawings of the architects Picionis and Constandinidis. Postulate the essentials of continental and mediterranean architectural typologies.

  Design solutions develops skills on 1:200 and 1:50 scale drawings (plan, section, elevation), taking the theme of a rural house, on alternative plots optional by students, in an equally discrete Greek settlement.

- ***Photogrammetry II***
  Optional course in the 6th semester.

  Review of Photogrammetry I: image and stereopair orientation, coplanarity condition, analogue stereoplotters. Aerial cameras. Planning and specifications of flight. Analytical processing of photogrammetric measurements. Bundle adjustment. Principles and methods of aerotiangulation and phototriangulation. Principles, types, work-flow and potential of analytical stereoplotters. Photogrammetric mapping and types of photogrammetric products. Photogrammetric production of digital elevation models. Monoplotting. Aspects of digital photogrammetric techniques. Geometric transformations of digital images, digital products. Orthophotography: method, specifications, accuracy. Planimetric and heighting accuracy. Accuracy specifications of photogrammetric mapping. Close-range photogrammetry.

- ***Transporation Infrastructure Design – Economic Aspects.***
  Mandatory course in the 6th semester.

  Railroad engineering: Introduction. Track-Train dynamics. Design of horizontal and vertical alignment. The case of railway tracks. Track connections. Airport engineering: Introduction. Airfield components and structures. Selection of site. Airport layout. Flight elements. Runways and taxiways configuration.

Design of horizontal and vertical alignment of runways and taxiways. Earthwork.
Economic elements (general principles of feasibility studies). Introduction. Development planning / programming. Fundamental concepts. Investments. Category of investments. Feasibility studies methodology. Financial and economic evaluation. Conclusions.

- ***Thematic Cartography***
  Optional course in the 6th semester.

Introduction (basic principles, classification of thematic maps, spatial information and cartographic language, visual variables, visual perception). Thematic data (data sources, geo-reference, nature of thematic data, accuracy issues, absolute-derived values). Data processing (data classification, statistical processing, spatial interpolation). Methods of data representation (qualitative data, quantitative data, isarithmic mapping, choropleth mapping, oblique views, cartograms, dot maps, topological transformations). Representation of spatial relationships. Diagrams. Atlases. Thematic maps and multi-media. Thematic map composition and production.

- ***Settlements' Networks***
  Optional course in the 6th semester.

The settlements' networks of the periphery. Network theories. Hierarchy, economical poles, administrative poles. Settlements in Greece. The settlements' problem. Abandonment of settlements, settlement pressure, expansion of present settlements. Settlements' networks of second home area. Co-operations, limits' recognition, town planning, administrative organization, Greek and international law.

- ***Geodetic Astronomy***
  Optional course in the 6th semester.

Getting acquainted with the stars. Characteristics, movements and identification of celestial bodies. Reference frames and co-ordinate systems on the celestial sphere (horizon, celestial, equatorial and astronomical system). Elements of spherical trigonometry and astronomical (position) triangle. Conversion of co-ordinates between the various systems. The diurnal rotation of the celestial sphere and the measurement of time. Sidereal time, Universal time, Atomic time. Astronomical refraction and variations of the celestial co-ordinates. Precession, nutation,* parallax and aberration of light. Determination of the astronomical azimuth: general methods and use of the Polaris. Determination of the astronomical longitude (Mayer method) and latitude (using Polaris and the Sterneck method). Principles of the simultaneous determination of the astronomical co-ordinates.

- ***Reference Systems & Geodetic Projections***
  Optional course in the 6th semester.

Reference surfaces and Reference frames. Motions of the Earth (polar motion, precession and nutation). Earth tides-tectonic movements. Global (ITRFxx) and Geodetic Reference Systems. Astronomic system. Geodetic Reference Systems used in Greece. *G*reek *G*eodetic *R*eference *S*ystem 1987 *(ΕΓΣΑ 87 GGRS 87*).

Map projections and distortions. Map projections used in Greece. Oblique azimuthal equidistant projection (*HATT*).*T*ransverse *M*ercator projection.*TM* Projections used in Greece (TM 3^{o}, UTM, TM for GGRS 87). Corrections to the geodetic observations due to the projection. Datum transformations and coordinate changes. Comparisons. Accuracies.

- ***Field Course in Geodesy II***
  Summer Optional course in the 6th semester.

  Summer field course based on geodetic subjects taught up to the 6th semester. The subject of the course is a complete Topographic and Cadastral Survey of a village or a town. The site and the exact subject is decided each year by the Section of Topography after arrangements made with organizations and local authorities, in places outside the greater Athens area.

- ***Special Subjects of Geodesy***
  Optional course in the 6th semester.

  Urban surveys and street tracing-Legal specifications-Application of rights of property-Shoreline determination.
  Special methods for precise height difference determinations-Instrumentation-Geometric corrections -Geodetic refraction.
  Special surveys-Mine and cave surveys-Underwater surveys.

- ***Photogrammetry III***
  Optional course in the 7th semester.

  Introduction to digital procedures. The digital image. Digital image acquisition, instrumentation for data collection. Elements of digital image processing. Measurements on the digital image. Digital image matching. Automation of photogrammetric procedures including interior relative and absolute orientation, DTM collection, automatic aerial triangulation, digital orthophoto production and object recognition. Presentation of digital phorogrammetric systems. Digital photogrammetric products and applications.

- ***Economic Geography.***
  Optional course in the 7th semester.

  The course of Economic Geography consists of: Introductory Economic Concepts-Geographical Concepts. Systems Theory. Introduction to Economic Geography. Models of Spatial Analysis-Central PlaceTheory Christaler/Losch. Empirical Paradigms/Models of Urban Systems Hierarchy. Theories of Spatial Analysis. Spatial Differentiation of Production Factors. Transportation Costs. Production Costs. Demand and Economies of Scale. Theory of Decision Making in Activity Location. Behavioural Theory. Evolution of Spatial Structure-Economic Development in Space and Time. Theories of Regional Development. New Technologies and Regional Development. Sustainable Regional Development

- ***Matrix Analysis of Structures.***
  Optional course in the 7th semester.

  Properties of matrices, partitioned matrices, Gaussian elimination. Elements of Graph theory. Branch -Node Incidence Matrix. Plane Trusses-Space Trusses: Primitive stiffness matrix, bar unit vector, load & displacement matrices, the system matrix, decomposition of the stiffness matrix.

  Plane Frames-Space Frames: rotation matrix, local coordinate system, member forces, end-of- member forces, member displacement, member stiffness matrix, primitive stiffness matrix, the system matrix, decomposition of the stiffness matrix.
  Finite element, element stiffness matrix (beam element, triangular plane stress element, plate element).

- ***Hydrography and Elements of Oceanography.***
  Optional course in the 7th semester.

  Historical evolution of Hydrography and Oceanography. Chemistry of water, physical parameters. Oceanology. Tides, classical and dynamic theory, tide gauges, tidal maps, energy from tides. Sea currents, thermohaline and geostrophic, current measurements. The influence of currents on the environment. Law of the sea.

- ***Introduction to the Earth's gravity field***
  Optional course in the 7th semester.

  Introduction to the nature of the field and to the quantities for its study. Connection to applications within Earth disciplines. The concept of field of reference (normal field). Boundary value problems of geopotential. Applications in terrestrial geodesy. Analysis of the field and methods of gravimetric geoid determination. The concept and implementation of gravity reductions. Management of gravity measurements. Terrain effect and terrain correction. Principles to study the local field. Height and gravity. Basic principles and elements of geodynamics (vertical crustal movements).

- ***Cadastre***
  Mandatory course in the 7th semester.

  The importance of Land and the concept of real estate property. Ownership, use, acquisition and ownership restrictions, special rights. Elements of technical legislation, title implementation. Urban, forest and rural Land-parcel topology. Cadastral issues from transforming rural grounds to urban. Cadastral concept and evolution through the years. Cadastral systems. Cadastral Books-Cadastral Maps-Cadastral Identification Numbers. Implementation, keeping and updating procedures of the Hellenic Cadastre. Digital Cadastral Map. Analog diagrams digital and analytical data. Digital transformation and orthophotography. Hardware. Software. Hellenic Cadastre. Users, recoverability. Implementation procedure. Cadastral information collection methods. Legislation, technical specifications and operational cost. Administrative structure, setting-up, management and maintenance-updating of the system.

- ***Railroad Engineering***
  Optional course course in the 7th semester.

  Introduction. General planning principles. Planning and operation of railway systems. Railway networks and systems. Rail shape. Subgrade design. Trains. Construction elements. Track-train dynamics. Electrification. Station layout categories / types. General railroad design.
  Automatic safety devices. Traffic signals. Automatization. Metropolitan railroads. Light rail systems. Special railroad types (Rack railway, Rope-pulled railway). Interrelationships and connection of railroad systems with other transport modes. Fundamentals of high speed trains.

- ***Geodetic Satellite Positioning***
  Optional course in the 7th semester.

  Introduction to Geodetic Satellite Positioning. Principles of satellite positioning. Introduction to GPS. The broadcast signal. Broadcast orbits. Precise orbits. Time. Reference Systems. Measurements. Pseudorange and phase measurements. Phase differences, single, double, triple. Advantages and disadvantages of the phase differences, their use. Sources of error. Positioning methods. Accuracies. GPS processing, ambiguity resolution, three dimensional baselines and networks. Advanced positioning methods. Fast ambiguity resolution. Accuracies. Geodetic, surveying and navigation instruments. Applications of GPS. Static applications on land. Kinematic applications on land, sea and in the air.

- ***Soil Mechanics and Foundations***
  Optional course in the 7th semester.

  Introduction: Soil structure, Types of soils, In situ stresses, Permeability, Flow nets. Soil properties: friction, cohesion, effective stresses, compressibility, shear strength, consolidation. Soil classification, Site Investigation, In situ testing. Earth pressures: Rankine and Coulomb theories. Retaining walls: Gravity, Cantilever, Reinforced earth. Seismic analysis of walls. Bearing capacity of shallow foundations: Terzaghi 's theory, allowable pressure, influence of eccentricity and inclination of loads, influence of underground water. Settlements: estimation of settlements based on the compressibility diagram and on SPT. Allowable settlements. Time rate of settlements. Slopes: Types of failure, Factor of safety, Method of friction circle, methods of slices, Sarma 's method. Soil improvement. Proctor and CBR tests. Principles of pavement analysis.

- ***Urban Planning***
  Mandatory course in the 7th semester.

  Introduction to urban planning: Aim, objectives, laws. Urban standards and functions. Types of plans, land uses. Systematic planning and post-modern trends. Urban mechanisms and motives. Ways of interference. Mater Plan of Athens, Structural Plan, Action Area Plan. Centers, industrial areas. Habitation - fundamental meanings.

- ***Engineering Hydrology***

  Mandatory course in the 7th semester.

  Introduction to Hydrological Processes. Elements of Geomorphology. Statistical Analysis of Hydrological Information. Measurement and Analysis of rainfall and snow data. Hydrometry: Networks and Data analysis. Floods. Routing through reservoirs or stream sections. Meteorological and Hydrological Drought analysis.

- ***Digital Cartography***
  Optional course in the 7th semester.

  Introduction (basic principles, the impact of technology in cartography). Data structures (data models, vector-raster data structures, raster to vector conversion). Data collection (digitisation from paper maps, manual-automated digitisation, data editing). Cartographic database design (user needs assessment, logical design, normalisation, physical design, map library, networks of cartographic databases, accuracy and errors issues). Algorithms for cartographic generalisation (data reduction algorithms, knowledge-based generalisation systems). Digital data representation (digital mapping, the color and computer display, color separation, cartographic applications and multi-media, electronic map-atlas). Cartographic data exchange.

- ***Highway Engineering II (Traffic Flow)***
  Optional course in the 7th semester.

  Traffic characteristics. Traffic measurements. Methods. Technologies. Basic relationships between traffic characteristics. Traffic stream models. Capacity analysis. Level of services. Basic freeway segments. Two-lane highways. Traffic events.
  Driver characteristics. Perception and reaction process. Gap acceptance. Intersection control. Delays at intersections. The bottleneck problem. Shock wave analysis. Traffic signalization. Urban networks. Signal coordination. Computer simulation models. Traffic control techniques on freeways. Speed control. Adaptive speed limits. Ramp metering. Lane control. High occupancy lanes.

- ***Radiometry and Microwave Remote Sensing***
  Optional course in the 7th semester.

  Introduction. Atmospheric radiative transfer process.
  Electro-Optical sensors. Radiometric instruments. Measurements and applications in the scientific field of the Rural and Survey Engineer.
  Hyperspectrometry and applications.
  Radar fundamentals.
  Geometry of the SAR images.
  SAR imagery processing and interpretation.
  SAR interferometry.
  Digital Terrain Models based on the interferometry. Comparison with other methods.
  Applications of SAR imagery analysis and processing methods and techniques in land use/cover inventories mapping and monitoring.
  Applications of the SAR imagery processing and interpretation in Hydrology, Oceanography, Geology and Forestry.

- ***Reclamation Works***
  Optional course in the 8th semester.

  Introduction. Soil water-crops-atmosphere continuum. Irrigation water quality. Estimation of irrigation needs. Irrigation methods. Design discharges for irrigation systems. Sprinkler irrigation. Water Hammer-Protection measures. Irrigation canals. Drainage theory and drainage systems.

- ***Regional Planning***
  Mandatory course in the 8th semester.

  Introduction to Regional Planning. Planning and development. Spatial Planning Approach. Planning Process I. Planning Process II. Regional Planning in Greece. Regional Planning and Legal framework in Greece. Introduction to interregional Analysis. Introduction to interregional Analysis. European Union and Regional Planning in Europe.

- ***Design of Engineering Structures***
  Optional course in the 8th semester.

  Structural elements made of reinforced concrete: Two-way slabs, Marcus tables, Czerny tables. Slabs with joists. Staircases. Footing (central, eccentric, flexible, stiff). Elements of earthquake desing, earthquake loadings, spectral acceleration, elements of earthquake code. Column. Shearwalls. Short cantilevers. High web beams. Retaining walls. Introduction to bridge design.
  Laboratory tests: mechanical properties of steels & concrete. Strength of steel, strength of concrete, ultrasounds, e.t.c.

- ***Design of Steel Structures***
  Optional course in the 8th semester.

  Structural steel, mechanical & physical properties. Basic concepts of design. Methods of design. Connections (bolts, welds). Strength of steel cross sections under elastic and under plastic analysis (tension, compression, bending, shear, torsion, combined loadings). Stability of structural system. Components of steel structures (steel sheet roofings, girders, beams, columns). Trusses, frames, sheds.

- ***Marine Geodesy.***
  Optional course in the 8th semester.

  Law of the sea. Delimitation of the Seas. Standards for Hydrographic surveying. Position lines and their mathematical models. Classical methods for hydrographic surveying. Electronic, satellite, acoustic, airborne and inertial positioning. Physics of echosounding. Vertical echosounders and side-looking sonars. Sub-bottom profilers. Modern Hydrographic Surveying.

- ***Geophysical Prospecting – Gravimetry.***
  Optional course in the 8th semester.

  Basic concepts, application fields, possibilities and limits of Applied Geophysical research. Geophysical prospecting methods. Gravity prospecting. Instruments and measuring techniques, corrections and reductions. Gravity networks and surveys. Magnetic, electrical and seismic methods, instruments and measuring techniques. Representation and interpretation of Geophysical data. Practical applications, examples.

- ***Rural Settlements.***
  Optional course in the 8th semester.

  Classification theory of rural settlements. International rural patterns, rural industrialisation, planning rural settlements and new land use. Rural and vernacular architecture. Rural building regulations and standards. Local architectural typology. Emphasis is given to the meaning and place of vernacular architecture, in the context of rural settlement, during the contemporary Greek development. Revival, renewal, restoration and modernisation in stagnant and declining communities. Ecological tourism and designing with nature. Planning and design methodology of cluster dwelling typologies, in a given Greek rural settlement, with population under 2000 persons, in harmony with local characteristics. Analysis of rural design primers (population, occupation, family size, circulation, density, dimensional housing and settlements standards, typology of rural housing). Synthesis of initial solutions and comparative evaluation, with critical position on the architecture of rural housing, the pedestrian and vehicular traffic, the public spaces and the orientation.

- ***Transportation systems***
  Optional course in the 8th semester.

  Introductory concepts. The transport system. The need for a theoretical assessment of transport. Transport policy and economic implications. General principles of transport economics. Transport economic policy. Transport networks. Intermodality. Transport planning and programming of transport systems. Assessment of transport systems. Quality control and transport systems. Logistics and transport systems. Strategic planning and programming involving transport systems. Transport policy of E.U.-Traneuropean networks-Other country policies. Modern financing methods of transport infrastructure. Methodology of transport planning project execution.

- ***Photogrammetry IV***
  Optional course in the 8th semester.

  Selected Chapters of Photogrammetry with Emphasis on its Mathematical-Geometric Foundations: Mathematical Models-Computer Programming and Simulations-Investigations of Geometry and Study of Errors-Practical Applications. Geometry of the Single Image-Monoscopic Extraction of Metric Information. Projective Relations in Photogrammetry-Direct Linear Transformation. Programming and Investigation of Basic Photogrammetric Algorithms: Camera Calibration-Space Resection and Intersection-Relative and Absolute Orientation. Applications with Images taken by the Students. Phototriangulation: Selfcalibration-Additional Parameters-Reliability.

The Use of Non-Conventional Features in Photogrammetry: Linear and Area Features. Aspects of Automation in Photogrammetry. Automatic DEM Collection: Methods-Accuracy-Problems. Automatic Edge Extraction: Programming of an Extraction Filter. Photogrammetry and Computer Vision.

- ***Environmental Impact Assessment from Projects and Programmes.***
  Optional course in the 8th semester.

The lesson provides scientific knowledge concerning the impacts which the critical development caused.
It also presents the methods of the environmental impact assessment.
Its aims are to give to the students the sensibility and the tools to evaluate the impacts and restore the environment.
The lesson is in the position to integrate the knowledge from the order related lessons. The students have the opportunity to apply this knowledge and get important experience.

- ***Sustainable use of Natural Resources.***
  Optional course in the 8th semester.

The lesson provides specific information and knowledge by examining the main categories of the natural resources, their structure and spatial distribution and by evaluating them.
It also presents the importance of the sustainable use of the environment and the critical role of the technological evolution. As we approach the new millennium, a great physical and cultural diversity is facing us.
Thinking and learning are achieved in lab classes where the students have the opportunity to deal with the methods and techniques in a professional way.

- ***Coastal Zone Management.***
  Optional course in the 8th semester.

Introduction. Definitions and general characteristics of coastal zones. The coastal zone environment and associated problems. Coastal dynamics. Coastal sensitivity and resilience. Special issues such as coastal waves, sediment transport in the coastal zone, technical structures for coastal protection, elements of port and harbor design, coastal zone pollution, etc. Human uses and management of coastal zones. Goals and management strategies such as economic and tourist development, environmental protection, etc. Sustainable coastal zone management.

- ***Groundwater Hydrology.***
  Optional course in the 8th semester.

Introduction. The role of groundwater aquifers and their significance in water resources management. Classification of groundwater aquifers. Hydraulic parameters of porous media and groundwater aquifers. Darcy's law. Dupuit assumptions for phreatic aquifers. Inhomogeneity and anisotropy. Continuity equation and fundamental equations of flow in groundwater aquifers. Initial and boundary conditions. Methods of solution in special cases using analytical approaches. Hydrologic maps and flow nets.

Well hydraulics and pumping tests. Solution of governing equations using finite differences. Artificial recharge and evaluation of aquifer capacity.

- ***Metrology***
  Optional course in the 8th semester.

  Statistical evaluation of the geodetic measurements. Principles and functioning of geodetic and photogrammetric instruments. Systematic and accidental errors in measurements. Hellenic and International specifications for testing and calibrating of geodetic and photogrammetric instruments (according to DIN, ISO, etc). Laboratory and field exercises.

- ***Theory of Errors & Adjustments II***
  Optional course in the 8th semester.

  Adjustments by the method of observation equations with constrains.
  General Least Squares adjustments.
  Measures of accuracy for absolute and relative positioning, confidence intervals and regions based on population and sampling distributions. Hypothesis testing.
  Optimization of Geodetic Networks.(accuracy and reliability)
  Statistical tests.

- ***Navigation***
  Optional course in the 8th semester.

  Navigation in two and three dimensions (land, sea, air). Reference systems, ellipsoidal, two and three dimensional cartesian and coordinates. Coordinate transformations. Azimuth and distance. Reference systems of marine maps and marine map projections. Satellite positioning (GPS).
  Differential GPS (DGPS). Kinematic positioning. Real time kinematic positioning. (RTK). Accuracies of position and velocity determination. Accuracy measures. Kalman filter. Applications. Satellite positioning for velocity and maneuverability trials of surface ships. Cable laying. Aviation. Airtriangulation.

- ***Highway Engineering III (Intersection design and operation)***
  Optional course in the 8th semester.

  Introduction to highway intersections. Design criteria. Intersection spacing. Basic highway intersection types. Vehicle occupancy space on intersections. Design of edge strips. Widening design. Pavement widening. Selection and design of turning lanes. Types and design methods of islands. Sight distance. Pedestrian movements. Traffic control devices. Crossings. Signs. Capacity of unsignalized intersections. Operation of turning lanes and mixed lanes. Roundabouts.
  Intersection of interchanges. Interchange types and categories. Design criteria. Ramp design. Design speeds. Cross-sections. Weaving areas. Merging. Stream separations. Acceleration and deceleration lanes. Design of ramp junctions. Vertical signing at intersections. Ramp capacity analysis. Ramp metering.

- ***Hydraulic Works***
  Mandatory course in the 8th semester.

  Analysis of flow in closed conduits. Municipal water supply: Demand prediction-Water quality. Reservoir design. Water supply network design and technology. Urban drainage networks design and management. Principles of operation and maintenance. Elements of other hydraulic works.

- ***Cadastre and Land Information Systems.***
  Optional course in the 8th semester.

  Geographical Information Systems. Land Information Systems. The developmental nature of modern Cadasrte systems.

  Use and recoverability of a modern Cadastre. Digital Map. Digital and analytical data. Spatial data collection and management methods. Hardware. Software. Updating using data from various sources. Proprietary and thematic data Collection and Management. Data bases. Planning principles, structure, management, data presentation, production. Rational L.I.S. development. Operation, management and policy sections. L.I.S. as a means of managing resources and decision making. Basic L.I.S. sub-systems and their content. Priorities. Servicing sections. Applications. Modern Cadastre and L.I.S. systems in use.

- ***Summer Field Exercises in Higher and Satellite Geodesy***
  Summer Optional course in the 8th semester.

  Training of instruments and measurements of Higher and Satellite Geodesy (GPS). Planning, lay out and execution of works and measurements for the establishment geodetic networks of higher order using satellite techniques. Reductions and calculations on the reference ellipsoid and in cartesian reference systems GPS baselines computation and analysis. Technical report composition.

- ***Summer field course in Photogrammetry***
  Summer Optional course in the 8th semester.

  Compilation of an integrated project, which constitutes a practical work for the solution of photogrammetric issues. The project includes:
  The compilation of digital rectification of an object, such as the facades of a building or monument, by using control points or known distance lengths,
  or the compilation of stereo-restitution at an analytical or digital photogrammetric instrument, through airphotos or close-range photos taken either by a metric or an amateur camera,
  or the compilation of integrated photogrammetric surveys, which include both field work and office work,
  or the solution of special problems, by writing the proper software,
  or the use of specialised photogrammetric software,
  or the appropriate modification of general usage software packages for photogrammetric purposes.

- ***Summer Practice Course in Photointerpretation and Remote Sensing***
  Summer Optional course in the 8th semester.

  Practical exercise involving applications of analogue and digital image analysis methods and techniques applied to projects of natural resources inventories and monitoring and in specific fields of interest to the students. Field work techniques for image processing and classification algorithms.

- ***Rural Constructions and Open Spaces***
  Optional course in the 9th semester.

  Reading, survey and understanding of the forms and the functions of open, covered and enclosed building structures of the human environment. Criteria of evaluation: vitality, access, control, fit (between form and function), structure, identity and meaning. The basis of our judgement is the human being.
  Examples of open spaces and squares of Greek traditional cities. Selective examination of characteristic examples of (medieval, renaissance, e.t.c.) squares of European and American cities. Architectural design of open spaces, open markets, farm buildings, agricultural buildings (barns, light structures, e.t.c.).Organization of farms. Protection, preservation and possible change of use of barns, e.t.c. (exhibition space, e.t.c.). Architectural design and drawing in scales: 1/200, 1/100, 1/20,…

- ***River Engineering***
  Optional course in the 9th semester.

  Introduction. Flood hydrograph models. Properties of water and sediment. Bed forms of alluvial streams. Velocity distribution. Bed roughness-shear stress. Sheet erosion. Universal Soil Loss Equation. Sediment discharge. Bed-load transport and suspended load transport equations. Einstein's theory. Computation of a non-eroded stream. Channel rectification techniques-Flood protection measures.

- ***Real Estate Valuation and Land Management.***
  Optional course in the 9th semester.

  Real Estate Valuation. Content. Concepts. Definitions. "Real Estate Market" analysis and operation. Equilibrium and adequacy conditions. Demand-Supply interdependence. Prices evolution. The need to define the Value. Law previsions. Real Estate taxing. "Real Estate Market" affecting factors. Classification. Impacts. Spatial interdependence. Real Estate use as an element primarily affecting price setting. Use restrictions. Best use. Classic valuation methods accordingly applied. Developing a Real Estate "Massive Valuation" system. Valuation using G.I.S. GRSA methodology. Developing CAV systems. CAMA system. Real Estate Value as a Cadastral or modern L.I.S. element. Ministry of economics' "value objective definition system". Land Management. Management means. Land Information management system. Investment financial capabilities and legal restrictions for Real Estate Development. Special categories and special applications.

- ***Surveying and Documenting of monuments***
  Optional course in the 9th semester.

  The concept of monument-Documentation, restoration, rendering and protection of monuments. Guidelines for surveys-International Contracts for the protection of monuments. Technical Specifications and visualisation of monument surveys. Field surveying and photogrammetric techniques-Establishment, measurement and calculation of geodetic networks and control points. Planning the suitable close range photography obtainment. Modern geodetic instruments and close range photogrammetric cameras (metric, semi-metric and amateur). Digital cameras and video machines. Modern methods of restitution (CAD systems and photorealistic systems), analytical and digital photogrammetric instruments and products-monument recording. Monument surveying applications. Semester thesis.
  The lectures are being conducted in collaboration of the Lab. of Photogrammetry and Lab. of General Geodesy.

- ***Environmental Planning - Case studies***
  Optional course in the 9th semester.

  Environmental planning constitutes a course-case study, which focuses to direct the students to approach a real world problem through an integrated approach taking into consideration all the quantitative and qualitative environmental variables.
  The environmental carrying capacity, ways of evaluation and promotion of the environmental qualitative variables the socioeconomic dimensions of the environmental planning constitute a few key issues to be answered through the selected case study. The students are called during this case study-course to utilize all the received unknowledge from their previous years in order to produce an environmental integrated course of action through a spatial planning scheme.

- ***Water Resources Management.***
  Optional course in the 9th semester.

  Estimation and forecasting of water needs for various uses of water. Hydrologic analysis of a water catchment. Estimation of surface and groundwater resources. Schematization of a system of water resource management.

  Optimal selection of projects and measures for a catchment. Optimal use of water resources using various optimization techniques.

- ***Satellite Geodesy***
  Optional course in the 9th semester.

  Introduction to Satellite Geodesy and historical review. Reference Systems: Celestial, Sidereal and Terrestrial Systems. Precession, nutation, polar motion. Earth rotation and time. Satellite reference system WGS 84. Reference systems transformations. Geodetic satellites. Satellite motion. Satellite orbits. Satellite observation techniques and methods: Laser Ranging, V.L.B.I., Satellite Positioning- GPS, Satellite Altimetry-SAR. Determination of the earth's gravity field via satellites. Applications : Tectonics, Reference Systems-ITRF, Geoid, Navigation.

- ***Engineering Geodesy***
  Optional course in the 9th semester.

  High precision geodetic measurements and instrumentation. Design, field work, computations and analysis of deformation surveys (for building, technical constructions and the earth's crust). Industrial Geodesy-Instrumentation and methods. Large scale surveys (buildings and constructions). Geodetic works in athletic installations and stadiums-Horizontal measurements of athletic records.

- ***Applications of Urban Planning***
  Optional course in the 9th semester.

  Introduction to forms and procedures of town planning. Greek law of town planning. Problems of practice. Techniques and models of town planning. The use of computers in action area plans. How to realize approved plans. Practice in reformation areas. Ways and methods of reforming urban space.

- ***Highway Engineering Project***
  Optional course in the 9th semester.

  The project aims at executing a complete road building study and it consists of 4 stages. At the first stage, the road category is determined in relation to the level of connection and the traffic volumes that the road will serve. Furthermore, the design speed and the typical cross section are defined, which specify the characteristics of the road alignment. At the second stage, the shape that the road area is selected as a result of in-situ finding out process. In parallel, the necessary maps of the greater road area are realized preferably by photogrammetric mapping. At the third stage, the highway design is carried out including the selection of intersection geometry, the hydraulic study, the study of the necessary technical works, the traffic assessment and the pavement design. Finally at the fourth stage, the road axis and roadway limits are staking out on the ground.

- ***Applications of Regional Planning.***
  Optional course in the 9th semester.

  Lectures and exercises are concerned with comprehensive plans in a selected region, where all steps in creating a regional plan are followed. Although each lecture and exercise is focused on a specific region, at the same time the cource is concerned with the means and mechanisms for formulating, checking and supporting regional plans. And in particular with plans for spatial interventions as well as the impacts from regional development plans and policies.

- ***Special Applications of Photointerpretation and Remote Sensing (Project)***
  Optional course in the 9th semester.

  Theory and practical, applications of photointerpretation, remote sensing and digital image processing techniques to the geosphere and biosphere.
  Landforms, drainage patterns and soils: their interpretation, spectral properties and application to Engineer Works.

Agricultural applications. Water resources. Crop yield.
Forestry applications and damage assessment. Range resource assessment. Wildlife mapping, wetland mapping.

- ***Cadastre and Land Policy***
  Optional course in the 9th semester.

  Cadastre and Land Policy. Basic concepts, relations, interactions and interdependencies at the constitutional, legal, technical, economic, political and social levels.
  Critical evaluation of Land Policy measures in Greece. Legal Infrastructure, administration activities and impact assessment.
  Edge technologies, Cadastre and Land Policy.
  The contribution of Integrated Cadastral Land Information Systems and of the Rural and Surveying Engineer towards planning, implementing, monitoring and evaluating specific Land Policy measures.

- ***Highway Engineering IV (Construction Elements)***
  Optional course in the 9th semester.

  Road structural elements. Subbase. Base. Surface courses. Construction of fills and embankments. Soil and granular stabilization. Compaction. Flexible and rigid pavements. Pavement design methods. Spreaders, pavers, rollers, finishers and other construction machines. Concrete pavement construction. Joints. Types of crash. Maintenance and rehabilitation. Pavement recycling methods. Bituminous materials. Drainage and drainage structures. Porous and noise insulating pavements. Highway construction elements for traffic calming zones. Special topics (Tunnels, bridges etc).

- ***Sanitary Engineering and Environment.***
  Optional course in the 9th semester.

  Basic concepts of chemistry and microbiology of water. Basic types of wastes and their consequences to the environment.

  Disposal of wastes to water receivers and assimilative capacity of receivers. Ground disposal. Wastewater treatment methods. Usual types of treatment for urban and agricultural wastes.

Diploma Thesis

(Senate resolution of 5 July 1991)

The Diploma Thesis (DT) is a major work of analytic, synthetic, experimental or applied character. It is required from students who are in the last year of their studies, as the final step in order to obtain the degree of NTUA Diploma Engineer. DTs are normally supervised by TRP members; however, the task may be also delegated to experienced STP members.

a. Prerequisites and time of assignment

The tenth semester of studies at NTUA is devoted to the DT. There are two periods of assignment: *October* and *February*, with the exact dates being prescribed by the academic calendar.

In order to be entitled to apply for DT assignments, students must have successfully completed all courses but the ones of the ninth semester (or an equal number of previous semesters' courses) plus no more than three more.

Under these conditions, students may graduate after two semesters, having succeeded in all courses pending and the DT. Graduation is also possible one full semester after application for a DT assignment, provided no more than three courses are pending at the time of application.

b. Procedure of assignment

The Department's Executive Board is ultimately responsible for DT assignments, but it may delegate the task to a special committee.

DT subjects should lie in the scientific areas of the Department' s Sections or Sections belonging to other NTUA Departments that offer courses to the student's home Department.

Students who fulfil the assignment premises prescribed above may apply to the **Department's Secretariat**, mentioning the fields at which they wish to do their DT. Each application should include, in order of preference, three fields in which a subject is sought, belonging to one or more Sections.

The Department's Executive Board forwards applications to the Sections involved, together with a proposal portraying a reasonably proportional allocation in accordance with each Section's capacity of supervision.

Sections may accept or reject the proposed allocation. If accepted, the proposal is returned to the Board, accompanied by the names of appointed supervisors, as well as the Section's nominations for the 3-member examination committee in each case. If the Board's proposal is rejected, the matter is referred to the Department's general assembly.

In case a DT is assigned by a Section which does not belong to the student's home Department, this Section appoints the supervisor and one of the examination committee members from its own staff, but the other members of the committee must come from the student's home Department.

In general, each student should have his own subject. If this is not possible or desirable, joint theses are allowed, provided that no more than three students are involved.

It is understood that, with joint theses, there must be a part that is produced jointly by all students as well as a part produced separately by each individual.

c. Process

The student draws up a work plan in cooperation with the supervisor who should be informed regularly of the progress made and any other developments.

At the end of the work, the supervisor gives the final approval and notifies the student's home Department Secretariat, one month before examination time, that the thesis has been accepted in principle.

Five copies of the DT are submitted to the corresponding Section one week before the examination. Three of them go to the examination committee, while the other two go to the libraries of the Department and the Section.

The Department's secretariat confirms that the student has indeed completed all courses and fulfilled his obligations before publishing the examination schedule.

d. Examination

The examination is oral and takes place on dates prescribed by the academic calendar. Students may only be examined if they have previously completed successfully all courses of the curriculum.

If a joint DT has been formally accepted, and some of the students have courses pending, it is possible, subject to the approval of the examination committee, to have the DT presented on condition that the mark for those students with pending courses will not be formally announced before they have successfully completed any such pending courses.

Students present their DTs in public.

The mark given by the committee depends on the quality of the thesis, the knowledge gained as well as the presentation it self.

e. Support

To maintain and improve the DT quality it is necessary that:

- NTUA supports DTs financially
- DTs be included in research programmes
- DTs be combined with research and engineering projects in cooperation with local authorities and public institutions
- Selected DT parts are jointly published together with the supervisor

Format specification for the Diploma Thesis
(Drawn up by the Department of Rural & Surveying Engineering in accordance with §5 of the Senate's resolution)

a. DTs are submitted typed and bounded in DIN A4 format. Departments may prescribe additional features, such as colour and line art for the cover, etc.

b. Figures and diagrams must be drawn (preferably with Indian ink) in presentable style and in accordance with the rules of linear and topographical drawing. In case the figures are larger than the standard page size, a separate booklet could be made to include those figures, suitably folded.

c. DT structure should include:

- Preface
- Table of contents
- Table of figures
- Table of diagrams
- Summary
- Summary in an international language (optional)
- Introduction
- Main Text (Chapters 1, 2, 3, etc.)
- Conclusions
- Proposals
- References
- Appendices (if any)

d. The **summary** should give a comprehensive description of the DT in one or, at most, two pages.

e. The **introduction** reveals the motive which led to the specific choice of subject and describes the methods used in handling the problem. Difficulties encountered, the scientific and social expediency, etc. should also be included here.

f. The **main text** is divided into numbered chapters, and each chapter is further divided into sections and subsections. They are all decimally numbered, i.e. 3.2.1. where 3=chapter number, 2=section number and 1=subsection number.

g. **Tables**, **figures** and **pictures** are numbered separately and carry explanatory captions. They are cross-referenced in the text (i.e. table 3, fig. 12, picture 10). The same holds for references.

h. **Formulae** are cross-referenced relative to the chapter in which they appear and are numbered sequentially (i.e. formula 1.5, where 1=chapter number and 5=formula number within the chapter).

i. The **conclusions-proposals** include justification and evaluation of the results achieved, as well as the author's view for further research on the subject.

References are placed at the end, in alphabetical order.

In particular, references to books should include, in order: author's name, book title, published, year of publication, etc. *Example:* Rutherford D.E., Vector Methods, Oliver & Boyd Ltd., 1957.

References to scientific papers should include: author's name, paper title, journal's name, volume, pages, year of publication, etc. *Example:* Rutherford, D.E., Vector Methods, Phys.Rev. 8, 723 (1963).

Finally, references to presentations made in scientific conferences should include: author's name, paper title, title of proceedings, editor, publisher, place of publication, year of publication, etc. *Example:* Rutherford, D.E., Vector Methods, Proc. Of the 12th Intern. Conf. of the Physics of Semiconductors, ed. M.H.Pilkuhn, Flammarion, Paris, 1972.

Scholarships

For Undergraduate students

- **THOMAIDIS AWARD**

  It is granted to the students who obtain the highest mark in each NTUA Department.

- **KONTODIMOS PRIZE**

  It is granted to the students who read for Civil Engineering or Rural & Surveying Engineering with the highest mark in the 9th semester

- **EM. VOUYOUKLAKIS PRIZE**

  It is granted to students with the highest mark in the course *Descriptive and Higher Geometry.*

- **GANIOTIS-PAPAGEORGIOU SCHOLARSHIP**

  It is granted to the students who originate from Greek islands, who have limited financial means and achieve the highest marks in the national examinations for university entrance, provided that they haven' t got any other scholarship except those offered by the State Scholarship Institution.

- **PAPASTAVROS SCHOLARSHIP**

  For students originating from the town of Terpsithea of the Nafpaktos province. If there are no such students, the scholarship goes to students of Greek nationality who have been distinguished in the national examinations for university entrance and have limited funds.

- **DIOMIDIS KOMNINOS PRIZE**

  It is granted to the most successful student in the entrance examinations to the NTUA Departments of Civil Engineering, Architecture and Rural & Surveying Engineering.

- **NIKOS KRITIKOS SCHOLARSHIP**

  It is granted to students of each NTUA Department who achieve, over two examination periods, the highest mark on all mathematical courses given during the first year of studies at NTUA.

- **ARGYROPOULOS SCHOLARSHIP (in memory of Achilles and Penelopi Argyropoulos**)

  It is granted to senior students at the Departments of Civil Engineering or Rural & Surveying Engineering, who originate from Pontos, Asia Minor, and are among the first three students in the course of *Theoretical and Applied Hydraulics* (since the curriculum has changed, the average mark obtained in the courses *Fluid Mechanics* and *Applied Hydraulics* is taken into account instead) over the last two examination periods.

Other scholarships are available to undergraduate students from:

- The State Scholarship Institution
- The Technical Chamber of Greece

For Graduate students

- EVGENIDIS FOUNDATION SCHOLARSHIPS

  For top Greek NTUA students with inadequate financial resources for graduate studies abroad. To receive such a scholarship, students must already have been accepted by a foreign university; no financial support from other source is allowed, and applicants must accept the condition to return to Greece and work on the studied subject after the completion of studies. Scholarships last at most one year.

There are more scholarships available to students of the Department of Rural & Surveying Engineering who wish to undertake graduate studies either in Greece (mainly from the State Scholarship Institution) or abroad. Such scholarships are given by:

- The Academy of Athens (Lambadarios Scholarship – exclusively for graduates of the Department of Rural & Surveying Engineering)
- The State Scholarship Institution
- The Technical Chamber of Greece
- The Onassis Foundation

as well as by other public institutions.

Interested students should seek detailed information from the Department's Secretariat in good time (not later than the 8th semester of their studies).