ARISTOTLE UNIVERSITY OF THESSALONIKI
(G – THESSAL 01)
FACULTY OF SCIENCES
SCHOOL OF MATHEMATICS

E.C.T.S. GUIDE

EUROPEAN COMMUNITY COURSE CREDIT TRANSFER SYSTEM

ERASMUS/SOCRATES
European Community Action Scheme
for the Mobility of University Students

THESSALONIKI 2018

This Guide gives information on the Aristotle University of Thessaloniki and on the structure of the courses offered by the School of Mathematics, in order to help prospective ECTS students prepare for their study period at this institution. It also contains information on the city of Thessaloniki and other useful facts for all ECTS incoming students.
Efthimios Kappos, Assoc. Professor, ECTS Coordinator for the School of Mathematics of the University, prepared the current version of this ECTS guide.

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1. WHAT IS ECTS?

A. General Introduction

ECTS, the European Credit Transfer System, was implemented by the European Commission in order to develop procedures for organizing and improving academic recognition of studies abroad. Through the use of commonly understood measurements -- credits and grades-- ECTS provides a means to interpret national systems of credit allocation, compare students learning achievements and transfer credit units from one institution to another. The ECTS system includes three core elements: *information* (on study programmes and student achievement), *mutual agreement* (between the partner institutions and the student) and *the use of ECTS credits* (to indicate student workload). Each ECTS department describes the courses it offers, not only in terms of content, but also assigning credits to each course.

The ECTS system is based on voluntary participation and a climate of mutual trust and confidence in the academic performance of partner institutions. The rules of ECTS are set out to create transparency, to build bridges between institutions, to enable studies abroad and to widen the choices available to students.

ECTS provides transparency through the following means:

- The *information package*, which supplies written information to students and staff on institution, schools/faculties, the organization and structure of studies and course units.
- *ECTS credits* which are a numerical value allocated to course units to describe the *student* workload required to complete them.
- The *transcript of records*, which shows students' learning achievements in a way which is comprehensive, commonly understood and easily transferable from one institution to another.
- The *learning agreement*, covering the programme of study to be undertaken and the ECTS credits to be awarded for their satisfactory completion, committing both home and host institutions, as well as the student.

B. The ECTS Credits

ECTS credits are a numerical value (between 1 and 60) allocated to course units to describe the student workload required to complete them. They reflect the quantity of work each course unit requires in relation to the total quantity of work necessary to complete a full year of academic study at the institution, that is, lecture, practical work, seminars, tutorials, fieldwork, private study - in the library or at home - and examinations or other assessment activities. ECTS is thus based on a full student workload and not limited to contact hours only.

From the 60 credits, which represent the workload of a full year of study, normally 30 credits are given for one semester. It is important to indicate that no special courses are set up for ECTS purposes, but that all ECTS courses are regular courses of the participating institution, as followed by home students under normal regulations.

It is up to the participating institutions to subdivide the credits for the different courses. ECTS credits should be allocated to all the course units available, whether compulsory or elective. Credits can also be allocated to project work, thesis and industrial placements, where these "units" are a normal part of the degree programme. Practical placements and optional courses, which do not form an integral part of the course of study, do not receive academic credit. Non-credit courses may, however, be mentioned in the transcript of records.

Credits are awarded only when the course has been completed and all required examinations have been successfully taken.

C. ECTS Students

The students participating in ECTS will receive full credit for all academic work successfully carried out at any of the ECTS partner institution and they will be able to transfer these academic credits from one participating institution to another, on the basis of prior learning agreement on the content of study programmes abroad between students and the institutions involved.

All students of the participating schools who are willing to take part in the ECTS Pilot Scheme may do so provided their institution agrees, subject to limits of available places.

Students selected by each institution to participate in ECTS may only be awarded a student mobility grant if they fulfil the general conditions of eligibility for the ERASMUS grant. These are:

- Students must be citizens of one of the EU Member States or citizens of one of the EFTA countries (or recognized by one member State or one EFTA country as having an official status of refugee or stateless person or permanent resident); as to EFTA nationals, students will be eligible provided they are moving within the framework of ERASMUS from the respective EFTA home country to an EU Member State. EFTA nationals registered as students in ECTS participating institutions in other EFTA countries or in Community Member States are only eligible for participation in ECTS if they have established a right of permanent residence;
- Students shall not required to pay tuition fees at the host institution; the student may, however, be required to continue to pay his/her normal tuition fees to the home institution during the study period abroad;
- The national grand/loan to which a student may be entitled for study at his/her institution may not be discontinued, interrupted or reduced while the student is studying in another Member State and is receiving an ERASMUS grant;
- One study period abroad should not last less than three months or more than one year;
- Students in the first year of their studies are not eligible for receiving ERASMUS grants.

Most students participating in ECTS will go to one single host institution in one single EU Member State, study there for a limited period and then return to their home institution. Some may decide to stay at the host institution, possibly to gain a degree. Some may also decide to proceed to a third institution to continue their studies. In each of these three cases, students will be required to comply with the legal and institutional requirements of the country and institution where they take their degree.

When the three parties involved – the student, the home institution and the host institution – agree about the study programme abroad, they sign a learning agreement attached to the application form. This agreement, which describes the programme of the study abroad, must be signed before the student leaves for the host institution. Good practice in the use of the agreement is a vitally important aspect of ECTS.

The home institution provides the student with a guarantee that the home institution will give full academic recognition in respect of the course units listed on the agreement.

The host institution confirms that the programme of the study is acceptable and does not conflict with the host institution's rules.

Students may have to modify the agreed programme of study upon arrival at the host institution for a variety of reasons: timetable clashes, unsuitability of chosen courses (in level or content) etc. The learning agreement form therefore provides for changes to the original agreed study programme/learning agreement.

It must be stressed that changes to the original agreed programmes of study should be made within a relatively short time after the student's arrival at the host institution. A copy of the new learning agreement should be given to the student and the coordinator of the home and host institutions.

When the student has successfully completed the study programme previously agreed between the home and the host institutions and returns to the home institution, credit transfer will take place, and the student will continue the study course at the home institution without any loss of time or credit. If, on the other hand, the student decides to stay at the host institution and to take a degree there, he or she may have to adapt the study course due to the legal, institutional and school's rules in the host country, institution and school.

USEFUL SERVICES TO STUDENTS

Anyone studying at Aristotle University of Thessaloniki may request the assistance of University services, such as the ones listed below, in order to solve any problems they may face during their studies. They can also themselves become volunteers, by offering their services to their colleagues or to fellow students in need.

Social Policy and Health Committee

The Social Policy and Health Committee (SPHC) aims to create conditions that will make the University an academic area accessible to all members of the university community, giving priority to space accessibility of disabled persons.

For this reason, qualified members of the teaching staff can train students with visual impairment to use electronic equipment linked with Braille printers installed in some of the

University libraries. Also the SPHC tries its best to ensure the granting of books with voice output to such students.

The SPHC also provides a bus for disabled persons, in order to facilitate their movement around campus for classes and exams during the academic year. In this context, the University has created a Program for the Promotion of Self-Help, which is run by a team of volunteers, the majority of whom are students. Email: selfhelp@auth.gr

Some years ago, the Social Policy and Health Committee established the institution of Voluntary Blood Donation, which also led to the creation of a Blood Bank in AHEPA hospital. Since May 2007, a second Blood Bank was founded in the Department of Physical Education in Serres, with the collaboration of the Social Policy and Health Committee and the General Hospital of Serres. Voluntary blood donation takes place twice a year, during the months of November and April, at the Ceremonial Hall of Aristotle University. The immediate target is to cover all needs for blood through voluntary blood donation, and currently covers 40% of total needs. Volunteering for blood donation, which is a safe procedure, without complications, is open to every person above 18 years of age who does not have any special health problems.

Email: socialcom@ad.auth.gr
fititikiline@ad.auth.gr
Website: http://spc.web.auth.gr
Tel / Fax: 2310 995386, 2310 995360

Observatory for the Academic Progress of Students belonging to Vulnerable Social Groups

The role of this Observatory is to assist:

- Students with disabilities
- Foreign students
- Minority students, foreign students of Greek descent or repatriated students
- Any other category of students who face problems hindering their studies

The above mentioned students can inform directly the Observatory – and also inform the Student Advisors of their Department – of any serious problem that they might face in the course of their studies, which arise either because of their disability or because of cultural, language or health problems.

Email: stud-observ@ad.auth.gr
Website: http://acobservatory.web.auth.gr
Tel./Fax: 2310.995360

Counselling and Psychological Support Committee

The Counselling and Psychological Support Committee (PSC) aims to coordinate the organization and function of the university units that offer psychological assistance and counselling to AUTh students.

The services provided by the University Centre for Counselling and Psychological Support are offered to students and university staff alike.

The Committee works closely with other related Committees and organizes dialogue workshops with students, as well as with the administrative and other staff of the university community.

Among the future aims of the PSC is the operation of a campus hotline, in order to provide immediate assistance to people in crisis and to those facing personal difficulties that could feel safer to talk about their problems in anonymity and in the absence of visual contact.

PSC is located on the ground floor of the Lower University Student Club, in the Sanitary Service Section, offices 5 & 8.

Email: vpapadot@ad.auth.gr
Tel.: 2310 992643 & 2310992621
Fax: 2310 992607 & 210992621

Volunteer Committee

The Volunteer Committee has as its main goal to promote to the members of the university community of AUTh the idea of volunteering as a contemporary social imperative.

The Volunteer Committee has as its motivation the improvement of the daily life of everyone working in Aristotle University, students and teaching and administrative staff, in areas such as student affairs, environmental issues and social aid. It encourages all members of the university community to take the initiative, by submitting ideas and suggestions.

A number of cells of volunteers in various Departments and Faculties have already been created to this end, consisting of a faculty member and a student, in order to develop a body of volunteers in each Department / Faculty of AUTh.

Email: vrect-ac-secretary@auth.gr
Tel: 2310996713, 996708
Fax: 2310996729

2. GENERAL INFORMATION

A. Brief History of Thessaloniki and its Cultural Life

One of Europe's most ancient cities, and the second largest city in Greece, Thessaloniki was founded ca.315 BC by Cassander, King of Macedonia, who named it in honour of his wife, Thessaloniki, half-sister of Alexander the Great. It rapidly grew into the most important city in the kingdom, and its principal commercial port.

Macedonia had been a centre of intellectual and educational activity since the age of mythology. During the reign of kings Perdikkas II and Archelaos I (438-399 BC), many important figures of Hellenic civilisation made their way to Macedonia, among them Hippocrates, the poet Melanippides, the tragic poets Euripides and Agathon, the epic poet Choirilos, the musician Timotheos and the painter Zeuxis.

Next came Aristotle, arguably the greatest of all the Greek philosophers. A native of the town of Stageira, not far from Thessaloniki on the Chalkidiki peninsula, his students included Alexander the Great, who was to carry Hellenic civilisation to most of the then known world.

During the Roman age, Thessaloniki was famous for its epigrammatists: Antipatros, Philippos and Epigonos. Saint Paul preached in Thessaloniki; and it was at nearby Philippi that in the year 50 of the Common Era he founded the first Christian Church in Europe. The *Epistles to the Thessalonians*, the two letters he later wrote to the people of Thessaloniki, are among the earliest documents of Christian writing.

With the foundation of the Byzantine Empire, Thessaloniki became its second urban centre, fostering and developing the intellectual and artistic movements that earned it the appellation of "the Athens of Medieval Hellenism". Unfortunately, there are very few documentary references to the learned institutions that flourished here during this period, and what does exist is tucked away in local monasteries. Those who have studied the history of the city, however, affirm that Thessaloniki never ceased to be a centre of learning. The continuous development of the arts and sciences in the city was further supported by the presence, from the 11th century onwards, of numerous Orthodox monasteries in the surrounding area and on Mount Athos.

When Thessaloniki fell to the Ottomans, most of its leading lights fled to the Christian West. The city continued to be an important centre of Jewish life and culture, especially after the arrival of a large Sephardic community escaping persecution from Spain in the 15th century. During this period the little progress made in Greek education took place in the nearby Mount Athos, culminating in the foundation in 1749 at Karyes of the Athonite School, where students were taught theology, philosophy, Latin, mathematics and - for the first time - physics (by Evgenios Voulgaris).

It was not until the end of the 19th century, in the last years of the reign of Sultan Hamid II, that the Ottomans state assumed responsibility for education. In 1879 it founded a High School in Thessaloniki so that government officials would be trained there. The building that housed it is now the Old Building of the University's School of Philosophy.

A victorious Greek army took Thessaloniki on October 26, 1912 at the end of the First Balkan War.

The year 1912 marked the beginning of a new period in Thessaloniki's economic, social and cultural life, one that turned the city, now part of Greece, into the economic, political and cultural capital of Macedonia and Thrace and the second largest and most important city in Greece.

When it was founded in 1926, the Aristotle University of Thessaloniki opened its doors to just 65 students: by 1960, the student body had grown to 9000, climbing to 37,000 in 1976, while today it numbers more than 60,000 students. The city of Thessaloniki now has two other universities, the "University of Macedonia" and the "International Hellenic University" and one technological institute the "Alexander Technological Educational Institute of Thessaloniki".

In the city there are numerous libraries, a variety of fine cultural and intellectual centres and institutions, museums, sculpture and art galleries, public and private theatres, conservatories and symphony orchestras. It also hosts a wealth of scientific and artistic events, especially during the annual "Dimitria" Festival.

Some of the features of the economic activity of the city, which has developed into one of the most important trade and communications centres in south-eastern Europe, are the Port with its Free Zone, the European Centre for the Development of Vocational Training (CEDEFOP), "Makedonia" International Airport, and HELEXPO, the International Trade Fair Exhibition Centre. More information is available in http://www.thessaloniki.gr

B. The Aristotle University of Thessaloniki

The University of Thessaloniki was founded under the First Hellenic Republic, when the Fourth National Assembly passed a motion introduced by Alexandros Papanastasiou into law on June 14, 1925. Statute 3341 instituted five Schools: Theology, Philosophy, Law and Economics, Physics and Mathematics, and Medicine. To these were soon added Schools of Agronomy and Forestry, Veterinary Science, Engineering, and Dentistry.

The first to open its doors, in 1926, was the School of Philosophy (Faculty of Arts). This was followed a year later by the School of Physical and Mathematical Sciences, initially having only a School of Forestry, but by the 1928-29 academic year the Schools of Physics, Mathematics and Agronomy were added. The School of Law and Economics was also established in two stages, with the Faculty of Law in 1928-29 and the Faculty of Political and Economic Sciences a year later. In 1937 the Schools of Forestry and Agronomy were separated from the School of Physics and Mathematics and re-constituted as the School of Forestry and Agronomy. The School of Physics and Mathematics continued to grow, with the successive addition of the Schools of Chemistry, Natural Science (abolished in 1975-76), Pharmacology and in 1973-74, Biology and Geology. The Schools of Medicine and Theology, instituted by the original Law, opened in 1942. A Faculty of Dentistry was established in 1959-60 as part of the School of Medicine, but in 1970 broke off and instituted itself as a separate School in the following academic year (1970-71). The School of Veterinary Science - the only one in Greece - was founded in

1950. The School of Engineering, opened in 1955-56 with a single School of Civil Engineering, and successively expanded by the addition of the Schools of Architecture (1957-58), Agronomic and Survey Engineering (1962-63), Chemical Engineering (1972-73) and Electrical and Mechanical Engineering (1972-73), this last being divided four years later into a School of Electrical Engineering and a School of Mechanical Engineering.

The years 1951-52 saw the foundation of the Institute of Foreign Languages and Literatures, attached to the School of Philosophy; the School of English Language and Literature, inaugurated that same year, was followed three years later by the School of French Language and Literature and in 1960-61 by the corresponding Schools for Italian and German Language and Literature.

The Aristotle University of Thessaloniki is now the largest university in Greece, with over 60,000 students, a faculty of around 2000, 195 special educational staff, and 296 supplementary teaching personnel. The University also has a special technical administrative staff of around 700.

The University campus, where most of the university services are located, occupies an area of 43 hectares in the centre of the city. However, the particular requirements of certain of its schools, in conjunction with the already overcrowded campus, have led to the development of new installations - some still under construction and some already in use - with an eye to the future. Some of these off-campus buildings are located outside the city proper: the School of Fine Arts and the School of Physical Education and Sports, for example, will be located on a 20 hectare site near Thermi; while the School of Forestry and Environmental Science has moved to premises in the Finikas area.

The law "On the structure and operation of the Greek Universities", which came into effect in the academic year 1982-83 and has subsequently been supplemented and modified by later legislation, introduced major changes in the structure and administration of the University and in its curriculum. The School of Physics and Mathematics, renamed the School of Sciences, has since the 1992-93 academic year included a School of Informatics. Today, the Aristotle University of Thessaloniki comprises the following Faculties and Schools:

1) **Faculty of Theology**:
   * School of Theology
   * School of Ecclesiastical and Social Theology
2) **Faculty of Philosophy**:
   * School of Philology
   * School of History and Archaeology
   * School of Philosophy and Pedagogy
   * School of Psychology
   * School of English Language and Literature
   * School of French Language and Literature
   * School of German Language and Literature
   * School of Italian Language and Literature
3) **Faculty of Sciences**:
   * School of Mathematics
   * School of Physics
   * School of Chemistry

* School of Biology
* School of Geology
* School of Informatics

4) **Faculty of Law, Economics and Political Sciences**:
   * School of Law
   * School of Economics
   * School of Political Sciences
5) **Faculty of Agriculture**
6) **Faculty of Forestry and Natural Environment**
7) **Faculty of Veterinary Medicine**
8) **Faculty of Medicine**
9) **Faculty of Dentistry**
10) **Faculty of Engineering**:
    * School of Civil Engineering
    * School of Architecture
    * School of Rural and Surveying Engineering
    * School of Mechanical Engineering
    * School of Electrical and Computer Engineering
    * School of Chemical Engineering
    * School of Mathematics, Physics and Computational Sciences
    * School of Urban-Regional Planning and Development Engineering (Veroia)
11) **Faculty of Fine Arts**:
    * School of Visual and Applied Arts
    * School of Music Studies
    * School of Drama
    * School of Film Studies
12) **Faculty of Education**:
    * School of Primary Education
    * School of Early Childhood Education
13) **Independent Schools:**
    * School of Pharmacy
    * School of Physical Education and Sports Sciences
    * School of Physical Education and Sports Sciences (Serres)
    * School of Journalism and Mass Media Studies

There are also the following University Units

1) School of Modern Greek Language
2) Institute of Modern Greek Studies
3) Centre for Byzantine Research

Each of these Schools offers at least a Bachelor's degree (*ptychio* in Greek).

The School of Modern Greek Language offers both regular semester courses and intensive winter and summer programmes. Its programmes are addressed to the foreign students attending the University.

The "Manolis Triantafillidis" Institute of Modern Greek Studies is set up to study and cultivate Demotic Modern Greek and Modern Greek Literature.

The Aristotle University of Thessaloniki is a State University under the responsibility of the Ministry of Education. The decision-making bodies are:

1. **The Senate**.
   Consists of the Rector, the three Vice-Rectors, the Deans of all the Schools, the Chairmen of all the Schools, representatives of the faculty, the technical administrative staff and the graduate student body, plus one undergraduate representative from each School.
2. **The Rector's Council**.
   Consists of the Rector, the three Vice-Rectors, one student representative and the University Registrar.
3. **The Rector**.

For the years 2014-2018, the Rector is Professor P. Mitkas and the Vice-Rectors are Professors Tzifopoulos, Argyropoulou-Pataka, Varsakelis, Laopoulos and Klavanidou.

The respective faculty general assemblies take decisions on the academic affairs of each School. There is also student participation on issues of their concern. More information is available in http://www.auth.gr

3. STUDENT INFORMATION

A. Freshman Registration

Every year, about 160 students are admitted to the School of Mathematics strictly on the basis of their performance in the National Entrance Examinations administered by the Ministry of Education. There is a limited number of places reserved for transfer students, who are admitted after special examinations conducted by the University during the fall semester. Students at the Greek Universities pay no tuition and receive all textbooks for their courses free of charge. A limited number of places at state-sponsored dormitories are available. Free meals are also offered to all registered students in the student mess hall. Financial aid in the form of honorary scholarships is available. Some of these grants are given to students strictly on the basis of academic performance regardless of financial need, while others are offered only to needy students who have demonstrated a highly satisfactory academic performance.

Successful candidates are invited to register within a time period fixed by the Ministry of Education, and are notified to this effect by means of a Presidential Decree issued each year and also published in the media.

No student already enrolled in any University School or School in Greece or elsewhere may be registered unless their prior registration is cancelled.

B. The Academic Year

All University of Thessaloniki programmes are structured on a semester system, with two Semesters (Winter and Spring) of thirteen teaching weeks each in one academic year.

In the Academic Year 2017-2018, the Winter semester begins on October 2nd and ends on January 19th, while the Spring semester begins on February 12th and ends on June 1st.

There are three examination sessions annually, each lasting three weeks: the January session beginning on January 22nd, and ends on February 9th, the June session beginning on June 4th, and ends on June 22nd, and the September session beginning on September 3rd and ends on September 21st 2018.

No lectures are given on the following official holidays: October 26th, October 28th, November 17, January 30th, March 25th, May 1st, and June 1st, and during the following holiday periods:

- Christmas and New Year’s (from December 24th to January 7th).
- Carnival (from February 19th to February 24th).
- Easter (from April 2nd to April 15th).

C. Libraries - Reading Rooms

The University Library comprises the Central Library and its Library Branches, which are associated to University Departments, Laboratories, Reading Rooms and Clinics.

The **Central Library Building** has a Faculty Reading Room, a Central Reading Room on the ground floor and a Student Reading Room on the first floor.

The Central Reading Room is open to students for work relating to assigned projects; students must apply to the Administration for a special pass, presenting the authorization note signed by the professor who assigned the work.

The Student Reading Room is open to all students in the University, and may be used for work on students' own books, textbooks, or the reference material available in the Reading Room itself. It is open morning and afternoon at the hours posted there.

The integration of the University Library into the Ptolemy II Library Network, begun in 1995, is expected to be completed soon; this will provide access to library materials via any computer hooked up to the system.

Anyone with access to the University network can freely browse the holdings of the libraries of the University of Thessaloniki and the University of Crete. The address is **http:/www.lib.auth.gr**

D. The University Student Union and its Services

Student services are provided at the University Student Union, located in the eastern sector of the University Campus.

The Student Union building houses restaurants, a health service, a reading room, a cafeteria, a barber shop, a hairdresser's with special student rates etc.

Board is provided subject to certain conditions; applications must be accompanied by the requisite documentation. Full details may be obtained from the Student Union offices.

Health care (medical, pharmaceutical and hospital) is provided for all under-graduate and post-graduate students. Students not already covered, directly or indirectly, by some other health care plan are issued Health Care Books upon registration. If a Health Book is lost, it may be replaced after an interval of two months. If this replacement book is lost, then a new one will be issued after the beginning of the following academic year.

E. Student Residences

There are three Student Residences on campus: Residence A, Residence B and Residence C. Admittance to these residences is subject to certain conditions, and applications must be accompanied by the proper documents. Full details are available from the USC Offices.

F. Cultural Activities

On-campus organizations include theatre, film and chess clubs, as well as the traditional Greek dance group and the football, basketball and volleyball teams, all of which organize various events.

In addition, given that the University is located in the heart of Thessaloniki, students have the opportunity to enjoy the wealth and diversity of events that contribute to the artistic and cultural life of this great city.

G. University Gymnasium

Students may use the facilities of the University Gymnasium, located in the eastern sector of the campus. Information: at the Secretariat of the Gymnasium.

Covering about 9 hectares, the University Gymnasium facilities provide all members of the University, students and faculty alike, with opportunities for physical exercise. Varsity teams in various sports represent the University in competitions both in Greece and abroad. There is also a traditional Greek folk dance group.

H. Public Transport (Student Discount Card)

Undergraduate and postgraduate students are entitled to a discount on domestic coach, rail and airfares.

At the time of registration, the Secretariat of each School will provide any student entitled to such discount with an interim special pass, valid for the named holder only and for one academic year. If this pass is lost, stolen or destroyed (for whatever reason), the student must declare its loss, theft or destruction to the Secretariat and a new card will be issued, after an interval of two months to allow for investigation into the circumstances of the said loss, theft or destruction.

The discount is valid for the duration of the academic year and for as many years as are normally required to complete the course of study, plus half that period again.

The discount granted is fixed by Ministerial decision on the basis of current fares for each form of transportation.

I. Accommodation for ECTS Students

The Aristotle University of Thessaloniki can provide accommodation for ECTS students upon request. Students should ensure that the Secretariat of EEC European Educational Programmes receives their applications at least three months before the beginning of the semester.

In all schools, registration dates are: September 1-30 for the winter semester and January 1-31 for the spring semester.

The Senate has resolved that ERASMUS students are to be treated as home students; this means that they have the same rights and obligations as Greek students, including:

1) Free registration, tuition and books,

2) Discount card for urban and inter-urban transportation,

3) Health insurance card and free hospitalization and medication,

4) Free meals in the Student Refectory.

In addition, the University has reserved some places in special dormitories, which are available to Erasmus students for a small rental fee. The rent is payable by the week so that it is possible for the Erasmus student to stay in the dormitory for as long a period of time as he or she wishes or until he or she finds another arrangement.

For ERASMUS-ECTS students who wish to prepare for their studies in Greece, the University offers intensive and regular Greek Language courses.

The intensive courses are one month long; these run from mid-September to mid-October and from early February to early March. For ECTS students, payment of the fees is covered by the University.

The regular courses (Beginners, Intermediate, and Advanced level) are year-long courses and free of charge. These programmes focus on the teaching of the Modern Greek Language, and touch on aspects of Greek civilization and culture. Each of the three levels covers four (teaching) hours a day, five days a week.

A certificate of attendance is delivered at the end of the programme.

ERASMUS students may also, if they wish, follow the regular semester courses offered by the Modern Greek Language School. (For further information: School of Modern Greek Language, AUTH 54124 Thessaloniki, Tel: 0030-2310-997571/ 0030-2310-997572, fax: 0030-2310-997573, http://www.gls.edu.gr).

The Office of European Education Programs is situated on the ground floor of the Administration Building. Opening hours: 08.00 – 14.30. Tel.: 0030-2310-995291, 5293, 5289, 5306. Fax: 0030-2310-995292.

More information is available in http://www.auth.gr

4. THE SCHOOL OF MATHEMATICS

The School of Mathematics was established in 1928; together with the Schools of Physics, Chemistry, Biology, Geology and Informatics, it is one of the six Schools of the Faculty of Sciences.

For administrative purposes, the School of Mathematics is sub-divided into the following five Departments:

1. Algebra, Number Theory and Mathematical Logic
2. Mathematical Analysis
3. Geometry
4. Numerical Analysis and Computer Sciences
5. Statistics and Operations Research

A. Administrative Structure

1. **The Head of the School**.
2. **The Administrative Board**.
   It consists of the Head, the Deputy Head of the School and the five Department Heads, plus two student representatives.
3. **The School's Council**.
   The School's Council comprises the teaching staff (25 faculty members) and student representatives.

Information:

School of Mathematics
Head of the School: Professor Nikolaos Karampetakis
Academic Secretary: A. Stergiou
Aristotle University of the Thessaloniki
Thessaloniki, Greece 54124
Tel.: 0030-2310-997920
0030-2310-997950
Fax: 0030-2310-997952

Erasmus Programme

The ERASMUS Coordinator of the School is:
Efthimios Kappos
kappos@math.auth.gr
Tel: +30-2310-997958
The Deputy ERASMUS Coordinator is:
Fani Petalidou
petalido@math.auth.gr
Tel: +30 2310 998104

B. The Staff

DEPARTMENT OF ALGEBRA, NUMBER THEORY AND MATHEMATICAL LOGIC

Professors	Charalambous, H. (Head of Department) Papistas, A. Tzouvaras A.
Department Secretary	Tsitsilianou M.

DEPARTMENT OF MATHEMATICAL ANALYSIS

Professors	Betsakos, D. Marias, M. Siskakis, A. (Head of Department)
Assistant Professor	Galanopoulos, P.
Lecturer	Fotiadis, A.
Department Secretary	Tsitsilianou M.

DEPARTMENT OF GEOMETRY

Associate Professors	Kappos, E. Stamatakis, S. (Head of Department)
Assistant Professor	Petalidou, F.
Department Secretary	Tsitsilianou M.

DEPARTMENT OF NUMERICAL ANALYSIS AND COMPUTER SCIENCES

Professors	Karampetakis, N.
	Poulakis, D.
Associate Professors	Gousidou-Koutita, M. (Head of the Department)
	Rachonis, G.
Assistant Professor	
Department Secretary	Tsitsilianou M.
Technical Assistants	Porfiriadis, P.
	Tzounakis P.

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

Professors	Antoniou, I.
	Kalpazidou, S.
	Tsaklidis, G.
Associate Professors	Kolyva-Mahaira, F.
Assistant Professor	Papadopoulou, A.
Lecturer	
Department’s Secretary:	Tsitsilianou M.
Technical Staff:	Bratsas Ch.
	Vlachou Th.

TEACHERS OF FOREIGN LANGUAGE

To be announced

SECRETARIAL STAFF

Secretary	Stergiou, A. Tel: +30 2310 997920
Secretarial staff:	Mantzouni, G. Tel: +30 2310 997920 Sotiriadou, A. Tel: +30 2310 997842 Tsianaka, O. Tel: +30 2310 997983 Tsitsilianou M. Tel: +30 2310 998096 Vlachou, Th., Tel: +30 2310-997930

Mailing Address: School of Mathematics
Aristotle University of Thessaloniki
Thessaloniki 54124
Greece

C. Library

The Library of the School of Mathematics, located in the western wing of the Sciences Building (Building 22), has a collection of more than 25,000 titles, and subscribes to 396 periodicals. Open Monday to Thursday from 9:00 until 18:00, and until 15:00 on Friday.

Lending facilities are restricted. Some books, chiefly textbooks used in the School, may be taken out upon presentation of the student's ordinary or student identity card.

Other books and all periodicals must be read in the Library Reading Room.

D. Computer Facilities

Information on the Mathematics School is also available via Internet, at:

http:// www.math.auth.gr

Students may use the computers in the Informatics Laboratory on the first floor of the Biology building.

The School also operates an FTP Server that provides, free of charge, a variety of software on different computer platforms. The address is:

ftp:// ftp.math.auth.gr

E. Registration for Examinations

Students **must** register for examination in **all** courses they are taking (compulsory, compulsory elective, elective and free elective–see below) at the beginning of each semester. This is done electronically on the site of the School, within a period specified by the Secretariat. The number of courses for which students may register is limited.

Students who do not register for their chosen courses in time will not be eligible to sit the examinations. In the January and June examination sessions, students are admitted **only** to examinations in the courses registered for at the beginning of that semester; in the September examination session, students are eligible for examination in courses for which they were registered in either of the two semesters of the academic year just completed.

A student who fails in any course may **re-register** for the same course in any semester when that course is taught (or in the conjugate semester, for students in their 8th or subsequent semester).

Curriculum regulations for students admitted in the 2014-2015 academic year will be announced by the Secretariat of the School.

F. Undergraduate Programme of Studies

The Undergraduate Programme in Mathematics is structured over eight semesters, and leads to the degree of "Diploma of Mathematics" (Ptychio).

There are four kinds of courses: *compulsory, compulsory electives, electives and free electives.* In order to complete the programme and be awarded the Diploma, students must successfully pass all the 24 compulsory courses plus 4 compulsory elective courses from four different departments and 12 elective courses. Of the elective courses, not more than 5 can be free elective. The total number of ECTS credits earned from all these courses must be at least 240. Additionally, every student must pass the course **Introduction to Computer Programming (Fortran 90/95 or C++).**

Listed below are all the courses offered by the School of Mathematics in the 2014-2015 academic year, with the following information for each: Name of Course, the indication G-LSUD (Greece – Long Study University Diploma), number of semesters taught, the ECTS code and course number, the number of hours per week, the number of weeks per semester, the type of examination (written or otherwise), whether or not there is a laboratory component, the number of ECTS credits provided, an outline of the course and the name(s) of the instructor(s). This is followed by tables, setting out a summary of all the above information in compact and easy-to-read form.

FIRST SEMESTER:

Introduction to Algebra and Number Theory
G-LSUD1 IALG - 0102
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Elements of set theory (sets - functions - relations - equivalence relations - partial ordered sets- lattices). Natural numbers and Integers (Mathematical induction-divisibility- prime numbers- Euclidean algorithm- GCD- LCM- Fundamental theorem of arithmetic- mod n). Elements of combinatorial theory. Elements of algebraic structures (Groups and subgroups, homomorphism of groups, rings and subrings, fields and subfields, multiplicative functions).
Instructor: Alvanos, Poulakis

Linear Algebra
G-LSUD1 LALGI - 0108
6h/w (5 hours' lectures, 1 lab), 13 weeks, written exams, credits: 8
Compulsory
Description: Vector spaces - Finite dimensional vector spaces - Matrices - Determinants - Matrices and Linear Transformations - Systems of linear equations - Eigenvalues - Eigenvectors - Characteristic polynomial - Euclidean and unitary spaces.
Instructors: A. Papistas, H. Charalambous, A. Tzouvaras, Vavatsoulas

Calculus I
G-LSUD1 CI - 0201
5h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Basic notions - Sequences and series of real numbers - Power series - Real functions - Limits - Continuity - The Derivative - Applications of the derivative - Taylor series - Study of functions.
Instructors: A. Siskakis, A. Fotiadis

Introduction to Computer Programming (C++)
G-LSUD1 ICPR - 0430
3h/w, 13 weeks, written exams, credits: 5
Compulsory
Description: Introduction to C++: Computer hardware - Computer software - Programming languages - An introduction to problem solving with Fortran 90/95 or C++ - The structure of a program - Simple input and output - Control structures - Iterations – Array processing (one dimensional and multidimensional matrices) - Functions - Subroutines - Modules - IMSL libraries - File organization (sequential files, direct access files) - Applications to mathematical problems.
Web link: http://users.auth.gr/~grahonis/C++.htm

Introduction to Fortran 90/95/2003 : Computer hardware - Computer software - Programming languages - An introduction to problem solving with Fortran 90/95/2003 - The structure of a program - Simple input and output - Control structures - Iterations – Array processing (one dimensional and multidimensional matrices) - Functions - Subroutines - Modules - IMSL libraries - File organization (sequential files, direct access files) - Applications to mathematical problems.
Web link: http://eclass.auth.gr/courses/MATH104
Instructors: Chatzifoteinou, G. Rahonis, P. Porfyriadis

Analysis of Mathematical texts in the English language
G-LSUD1 0601
3h/w, 13 weeks, credits: 3
Elective
Description: Details to follow
Instructor: to be announced

SECOND SEMESTER:

Calculus II
G-LSUD2 CII - 0202
5h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: The definite Riemann integral - Fundamental theorems of integral calculus - The indefinite integral modes of integration - Application of the definite integral (area, length of curves, area and volumes of revolution) - Improper integrals – Taylor series and power series, convergence. Differentiation and integration of power series.
Instructor: A. Fotiadis, M. Marias

Analytic Geometry I
G-LSUD2 ANGI - 0301
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Vector spaces: The concept of a vector space - Basis - Dimension - Inner product - Vector product - Orientation. Affine spaces - Affine coordinates - Lines and planes in A^2 and A^3 - Affine transformations - Affine classification of Conics. Projective space – homogeneous coordinates. Euclidean vector and affine spaces. Inner products, Isometries.
Instructor: E. Kappos, F. Petalidou

Theoretical Informatics I
G-LSUD2 ITI - 0401
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory

Description: Sets, relations, algorithms. Analysis of algorithms. Alphabets, languages and regular languages. Finite automata: deterministic, non-deterministic and equivalence. Finite automata and regular expressions. Decidability results.
Instructor: G. Rahonis

Mathematical Programming
G-LSUD2 MAPR - 0501
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Mathematical models - Linear programming - Graphical solution and graphical analysis of the sensitivity of the linear model - Simplex method - Sensitivity analysis - Introduction to Integer Programming - Transportation problem - Principles of dynamical programming - Non-linear methods of optimization - Applications.
Instructor: Karagiannis, C. Bratsas

Symbolic Programming Languages
G- LSUD2 ISYMA - 0461
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Introduction to computer algebra systems - Introduction to Mathematica - Building expressions Numerical calculations - Symbolic calculations - Symbolic manipulation of mathematical representations - Basic functions - List manipulation - Functions and programs - Mathematica packages - Special topics in Algebra (expansion - factorization - simplification - sets and matrices) - Analysis (equation solving - system equation solving - differentiation - integration - sums and products - limits - Taylor series) and Geometry (second order curves - second order surfaces - two and three dimensional plotting) - Introduction to other computer algebra systems such as Maple, Matlab, Reduce, Macsyma etc.
Instructor: N. Karampetakis, P. Porfyriadis

THIRD SEMESTER:

Algebraic Structures I
G-LSUD3 ALG I - 0106
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Groups, subgroups, group generated by a set - Homeomorphisms of groups - Lagrange’s theorem - Order of a group element - Euler’s theorem, Fermat’s theorem - Normal subgroups - Isomorphism theorems - Cyclic groups and their classification - Action of a group on a set - Permutation groups - Dihedral groups - Direct sums of groups.
Instructor: A. Papistas, Psaroudakis

Calculus III
G-LSUD3 CALIII - 0203
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Functions of several variables - Limits and continuity - Partial derivatives - Differentiation of scalar and vector functions - The chain rule - Higher order partial derivatives - Directional derivatives - Taylor's formula - Extremes of real valued functions - Lagrange multipliers - The implicit function theorem and the inverse function theorem.
Instructors: P. Galanopoulos

Topology of Metric Spaces
G-LSUD3 ELTOP - 0204
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Basic notions of Set Theory - Metric spaces - Topology of metric spaces - Convergence of sequences - Continuous functions - Compactness and Connectedness of metric spaces.
Instructors: Stylogiannis

Analytic Geometry II
G-LSUD3 INGII - 0302
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Applications in Euclidean spaces E^2, E, Ellipse - hyperbola and parabola - Tangents - Poles and polars - Conjugate diameters - Metric classification of figures of second degree in E^2- Hyperboloids, paraboloids, ellipsoids, cylinders and cones of second degree - Tangent planes - Metric classification of figures of second degree in E^3.
Instructor: F. Petalidou, S. Stamatakis

Probability Theory I
G-LSUD3 PROB - 0502
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: The sample distribution space - events - classical definition of mathematical probability - statistical regularity - axiomatic foundation of probability - Finite sample distribution spaces - combinatorics - geometric probabilities - Conditional probability - independence - Univariate random variables - distribution functions - function of a random variable - moments, moment-generating function - probability generating function - Useful univariate distributions: Discrete (Bernoulli, Binomial, Hypergeometric, Geometric, Negative Binomial, Poisson), Continuous (Uniform, Normal, Exponential, Gamma) - Applications.
Instructor: I. Antoniou, Karagiannis, G. Tsaklidis

Introduction to Meteorology and Climatology
G-LSUD3 METCLI – 1061
3h/w, 13 weeks, written exams, credits: 5
Free elective
Description: Climatic elements: solar and terrestrial radiation - Energy balance - air-temperature - atmospheric pressure - local winds - hydrologic cycle – evapotranspiration - water vapours - precipitation - Distribution of the climatic elements - Climate classifications - The climatic classification of Köppen and Thornthwaite - Climatic change theories.
Instructors: Dept of Geology staff

FOURTH SEMESTER:

Algebraic Structures II
G-LSUD4 ALG II - 0107
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Rings, subrings and ring homeomorphisms - Ideals and sum and product of ideals- Isomorphism theorems of rings- Integral domains - Quotient field- The ring of integers, the field of rational numbers- Prime fields- Prime and maximal ideals- Principal ideal domains - Unique factorization domains- Euclidean domains - Polynomial rings - Irreducible polynomials in Q[x], R[x], C[x]- Field extensions - Algebraic and transcendental elements - Algebraic extensions and the minimal polynomial - Field constructions.
Instructor: H. Charalambous, Psaroudakis

Calculus IV
G-LSUD4 CIV – 0205
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Multiple integrals - Line integrals - Surface integrals - The integral theorems of Vector Analysis.
Instructors: P. Galanopoulos, R. Malikiosis

Differential Equations
G-LSUD4 DE - 0206
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Differential equations of first order - The method of Picard - Linear

differential equations of order n=2 - Reduction of the order of a differential equation - Euler's equations - Systems of differential equations. Laplace transforms.
Instructors: Gkikas

Statistics
G-LSUD4 ST - 0503
5h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Elements of probability theory - Distributions of some useful statistics - Descriptive statistics - Methods of point estimation - Confidence intervals and tests of hypotheses for the mean, the variance and the proportion for one and two samples - Test of Goodness-of-Fit - Contingency tables - Tests of homogeneity - The method of least squares- Regression - Hypothesis testing and Confidence intervals in simple linear regression - Simple, multiple and partial correlation coefficient - Analysis of variance - The one-way layout - The two-way layout with and without interaction - Non-parametric methods - Kolmogorov-Smirnov tests, runs tests, rank tests and sign tests for one and two samples - Tests concerning k>2 independent and dependent samples - The Spearman correlation coefficient - Applications using statistical packages.
Instructor: F. Kolyva-Machera, C. Bratsas, Afendras

Mathematical Methods in Operational Research
G-LSUD4 MMOR - 0504
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: What is a stochastic process - Queuing Theory: birth-death processes - some well-known queuing systems - Markov Chains: n-step transition probabilities - classification of states - steady-state probabilities and mean first passage times - absorbing chains.
Instructor: A. Papadopoulou

General and Dynamic Meteorology
G-LSUD4 GDM - 1062
3h/w, 13 weeks, written exams, credits: 5
Free elective
Description: Chemical composition of air - Change of meteorological parameters of height – Barometric systems - General circulation of the atmosphere - Introduction to dynamic meteorology - Meteorological coordinate systems - The fundamental equations of motion-Scale analysis - The geotropic wind. The gradient wind - The cyclostrophic wind - Thermal wind. Continuity equation - Pressure tendency equation - The concepts of circulation and vorticity - Absolute, relative and potential vorticity - The vorticity equation - Principles of weather modification - Conceptual and theoretical models - Operational and experimental weather modification projects.
Instructors: Katragkou

FIFTH SEMESTER:

Number Theory
G-LSUD5 0136
3h/w, 13 weeks, written exams, credits: 5.5
Elective
Description: Unsolved problems in Number Theory. Linear congruences. Systems of linear congruences. Polynomial congruences. Arithmetic functions. Quadratic residues. Quadratic number fields. Applications.
Instructor: Alvanos

Computational Methods in Algebra and Algebraic Geometry
G-LSUD5 -151
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective
Description: Polynomial rings and ideals. Noetherian rings and the Hilbert Basis Theorem. Monomial orderings and polynomial division. Introduction to Gröbner bases. The Buchberger algorithm. Introduction to CoCoA. Applications to Algebra and Algebraic Geometry. Algebraic sets and the Nullstellensatz. Introduction to algebraic varieties.
Instructor: Kofinas

Introduction to Real Analysis
G-LSUD5 REAN - 0207
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Real numbers - Countable and uncountable sets - Sequences and series - Permutations of series - Representations of real numbers - The Cantor set and Cantor's function - Special classes of functions (monotone, bounded variation, absolutely continuous, convex) - Sequences and series of functions - uniform convergence and applications - Nowhere differentiable continuous functions – Space-filling curves - equicontinuity - Arzela-Ascoli theorem - Weierstrass approximation theorem - Lebesgue measure.
Instructor: D. Betsakos, R. Malikiosis

Classical Differential Geometry I
G-LSUD5 CDG - 0303
5h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Definition of a curve - The method of moving frames - Fundamental Theorem of the Theory of Curves - Definition of a surface - Curves on surfaces - Fundamental forms - Asymptotic lines - Christoffel symbols - Theorema egregium - The Gauss mapping - Fundamental Theorem of Surface Theory.
Instructor: E. Kappos, S. Stamatakis

Numerical Analysis
G-LSUD5 NA – 0402
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Structure of Computational systems and algorithms, number systems and errors - Interpolation and approximation (interpolation by Lagrange and Newton polynomials) - Numerical integration (midpoint, trapezoid and Simpson's rules, Romberg integration) - Numerical solution of non-linear equations (bisection method, secant, regula-falsi and modified regula-falsi, Newton's method) - Introduction to iterative methods for linear systems and ODE.
Instructor: M. Gousidou-Koutita

Probability Theory II
G-LSUD5 PROBII - 0505
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: The algebra of events - Probability Space - The axioms of Probability - Random variables - The notion of stochastic distribution - Multidimensional random variables - Multidimensional distribution functions - Marginal distributions - Denumerable multidimensional random variables - Continuous multidimensional distributions - Multidimensional normal distribution - Stochastic independence - Conditional Probability - Conditional density - Conditional distributions - Mean values for multidimensional random variables - Conditional mean values - Regression line - Mean square error - Random variable transforms - Compound distributions - Inequalities - Multiple Correlation coefficient - Ordered random variables - Characteristic functions - The sum of independent random variables - Characteristic functions of multidimensional random variables - Moment generating functions - Probability generating functions - Limit theory of random variables - Convergences - Relations between convergences - Central Limit Theorem – The Law of large numbers - The log log law.
Instructors: Afendras, G. Tsaklidis

Stochastic Strategies
G-LSUD5 STOSTRA - 0506
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory
Description: Stochastic problems - Stochastic networks - Stochastic problems of tools replacement and repairing - Renewal theory - Inventory.
Instructor: A. Papana

Statistical Learning and Knowledge Processing
G-LSUD5 ANVARE - 0531
4h/w, 13 weeks, written exams, credits: 5.5

Compulsory elective (for the Department of Statistics and Operational Research)
Description: 1) Organization of data collection for small and large data sets, 2) Principal component analysis, mutual information, 3) Proximity, similarity, affinity and applications, clustering and classification, 4) Data interpretation, 5) Applicatiuons to real large data sets
Instructor: Makris

Seismology
G-LSUD5 SEIS - 1063
3h/w, 13 weeks, written exams - lab., credits: 5
Free Elective
Description: Theory of elastic waves - Quantification of earthquakes – Theory of plate tectonics - Seismotectonics of the Aegean area - Macroseismic effects of earthquakes.
Instructor: P. Chatjidimitriou, T. Tsapanos.

Theoretical Mechanics
G-LSUD5 THMI - 1064
3h/w, 13 weeks, written exams, credits: 5
Free Elective
Description: Kinematics of a mass particle - Forces and laws of motion - Conservation theorems - Systems with one degree of freedom - Oscillations - Stability of equilibrium points - Phase diagrams - Central forces - Kepler’s problem - Systems of mass particles – Non-inertial frames of reference.
Instructor: C. Varvoglis.

SIXTH SEMESTER:

Complex Analysis
G-LSUD6 COMAN- 0208
4h/w, 13 weeks, written exams, credits: 7
Compulsory
Description: Complex numbers, the complex plane, topology of the plane, elementary complex functions - Holomorphic functions, Cauchy-Riemann equations - The complex integral, Cauchy's theorem and integral formula - The maximum principle, theorems of Morera and Liouville, the Schwarz lemma - Power series, the identity theorem - Laurent series, singularities, residues.
Instructor: A. Siskakis

Compulsory Electives

Group Theory
G-LSUD6 GTH - 0131
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Algebra, Number Theory and Math. Logic)

Description: The groups D_n, S_n, GL(n,K) - Action of a group on a set. Counting formulae - Applications: orbits and decoration problems, symmetric groups, crystallographic and wallpaper groups - Sylow theorems - Applications: groups of small order - Simple groups - Normal and solvable series - Solvable groups - Exact sequences - Finitely generated abelian groups.
Instructor: A. Papistas

Measure Theory
G-LSUD6 METHE - 0231
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Mathematical Analysis)
Description: Lebesgue measure on the real line - Measurable functions - Lebesgue integral - Monotone and dominated convergence theorems - Comparison of integrals of Riemann and Lebesgue - The fundamental theorem of Calculus for Lebesgue integral - Abstract measure theory - Signed and complex measures - Product measures - Fubini's theorem.
Instructor: D. Betsakos

Elements of Functional Analysis
G-LSUD6 FA – 0232
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Mathematical Analysis)
Description: Metric spaces, review of basic notions. The orem of Baire. Normed spaces, Banach spaces, examples. Inner product spaces and Hilbert spaces. Linear operators and linear functionals. Dual space. Hahn-Banach, Banach-Steinhaus, open map and closed graph theorems..
Basic notions - Metric spaces - Normed spaces - Inner product spaces - Linear operators and functionals - Norms in B(X,Y), Hahn-Banach, Banach-Steinhaus, open mapping and closed graph Theorems.
Instructor: G. Stylogiannis

Linear Geometry I
G-LSUD6 LINGEO - 0331
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Geometry)
Description: Multidimensional affine spaces – Affine subspaces – Affine mappings.
Instructor: Th. Theofanidis

Classical Differential Geometry II
G-LSUD6 CDGII - 0332
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Geometry)
Description: The Darboux frame - Normal curvature, geodesic curvature, geodesic torsion

- Principal curvatures, Gauss curvature and mean curvature - Lines of curvature - Dupin indicatrix and conjugate directions - Geodesics - Levi-Civita parallelism - The Gauss-Bonnet formula.
Instructor: S. Stamatakis

Computational Mathematics
G-LSUD6 COMMA - 0431
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Numerical Analysis and Computer Science)
Description: Interpolation and approximation with piecewise polynomials and splines, Numerical linear algebra: Gauss elimination for linear systems, pivoting, LU- factorization and an introduction to the stability of systems and algorithms, norms of vectors and matrices, condition number, iterative methods, introduction to the numerical solution of eigenvalue-eigenvector problem, numerical solution of ODEs (existence and uniqueness of initial value problem). Euler method, Taylor method, Runge-Kutta methods and multistep methods.
Instructor: M. Gousidou-Koutita

Theoretical Informatics II
G-LSUD6 ITI - 0432
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Numerical Analysis and Computer Science)
Description: Minimization of finite automata. Algebraic grammars. Syntactic trees. Algebraic languages and their properties. Relations between algebraic and identifiable languages. Stack automata.
Instructor: G. Rahonis

Matrix Theory
G-LSUD6 MATRIX - 0532
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Statistics and Operational Research)
Description: Prerequisite matrix theory - Matrix polynomials and normal forms - Functions of matrices - Inner products and matrix norms - Normal matrices - polar decomposition - singular value decomposition - Kronecker and Hadamard products - Nonnegative matrices - Generalized inverses.
Instructor: G. Tsaklidis

Deterministic Methods of Optimization
G-LSUD6 DEMEOP - 0533
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Statistics and Operational Research)
Description: Introductory concepts: Convex and Concave functions. Solving NLPs with one variable. Iterative methods of finding extrema of functions in R^n, $n>1$.
Instructor: G. Tsaklidis

Electives

Stochastic Processes
G-LSUD6 STPR - 0563
3h/w, 13weeks, written exams, credits: 5
Elective
Description: Definition of a stochastic process - Classification of stochastic processes - Stochastic dependence - Martingales - The Markov property - The strong Markov property - Classification of states - Classifications of Markov chains - The matrix method - Regular chains - Cyclic chains - Inverse Markov chains - General properties of Markov chains - Extension of the Markov property - The ergodic behaviour - Random walks - Galton-Watson Processes (or Branching Processes), Processes with independent increments - The Poisson process - The Wiener process - Brownian motion - Continuous parameter Markov processes - The transition probability function - Kolmogorov's equations - Feller's algorithm - Noteworthy classes of Markov processes - Renewal Processes - Diffusion processes - Applications.
Instructor: S. Kalpazidou

Data Analysis
G-LSUD6 0571
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Statistical methods applied to simple problems with th euse of statistical software, data recovery from relational bases and knowledge graphs. Descriptive analysis, diagrammatic representation, random number generation, confidence intervals, hypothesis testing, correlation matrices, regression functions, real-world studies.
Instructor: C. Bratsas

Mathematical Software and Knowledge Representation Languages
G-LSUD6 0967
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Introduction to software for the simulation and investigation of mathematical problems suitable for secondary school students, such as Sketchpad, Cabri and GeoGebra. Ontology web languages and applications to the semantic web.
Instructor: G. Makris

Time Series
G-LSUD6 0564
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Theory: stationary time series, autocorrelation function, linear models (AR, MA, ARMA), non-stationary models (ARIMA, SARIMA), Box and Jenkins prediction method, confidence intervals. Lab: statistical software SPSS or R.
Instructor: A. Papana

Special Topics A
G-LSUD6 ST - 1161
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: The instructor, in collaboration with the student, specifies a subject.
Instructor: Any one of the teaching staff upon decision to teach the course.

Free Electives

Continuum Mechanics
G-LSUD6 CM - 1066
3h/w, 13 weeks, written exams, credits: 5
Free elective
Description: Introduction to Tensor Analysis - Lagrangian and Eulerian description of the motion - Local and total derivatives - Streamlines and pathlines of particles - Potential flow - Strain tensor - Displacement vector - Rate of deformation tensor - Velocity distribution in infinitesimal regions - Circulation and turbulent flow - The equation of continuity - Mass forces, stress vector and stress tensor - Equations of motion of a continuum - Ideal and Newtonian fluids - Euler and Navier-Stokes equations - Applications - examples.
Instructor: E. Meletlidou

SEVENTH SEMESTER:

Compulsory Electives

Mathematical Logic
G-LSUD7 MALO – 0133
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Algebra, Number Theory and Math. Logic)
Description: Propositional calculus: language of PC. Truth values, logical inference. Sufficiency of connectives. Axiomatization of PC, completeness. Independence of the axioms. Predicate calculus. First-order languages. Structures, models, truth. Axiomatization of first-order predicate calculus, completeness.
Instructor: A. Tzouvaras

General Topology
G-LSUD7 GTO – 0233
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Mathematical Analysis)
Description: Topological spaces. Types of points. Countability and separability axioms. Continuity and convergence. Topologies derived from other topologies. Compact spaces. Connected spaces. Function spaces

Instructor: Ch. Papacristodoulos

Differential Manifolds I
G-LSUD7 DMI – 0304
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Geometry)
Description: Differentiable manifolds – Definition and examples. Product manifolds and quotient manifolds. Submanifolds of $\mathbb{R}^n$ – Theorem of regular value. Tangent vectors, tangent space of a manifold at a point, tangent bundle. Covectors, cotangent space of a manifold at a point, cotangent bundle. Vector fields, Lie bracket, 1-forms on a smooth manifold. Smooth maps between smooth manifolds. Tangent map of a smooth map between smooth manifolds and its dual map, pushforward and pullback. Immersions, embeddings, submersions. Submanifolds.
Instructor: F. Petalidou

Classical Control Theory
G-LSUD7 CLCOTH - 0433
3h/w, 13 weeks, written exam, credits: 5.5
Compulsory elective (Department of Numerical Analysis and Computer Science)
Description: Introduction to the concepts of Systems, Signals and Automatic Control, (brief historical review, basic structure of feedback control, examples) - Mathematical concepts and tools for the study of continuous and discrete-time signals and systems. (Laplace transform, z-transform, applications, block diagrams and signal flow graphs) - Classification of signals and systems. Continuous and discrete time signals and systems - Time invariance, linearity - Classical analysis of systems and control in the time and frequency domains - Linear time invariant single-input, single-output systems described by ordinary, linear differential equations - Input output relation and the transfer function description of a linear time invariant system – Free, forced and total response of systems in the time domain - Stability of linear time invariant systems and algebraic stability criteria - Routh test for stability - Frequency response of linear time invariant systems - Closed loop systems - Root locus - Nyquist stability Criterion - Stabilizability and Stabilization of systems via pre-compensation and output feedback - Synthesis of controllers and parametrization of stabilising controllers.
Instructor: N. Karampetakis

Error Correcting Codes
G-LSUD7 ECC – 0465
3h/w, 13 weeks, written exam, credits: 5.5
Compulsory elective (Department of Numerical Analysis and Computer Science)
Description: Hamming distance. Perfect codes, equivalence of codes, linear codes, generator matrices, message encoding, parity check matrices, decoding matrices, majority decoding, weight enumerator. Shannon's theorem, lower bound on codes, code generation, Singleton's bound, MDS codes, Plotkin's bound, Griesmer's bound, Hamming codes, Golay codes, Reed-Muller codes.
Instructor: D. Poulakis

Mathematical Statistics
G-LSUD7 MASTI - 0534
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Statistics and Operation Research)
Description: Distributions of functions of random variables - Normal distribution and the derived distributions from the normal - The exponential family - Sufficiency of a statistic for a parameter or for functions of parameters. The Rao-Blackwel theorem - Completeness and uniqueness - Unbiased estimators with minimum variance - The Cramer-Rao inequality - Efficient statistics - Consistent statistics - Maximum likelihood and moment estimators and their properties - Prior and posterior distributions and Bayes estimators - The minimax principle - Interval estimation. General methods for construction of confidence intervals - Approximate confidence intervals - Confidence regions.
Instructor: F. Kolyva-Machera

Electives

Algorithms and Data Structures
G-LSUD7 0464
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Introduction to algorithms, models and analysis of problems, complexity, bounds. Categories of algorithms, sorting algorithms. Data structures and basic operations, lists, static and dynamic stacks. Simple and circular queues. Trees, Huffman coding, links with graph theory.
Instructor: A. Chatzifoteinou

Computational Geometry
G-LSUD7 0471
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Bézier curves, cubic and Hermite interpolation, approximating curves, piecwise Bézier curves, curve synthesis, B-splines and applications. Parametric surfaces, rational Bézier curves, Bézier surfaces, rational B-splines, surface synthesis.
Instructor: P. Dospra

Stochastic Methods in Finance
G-LSUD7 STMFIN - 0562
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Introduction to probability theory - rates, time value of money - Options and derivatives - Options evaluation - Conditional mean value - Martingales - Self-financed processes - Brownian motion - The Black-School model - Stochastic differential equations - Stochastic integration - Evaluation of the European option.

Instructor: A. Papadopoulou

Stochastic Processes
G-LSUD7 STMFIN - 0563
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Definition and classification. Strong Markov property. Classification of finite Markov chains. Ergodic and circular chains, applications. Discrete parameter Markov processes, Markov jump processes, branching processes, independent-increment processes. Random walks.
Instructor: I Afendras

Special Topics A and B
G-LSUD7 SPETO – 1161, 1162
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: The instructor, in collaboration with the student, specifies a subject.
Instructor: Any one of the teaching staff upon decision to teach the course.

Free Electives

Observational Astronomy and Astrophysics
G-LSUD7 QBASTR - 1067
3h/w, 13 weeks, written exams, credits: 5
Free elective
Description: Sun as a typical star. Stars: Characteristics, classification, distances, photometry, H-R diagram - Stellar evolution: Equations of state, gravitational collapse, nucleosynthesis, neutron stars, black holes - Interstellar medium: Transfer equation, dispersion phenomena - Galaxies. Experimental astronomy: The celestial sphere. Telescopes - Classification of galaxies using the Palomar Sky Survey plates.
Instructors: J. Seiradakis

EIGHTH SEMESTER:

Compulsory Electives

Set Theory
G-LSUD8 SETTH – 0132
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Algebra, Number Theory and Math. Logic)
Description: Paradoxes in naïve set theory. Zermelo-Fraenkel axiomatic set theory (ZF). The ZF universe and the foundation axiom. Comparison of size of sets. Equinumerable sets. Schroder-Bernstein theorem and Cantor's theorem. Well-ordered sets, ordinal numbers and operations with ordinals. Transfinite induction and I-induction. Cardinals and

operations with cardinals. The axiom of choice and its equivalent forms (well-ordering principle, Zorn's lemma, Hausdorff's maximum principle.)
Instructor: A. Tzouvaras

Galois Theory
G-LSUD8 GALTHE - 0134
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Algebra, Number Theory and Math. Logic)
Description: Construction of fields. Algebraic extensions - Classical Greek problems: constructions with ruler and compass. Galois extensions - Applications: solvability of algebraic equations - The fundamental theorem of Algebra - Roots of unity - Finite fields.
Instructor: H. Charalambous

Advanced Topics in Algebra
G-LSUD8 0137
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory Elective (Department of Algebra, Number Theory and Math. Logic)
Description: Solvable and nilpotent groups, normal and composite series, theorems of Schreier, Jordan and Hölder, derived series, higher and lower central series, group algebra. Modules over a ring, finite generation, exact sequences, direct sum and product, free modules, modules over PIDs. Categories and functors, tensor product and elementary properties of Hom, Ext and Tor.
Instructor: H. Psaroudakis

Fourier Analysis
G-LSUD8 FOURAN - 0234
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Mathematical Analysis)
Description: Trigonometric series. Fourier coefficients, convergence criteria. Summability of Fourier series. Fourier series and space. Applications.
Instructor: P. Galanopoulos

Partial Differential Equations
G-LSUD8 PDE - 0235
3h/w, 13weeks, written exams, credits: 5.5
Compulsory elective (Department of Mathematical Analysis)
Description: Introduction, some simple PDEs. Well-posed problems. Classical solutions. Weak solutions and regularity. Four important linear PDEs

1) The equation of transport. Initial value problems, the inhomogeneous problem
2) The Laplace and Poisson equations. Fundamental solutions. Elements of the theory of distributions. Mean value formulae. Eigenvalues of harmonic functions. The strong maximum principle and uniqueness of some boundary value problems for Poisson's equation. Mollifiers and smoothness. Local estimates for the derivatives of harmonic functions. Liouville's theorem. The Harnack inequality. Green's function for a half-space and a ball.
3) The heat equation. Fundamental solution. Similar issues to the case (2)

4) The wave equation

Instructor: A. Fotiadis

Harmonic Analysis
G-LSUD8 HARAN - 0266
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Mathematical Analysis)
Description: Harmonic functions on R^n - Poisson kernels - Harmonic extensions of the upper half-space - Singular integral operators and the Calderon-Zygmund theory.
Instructor: M. Marias

Differential Manifolds II
G-LSUD8 DIFMAII - 0333
3h/w, 13weeks, written exams, credits: 5.5
Compulsory elective (Department of Geometry)
Description: Riemannian metrics. Riemannian submanifolds-induced metric, product Riemannian manifolds and quotient Riemannian manifolds. Isometries. Affine connections, covariant derivative, parallel transport, geodesics. Levi-Civita connection. Geodesics of a Riemannian manifold. Curvatures (curvature tensor, Riemann curvature, sectional curvature, Ricci curvature and scalar curvature). Second fundamental form. Spaces of constant curvature.
Instructor: F. Petalidou

Differential Forms
G-LSUD8 0361
3h/w, 13weeks, written exams, credits: 5.5
Compulsory elective (Department of Geometry)
Description: Review of Vector Analysis. Alternating algebra. Differential forms on a vector space, exterior product. Differential. Manifolds with boundary, The theorem of Stokes. Poincaré's lemma. Elements of de Rham cohomology.
Instructor: E. Kappos

Cryptography
G-LSUD8 CRYPT- 0434
3h/w, 13 weeks, written exams, credits: 5.5
Compulsory elective (Department of Numerical Analysis and Computer Science)
Description: Basic concepts- Historical examples of cryptosystems - The RC4 and DES cryptosystems - Basic computational number theory - The RSA and Rabin cryptosystems - The Diffie-Hellman Key Exchange Protocol - The ElGamal and Massey-Omura cryptosystems - Hash functions - The RSA, ElGamal and DSA Digital Signatures.
Instructor: D. Poulakis

Electives

Fuzzy Set Theory

G-LSUD8 0161
3h/w, 13weeks, written exam., credits: 5
Elective
Description:
Instructor: L. Moysis

Dynamical Systems
G-LSUD8 0236
3h/w, 13weeks, written exam., credits: 5
Elective
Description: *First part:* Continuous and dicrete dynamical systems. Recursions, fixed and periodic points, Sharkovskii theorem, chaotic behaviour. Examples, Cantor sets, fractals, the logistic equation. Symbolic dynamics. Statistical and topological behaviour of orbits.
Second part: Normal families of analytic functions. Iterations of analytic functions, dynamical behaviour, Julia and Fatou sets and their properties, Mandelbrot sets.
Instructor: A. Siskakis

Operator Theory
G-LSUD8 0267
3h/w, 13weeks, written exam., credits: 5
Elective
Description: Inner product spaces, Hilbert spaces, orthogonal projections, bounded linear operators in Hilbert space, examples. Dual operator, self-adjoint operators, isometries, orthonormal operators, positive operators, the square root of a positive operator. The spectrum of an operator and classification of its points. Spectral radius, Gelfand's theorem. Special classes (compact, nuclear, Hilbert-Schmidt, trace operators). The spectral theorem for compact and self-adjoint operators. The Fredholm alternative and applications to integral equations.
Instructor: K. Gkikas

Mathematical Theory of General Relativity
G-LSUD8 0367
3h/w, 13weeks, written exam., credits: 5
Elective
Description: Special theory of relativity. Curvilinear coordinates. Anti-tensors. Curved space. Parallel transport. Christoffel symbols. Geodesics. Covariant derivative. The Riemann curvature tensor. Flat spacetime. Bianchi identities. The Ricci tensor. Einstein's gravitational law. Newtonian approximation. The Schwarzschild solution. Black holes. The theorems of Gauss and Stokes. Harmonic coordinates. The electromagnetic field. The energy tensor. The priciple of gravitational action. The action for a continuous mass distribution, for the EM field and for charged matter.
Instructor: P. Porfyriadis

Modern Control Theory
G-LSUD8 MOCQNTR - 0462
3h/w, 13weeks, written exam., credits: 5

Elective
Description: State space models of LTI continuous time systems. Single input – single output systems. Multivariable systems. Block diagrams and realizations of state space models. Examples. System equivalence and state space coordinate transformations. Examples. Eigenvalues and eigenvectors. Diagonalization of matrices and diagonalization of state space models by coordinate transformations. State space realizations of transfer functions. State space system responses. Unit impulse and unit step response of state space models. LTI systems. Free and forced response of state space models. Canonical forms of state space models. Controllability. Observability. Controllability and Observability criteria. Stabilization of state space models and decoupling zeros. Stability of state space models. Eigenvalue criteria for stability. Asymptotic and BIO stability. State feedback. Eigenvalue assignment by state feedback. Constant output feedback. State Observers and state reconstruction. Stabilization by state observers and state feedback. The separation principle.
Instructor: N. Karampetakis

Sampling
G-SLUD8 SAM - 0566
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: What is Sampling? Estimation and Estimators - Simple Random Sampling in order to estimate Population (and Subpopulations) Mean - Percentages and Variance - Ratio Estimators and Regression, with socioeconomic applications - Coefficient of Variation - Stratified Sampling with proportional and optimal drawing of sample - Systematic Sampling with administrative applications and applications in populations where the studied random variables have some trend - Cluster Sampling, introduction and study of the cases with 1 and 2 level sampling techniques - Comparison of the studied sampling methods. Indices and their screening, general introduction to indices and a specialized study on price indices - The currency unit ECU as a weighted index.
Instructor: N. Farmakis

Statistical Inference
G-LSUD8 STIF – 0569
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Introduction to testing hypothesis - Selecting the test procedure - Testing simple hypothesis - Neyman-Pearson's fundamental lemma - Uniformly most powerful tests - Tests for the parameters of one or two normal populations - Likelihood ratio tests.
Instructor: Post-doc

Combinatorics and Graph Theory
G-LSUD8 0572
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Enumeration methods, special topics in enumeration, graphs, introduction to

random graphs.
Instructor: V. Karagiannis, I. Antoniou

Information Theory and Chaos
G-SLUD8 ITCH - 0570
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: Observation information. Probability and uncertainty. Messages, analogue and digital time-series, harmonic analysis, wavelets, sampling. Entropy, conditional information, mutual information and interdependence. Uncertainty, predictability, complexity, innovation. Stochastic processes and dynamical systems as sources of information. Ergodicity, mixing, Bernoulli, Kolmogorov and Markov processes. Chaos, noise. Communication channels as transformations of stochastic processes. Markov channel models. Coding, requirements for code generation. Selected applications in Statistics, Physics, Biology. Learning, decision making and games. Graphs and communication networks.
Instructor: I. Antoniou

Special Topics B
G-LSUD8 SPETOPB – 1162
3h/w, 13 weeks, written exams, credits: 5
Elective
Description: The instructor, in collaboration with the student, specifies a subject.
Instructor: Can be any one of the teaching staff if he/she accepts to teach the course

SUMMARY OF COURSE OFFERINGS BY SEMESTER

FIRST SEMESTER

Code	Courses	Hrs/Credits	
	Compulsory		
0102	Introduction to Algebra and Number Theory	3	**5.5**
0108	Linear Algebra	6	**8**
0201	Calculus I	5	**7**
0430	Introduction to Computer Programming	3	**5**

Code	Courses	Hrs/Credits	
	Electives		
0601	Analysis of Mathematical texts in the English language	3	**3**
Seminar	Writing mathematical texts in LaTeX	1.5	

SECOND SEMESTER

Code	Courses	Hrs/Credits	
	Compulsory		
0102	Introduction to Algebra and Number Theory (repeat)	3	**5.5**
0108	Linear Algebra (repeat)	6	**8**
0202	Calculus II	5	**7**
0301	Analytic Geometry I	4	**6**
0401	Theoretical Informatics I	3	**5.5**
0430	Introduction to Comp. Progr. (rep.)	3	**5**
0501	Mathematical Programming	3	**5.5**

Code	Courses	Hrs/Credits	
	Electives		
0461	Symbolic Programming Languages	3	**5**
0601	Analysis of Mathematical texts in the English language	3	**3**
Seminar	Writing mathematical texts in LaTeX	1.5	

THIRD SEMESTER

Code	Courses	Hrs	Credits
	Compulsory		
0106	Algebraic Structures I	3	**5.5**
0203	Calculus III	4	**7**
0204	Topology of Metric Spaces	4	**7**
0302	Analytical Geometry II	4	**6**
0502	Probability Theory I	4	**7**

Code	Courses	Hrs	Credits
	Free Elective		
1061	Introduction to Meteorology and Climatology	3	**5**

FOURTH SEMESTER

Code	Courses	Hrs	Credits
	Compulsory		
0106	Algebraic Structures I (repeat)	3	**5.5**
0107	Algebraic Structures II	3	**5.5**
0205	Calculus IV	4	**7**
0206	Differential Equations	4	**7**
0503	Statistics	6	**7**
0504	Mathematical Methods in Operational Research	3	**5.5**

Code	Courses	Hrs	Credits
	Free Electives		
1062	General and Dynamic Meteorology	3	**5**

FIFTH SEMESTER

Code	Courses	Hrs	Credits
	Compulsory		
0207	Introduction to Real Analysis	3	**5.5**
0303	Classical Differential Geometry I	5	**7**
0402	Numerical Analysis	3	**5.5**
0505	Probability Theory II	3	**5.5**
0506	Stochastic Strategies	3	**5.5**
	Free Electives		
1063	Seismology	3	**5**
1064	Theoretical Mechanics	3	**5**

Code	Courses	Hrs	Credits
	Compulsory Electives		
0136	Number Theory	3	**5.5**
0151	Computational Methods in Algebra and Algebraic Geometry	3	**5.5**
0531	Statistical Learning and Knowledge Processing	3	**5.5**
	Electives		

SIXTH SEMESTER

Code	Courses	Hrs	Credits
	Compulsory		
0208	Complex Analysis	4	**7**
	Electives		
0564	Time Series	3	**5**
0571	Data Analysis	3	**5**
0967	Mathematical Software and Knowledge Representation Languages	3	**5**
1161	Special Topics A	**-**	**5**
	Free Electives		
1066	Continuum Mechanics	3	**5**

Code	Courses	Hrs	credits
	Compulsory Electives		
0131	Group Theory	3	**5.5**
0231	Measure Theory	3	**5.5**
0232	Elements of Functional Analysis	3	**5.5**
0331	Linear Geometry I	3	**5.5**
0332	Classical Differential Geometry II	3	**5.5**
0431	Computational Mathematics	3	**5.5**
0432	Theoretical Informatics II	3	**5.5**
0532	Matrix Theory	3	**5.5**
0533	Deterministic Methods of Optimization	3	**5.5**

SEVENTH SEMESTER

Code	Courses	Hrs	Credits
	Electives		
0464	Algorithms and Data Structures	3	**5**
0562	Stochastic Methods in Finance	3	**5**
0563	Stochastic Processes	3	**5**
1161	Special Topics A	-	**5**
1162	Special Topics B	-	**5**
1070	Practical Training	-	**2**

Code	Courses	Hrs	Credits
	Compulsory Electives		
0133	Mathematical Logic	3	**5.5**
0233	General Topology	3	**5.5**
0235	Partial Differential Equations	3	**5.5**
0266	Harmonic Analysis	3	**5.5**
0304	Differential Manifolds I	3	**5.5**
0433	Classical Control Theory	3	**5.5**
0465	Error Correcting Codes	3	**5.5**
0534	Mathematical Statistics	3	**5.5**
0535	Stochastic Operations Research	3	**5.5**

EIGHTH SEMESTER

Code	Courses	Hrs	Credits
	Electives		
0161	Fuzzy Set Theory	3	**5**
0236	Dynamical Systems	3	**5**
0267	Operator Theory	3	**5**
0367	Mathematical Theory of General Relativity	3	**5**
0462	Modern Control Theory	3	**5**
0471	Computational Geometry	3	**5**
0566	Introduction to Sampling	3	**5**
0569	Statistical Inference	3	**5**
0570	Information Theory and Chaos	3	**5**
0572	Combinatorics and Graph Theory	3	**5**
0962	History of Mathematics	3	**5**
1162	Special Topics B	**-**	**5**
1070	Practical Training	**-**	**2**

Code	Courses	Hrs	Credits
	Compulsory Electives		
0132	Set Theory	3	**5.5**
0134	Galois Theory	3	**5.5**
0137	Advanced Topics in Algebra	3	**5.5**
0234	Fourier Analysis	3	**5.5**
0235	Partial Differential Equations	3	**5.5**
0333	Differential Manifolds II	3	**5.5**
0361	Differential Forms	3	**5.5**
0434	Cryptography	3	**5.5**
	Free Electives		
1067	Observational Astronomy and Astrophysics	3	**5**

G. Postgraduate Programmes of Study

The School of Mathematics of the Aristotle University of Thessaloniki offers:

- The postgraduate programme in «**Mathematics»** with three possible tracks, offered since the fall of 2002.

The postgraduate programme in **«Mathematics»** leads to the award of a Master's Degree or to a Doctorate in Mathematics. The objective of the programme is the advancement of knowledge and the development of mathematical research and applications.

The Master's Degree has the following three tracks:

1. **Pure Mathematics.**
2. **Statistics and Mathematical Modelling.**
3. **Theoretical Computer Science and Control and Systems Theory**.

The nominal duration of the Master's Degree on Mathematics is three semesters of study. Students are expected to complete the coursework during the first two semesters and prepare a Master's Degree dissertation during the third semester. The School started offering a part-time option for study for students who are employed (consult the Regulations of the Programme).

The requirements for the award of the Master's Degree are:

1. For the «Pure Mathematics» track: satisfactory completion of at least 6 courses from categories A, B, C which must include one each from A, B, C of this track.
2. For the «Statistics and Mathematical Modelling» track: satisfactory completion of at least 6 courses from the category SM.
3. For the «Theoretical Computer Science and Control Theory» track: satisfactory completion of at least 6 courses from categories A and B, containing at least one each from the categories A and B of this track.

Listed below are all the courses offered by the Department of Mathematics in the 2018-2019 academic year, with the following information: code G-MDUD (Greece-Master's Degree University Diploma), semester taught, the ECTS code and course number, the number of hours per week, the number of weeks per semester, the type of examination (written), whether or not there is a laboratory component, the number of ECTS credits provided, and an outline of the course. All courses are taught in Greek.

Information on the Postgraduate Programmes may be obtained from the Director of Postgraduate Studies, Professor E. Kappos:

e-mail kappos@math.auth.gr
Tel. 0030-2310-997958

Information is also available via the Internet at:

http://www.math.auth.gr/en

To enquire about the programme, you can contact the ERASMUS coordinators of the School, Profs E. Kappos or F. Petalidou.

M.Sc. Course in «Pure Mathematics»

Code: Group A: *Algebra*, Group B: *Analysis*, Group C: *Geometry*

Fall Semester

A.4 Topics in the Representation Theory of Algebras
A.5 Topics in Number Theory
A.8 Homological Algebra
B.7 Measure Theory and Integration
B.9 Complex Analysis
C.4 Differentiable Manifolds
C.8 Global Differential Geometry

Spring Semester

A.6 Topics in Group Theory and Lie Algebras
A.12 Topics in Mathematical Logic
B.13 Hyperbolic Geometry and Analysis
C.3 Line Geometry
C.9 Symplectic and Poisson Geometry

Third Semester

Master's Degree Dissertation.

DESCRIPTION OF COURSES

Semester A

A.8 Homological Algebra
G-MDUD2
3h/w, 13 weeks, written exams, 10 credits
Elective
Description: Category theory, abelian categories, the functors Hom and Tensor, projective and injective objects, complexes and homology, long exact sequence in homology, cones and semi-isomorphisms, homotopy, projective and injective resolutions, derived functors, Ext^1 and extensions, homological dimension,

triangulated homotopy category, derived categories and derived functors, Ext as the set of morphisms in the derived category, derived equivalence.

Instructor: H. Psaroudakis

A.5 Topics in Number Theory
G-MScUD1 0864
3h/w, 13 weeks, written exam., credits 10
Elective
Description:
Instructor: D. Poulakis

A.4 Topics in the Representation Theory of Algebras
G-MDUD2 0634
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: 1. *Introduction:* Introduction to Lie groups, construction of Lie algebras from Lie groups, basic definitions, derivations, ideals, solvable and nilpotent Lie algebras, example of the Lie algebra $sl_n(C)$ 2. *Simple and semisimple Lie Algebras:* Cartan subalgebras, Killing forms, Weyl group, Dynkin diagrams, classification of semisimple Lie algebras 3. *Enveloping Algebras:* Definition of enveloping algebras, Poincaré-Birkhoff-Witt theorem, exponential mapping of Lie algebras to a Lie groups, Casimirs, Hopf structure of enveloping algebra 4. *Representations and modules*: Theorem of Ado-Iwasawa, finite-dimensional irreducible representations, adjoint representation, tensor representations, induced representations, representations of solvable - nilpotent and semisimple algebras, Verma modules 5. *Applications:* Symmetries of integrable systems, Bäcklund-Lie symmetries, Lax operators in Hamiltonian systems, Lie-Poisson algebras, Symmetries of quantum systems and Lie algebras su(2), su(3).

References

1. J. E. Humphreys, *Introduction to Lie Algebras and Representation theory*, Springer Graduate Texts in Mathematics (1972).
2. W Fulton and J Harris, *Representation Theory,* Grad. Texts in Maths, Springer (1991).
3. B. C. Hall, *Lie Groups, Lie Algebras and Representations*, Grad. Texts in Maths. Springer (2003).
4. R. W. Carter et al., *Lecture Notes on Lie Groups and Lie Algebras*, London Math. Soc. Student Texts 32 (1995).
5. N. Jacobson, *Lie Algebras*, Dover (1962).
6. A. Roy Chowdhury, *Lie Algebraic Methods in Integrable Systems,* Chapman & Hall (2000).
7. A. O. Barut and Raczka, *Theory of Group Representations and Applications*, World Scientific (1986).

Instructor: C. Daskaloyiannis

B.9 Complex Analysis
G-MDUD2 0641
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Analytic functions. The general form of Cauchy's theorem. Local uniform convergence of analytic functions, the theorem of Weierstrass. Infinite products, canonical decomposition, Blaschke products. Runge's approximation theorem. Normal families of analytic functions, Montel's theorem. Conformal mappings, the Riemann mapping theorem, the Mittag-Leffler theorem. Harmonic functions, the maximum principle, the Dirichlet problem, subharmonic functions. Schwarz's symmetry principle, theorems of Bloch, Schottky, Montel-Caratheodory and Picard.

Prerequisites: Elements of complex functions, topology of metric spaces.

References

1. Ahlfors L. V., *Complex Analysis*, McGraw-Hill 1979.
2. Caratheodory C., *Theory of Functions I and II*, Chelsea Publishing Company 1960.
3. Sarason D., *Complex Function Theory*, Second Edition, Amer. Math. Soc. 2007.
4. Saks S. and Zygmund A., *Analytic Functions*, Elsevier 1971.

Instructor: D. Betsakos

B.7 Measure Theory and Integration
G-MDUD2
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: σ-algebras, measure, Borel measure, measurable and integrable functions, types of convergence, product measure, Fubini's theorem, the Lebesgue integral in R^n. Signed measures, absolutely continuous and sngular measures, the Hanh and Jordan decomposition theorems, the Lebesgue-Radon-Nikodym theorem, functions of boundd variation. Basic theory of L^p spaces.

Instructor: P. Galanopoulos

C.4 Differentiable Manifolds
G-MDUD2 0658
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Differentiable Manifolds (review of basic notions). Riemannian metrics. Affine connections. Geodesics, curvature. Riemannian submanifolds. Complete manifolds: theorems of Hopf-Rinow and Hadamard. Spaces of constant curvature.

References

1. M. P. do Carmo, *Riemannian Geometry*, Birkhäuser 1992.

2. John M. Lee, *Riemannian manifolds. An introduction to curvature,* GTM 176, Springer-Verlag 1997.
3. W. Boothby, *An introduction to differentiable manifolds and Riemannian geometry,* Academic Press 1975.
4. Loring W. Tu, *An introduction to Manifolds,* Universitext, Springer 2011.
5. John M. Lee, *Introduction to Smooth Manifolds,* GTM 218, Springer 2003.

Instructor: F. Petalidou

C.8 Global Differential Geometry
G-MDUD1 0655
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Elements of the theory of differentiable manifolds: Triangulation of manifolds, closed surfaces. Characterizations of the sphere (Theorems of Liebmann etc.) The Gauß-Bonnet theorem and its applications, Minkowski´s integral formulae. The index method (Poincaré). Congruence theorems for ovaloids, rigidity of ovaloids. Uniqueness theorems for the problems of Minkowski and Christoffel. The maximum principle method, complete surfaces. The Hopf-Rinow theorem. The Cohn-Vossen inequality.

Prerequisites: Classical Differential Geometry I and II.

References

1. Blaschke W. und Leichtweiß K. *Elementare Differentialgeometrie.* Springer (1973).
2. Hopf H. *Differential Geometry in the Large.* Lecture Notes in Mathematics Nº 1000. Springer (1983).
3. Hsiung C.C. *A First Course in Differential Geometry.* Wiley (1981).
4. Huck H. et al. *Beweismethoden der Differentialgeometrie im Großen.* Lecture Notes in Mathematics Nº 335 Springer (1973).
5. Klingenberg W. *A Course in Differential Geometry.* Springer (1978).
6. Stephanidis N. *Differential Geometry, Vol. II,* Thessaloniki (1987). (in Greek).

Instructors: S. Stamatakis, G. Stamou

Semester B

A.6 Topics in Group Theory and Lie Algebras
G-MDUD2
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: The free group F_n of finite rank n (definition, properties), the free abelian group of finite rank, the free nilpotent group of finite rank, the theorem of Nielsen-Schreier, the group of automorphisms of F_n, IA-automorphisms of the free group of finite rank.

Lie algebras (preliminary notions, construction of Lie algebras, bases, subalgebras of the free Lie algebra), free associative algebra, construction of Lie algebras from a group, the Johnson algebra $L(IA(F_n))$, the conjceture of Andreadakis.
Instructor: A. Papistas

A.12 Topics in Mathematical Logic
G-MDUD2 0639
3h/w, 13 weeks, 10 credits
Elective
Description: The intuitive notion of total and partial algorithm and the consequent concepts of computable function, computable set and computably enumerable set that arise from it. First formalization of computable functions through recursive functions. The class of primitive recursive functions and sets. The Ackermann function and the general class of recursive functions and sets. Recursively enumerable (r.e.) sets and their various characterizations. Arithmetization of recursive functions and Kleene's Normal Form theorem. The Halting Problem, the s-m-n theorem and the Rice theorem. Kleene's Fixed-Point theorems. Second formalization of computable functions through Turing Machines. Turing-computable functions and their equivalence with the class of recursive functions. The Chuch-Turing Thesis.
Instructor: A. Tzouvaras

B.12 Hyperbolic Analysis and Geometry
G-MDUD1 0648
3h/w, 13 weeks, written exams, 10 credits
Elective
Description: Möbius transformations, basic models of hyperbolic geometry, isometries, distance formulas, comparison with Euclidean geometry, groups of isometries, fundamental domains, the limit set, hyperbolic surfaces, heat kernel estimates.
References

1. Anderson J.W. (2007) *Hyperbolic Geometry.* 2nd ed. Springer.
2. C. Series (2013) *Hyperbolic Geometry.* Notes Warwick University. Available at: http://homepages.warwick.ac.uk/~masbb/Papers/MA448.pdf
3. Davies E.B. and N. Mandouvalos (1988). Heat kernels bounds on Hyperbolic Space and Kleinian groups. Proc. London Math. Soc. **57** (No 3): 182-208.

Instructor: A. Fotiadis

C.3 Line Geometry
G-MDUD2 0666
3h/w, 13 weeks, 10 credits
Elective
Description: A. *Introduction:* Cayley-Klein geometries and the Erlangen program. The n-dimensional affine space. The n-dimensional projective space. Plücker coordinates.

B. *Ruled surfaces:* Parameter of distribution and striction curve of a ruled surface. Developable surfaces. The Sannia and the Kruppa moving frame. Derivative equations. Complete system of invariants. Minding isometries. Closed ruled surfaces. Linear and angular opening. Right helicoid. Edlinger surfaces.

C. *Line congruences:* Moving frame and the integrability conditions. Focal surfaces. Curvature and mean curvature of a line congruence. The middle surface and the middle envelope. The Sannia and the Kruppa principal surfaces. Integral formulae. Closed line congruences. Specific line congruences.

Prerequisites*:* Classical Differential Geometry I and II

References

1. Farouki R.: Pythagorean – Hodograph Curves: Algebra and Geometry Inseparable. Springer (2008)
2. Finikow S. P.: Theorie der Kongruenzen. Akademie-Verlag (1959)
3. Hoschek J.: Liniengeometrie. Bibliographisches Institut (1971)
4. Pottmann H., Wallner J.: Computational Line Geometry. Springer (2001)
5. Stephanidis N.: Differential Geometry. Vol II, Thessaloniki (1987) (in Greek)

Instructor: S. Stamatakis

C.9 Symplectic and Poisson Geometry
G-MDUD2
3h/w, 13 weeks, 10 credits
Elective

Description: Symplectic vector spaces and symplectic forms. Symplectomorphisms. Generating functions. Theorem of Darboux. Lagrangian submanifolds. Contact forms and manifolds, Kähler manifolds. Elements of Hamiltonian mechanics. The moment map. Marsden-Weinstein reduction. Poisson brackets and Poisson manifolds.

References

1. A. Cannas da Silva: Lectures on Symplectic Geometry (LNM1764 2001, 2008)
2. R. Berndt: An Introduction to Symplectic Geometry (AMS 2007)
3. Arnold V.I. Mathematical Methods of Classical Mechanics (2nd ed.) (Springer 1982)

Instructor: E. Kappos

<u>Semester C</u>

Master's Degree Dissertation
G-MDUD2 0600
13 weeks, 30 credits.

M. Sc. Course in «Statistics and Mathematical Modelling»

Semester A

SM.02 Time Series Analysis
SM.07 Theory of Networks and Dynamical Systems
SM.10 Optimal Control Theory (see TCS-CST track)
SM.22 Statistics and Decision Making
SM.24 Stochastic Methods

Semester B

SM.04 Asymptotic Statistics
SM.06 Sampling and Statistical Processing
SM.08 Optimal Control Theory
SM.12 Quantic Information and Computation
SM.16 Information Theory, Entropy and Complexity

Semester C

Master's Degree Dissertation

DESCRIPTION OF COURSES

Semester A

SM.02 Time Series Analysis
G-MDUD1 0747
3h/w, 13 weeks, written exams, 10 credits
Elective
Description: Introduction. Basic characteristics of T-S. Linear stochastic processes. Stationary linear models. Non-stationary linear models. Forecasting. Spectral analysis. Non-linear analysis of T-S.
References
1. Brockwell P.J. and R.A. Davis (2002). Introduction to Time Series and Forecasting. 2^{nd} edition. Springer Verlag, New York.
2. Cryer J. (1986). Time Series Analysis. Wadsworth Pub Co.
3. Kantz H. and T. Schreiber (1999). Nonlinear Time Series Analysis. Cambridge University Press.
4. Tong H. (1997). Non-Linear Time Series: A Dynamical System Approach (Oxford Statistical Science Series, 6). Oxford University Press.
5. Vandaele W. (1997). Applied Time Series and Box-Jenkins Models. Academic Press, New York.

Instructors: D. Kugiumtzis

SM.07 Network Theory and Dynamical Systems
G-MDUD1 0750
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Phenomenological Laws, Scientific Method, Mathematical Modelling, the Prediction Problem. Differential Equations, Difference Equations and Dynamical Systems. Classification, Stability, Solutions (Analytic, Approximate, Numerical), Simulations. Selective Applications. Chaos, Random Number Generators, Population Dynamics and Chemical Reactions, Economics, Biology, Signals and Filters, Cellular Automata, Dynamics of Communication Networks.

The Objectives of the course are:
1) The understanding of Mathematical modelling in terms of Dynamical Systems in discrete time (Difference Equations) and in continuous time (Differential Equations).
2) The exploration of the possibilities and the identification of the difficulties to find solutions of dynamical models
3) The relevance of approximations and errors in applications.

References

1. Arnold V.I. (1978) Ordinary Differential Equations, MIT Press, Cambridge, MA.
2. Blum L., Cucker F., Shub M., Smale S. (1988), Complexity and Real Computation. Springer, New York.
3. Gustafson K. (1999), Introduction to Partial Differential Equations and Hilbert Space Methods. Dover, New York.
4. Hirsch M., Smale S. (1974), Differential Equations, Dynamical Systems and Linear Algebra. Academic Press, London.
5. Hörmander Lars, The Analysis of Linear Partial Differential Operators:
   Vol.1: Distribution Theory and Fourier Analysis. Springer (1990).
   Vol.2: Differential Operators with Constant Coefficients. Springer (1999).
   Vol.3: Pseudo-Differential Operators. Springer (1985).
   Vol.4: Fourier Integral Operators. Springer (1994)
6. Kalman R. (1968), On the Mathematics of Model Building, in "Neural Networks". ed. by E. Caianelo, Springer New York.
7. Katok A., Hasselblatt B.1995, Introduction to the Modern Theory of Dynamical Systems, Cambridge University Press, Cambridge, UK.
8. Kulesovic M.R.S., Merino O. (2002), Discrete Dynamical Systems and Difference Equations with Mathematicα. CRC Press.
9. Polyanin A.D., Zaitsev V.F. (2002), Handbook of Exact Solutions for Ordinary Differential Equations, CRC Press.
10. Sobolev S. (1989), Partial Differential Equations of Mathematical Physics. Dover, New York.
11. Wolfram S. (2002), A New Kind of Science. Wolfram Media, Champaign, Illinois.
12. Vvedesnsky D. (1992), Partial Differential Equations with Mathematica. Addison Wesley, New York.

Instructor: I. Antoniou.

SM.22 Statistics and Decision Making
G-MDUD1 0749
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: The characteristic functions for the multivariate random variables. The multivariate normal distribution and related topics. Application in statistical analysis (Cochran's theorem, ANOVA, regression, χ^2). Statistical inference: The Neyman-Pearson lemma. Likelihood ratio test and related procedures. Decision theory.

References

1. Lehman E.L. (1986), Testing Statistical hypotheses. John Wiley & Sons.
2. Patrick Billingsley (1995), Probability and Measure. John Wiley & Sons.
3. Feller W. (1971), An Introduction to probability theory and its Applications. John Wiley & Sons.
4. Dacunha-Castelle P. and Duflo M. (1986), Probability and Statistics. Volumes I and II. Springer-Verlag.
5. F. Kolyva-Machera (1998), Mathematical Statistics. Ziti, Thessaloniki. (in Greek).

Instructor: D. Ioannidis, F. Kolyva-Machera.

SM.24 Stochastic Methods
G-MDUD2 0746
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Renewal theory, limit theorems, Wald equation, key renewal theorem, renewal processes with reward, semi-Markovian processes, discrete and continuous time, martingales, Brownian motion**.**

References

1. Howard R.A. (1971). Dynamic Probabilistic Systems. Volumes I and II. John Wiley and Sons; New York.
2. Ross S.M. (1995). Stochastic Processes. John Wiley and Sons; New York.
3. Ross S.M. (2000). Introduction to Probability Models. 7^{th} edition. John Wiley and Sons; New York.

Instructors: A. Papadopoulou, G. Tsaklidis, P.C. Vassiliou.

<u>Semester B</u>

SM.04 Asymptotic Statistics
G-MDUD1
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Stochastic convergence, uniform and dominated convergence, uniform integrability. Law of large numbers. Central limit theorems. The delta method. Asymptotic theory of maximum likelihood estimators.

Instructor: I. Afendras

SM.12 Quantic Information and Computation
G-MDUD1 0751
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Introduction to Quantum Mechanics: Mathematical Introduction (Hilbert Spaces, Spectrum of self-adjoint and unitary operators, Lie group U(N), control theory of groups), Quantum states and observables, the state space of Hilbert space, the state space as a set of definite operators.

Quantum information theory: Quantum computer structure, quantum hits and registers, quantum gates, Toffoli theorem, invertible gates, quantum circuits and networks, Deutsch theory of elementary gates, decomposition in elementary gates, quantum codes, error correction and decoherence.

Quantum algorithms: Shannon entropy, Quantum entropy, Quantum transportation, Quantum cryptography.

References

1. Alicki R., Fannes M., Quantum Dynamical Systems, Oxford University Press, Oxford U.K.
2. Bohm A. (1993), Quantum Mechanics, Foundations and Applications, 3d ed, Springer, Berlin.
3. Fock V.A. (1986), Fundamentals of Quantum Mechanics Mir Publishers, Moscow.
4. Jammer M. (1974), The philosophy of Quantum Mechanics, Wiley, New-York.
5. Jauch J.M. (1973), Foundations of Quantum Mechanics, Addison-Wesley, Reading, Massatussetts.
6. Mackey G.W. (1957), Quantum Mechanics and Hilbert Space, American Mathematical Monthly 64, 45-57.
7. Mackey G.W. (1963), The Mathematical Foundations of Quantum Mechanics, Benjamin, New York.
8. Prugovecki E. (1981), Quantum Mechanics in Hilbert Space, Academic Press, New York.
9. Von Neumann J. (1932), Mathematical Foundation of Quantum Mechanics. Princeton Univ. Press, New Jersey.
10. Benenti G., Casati G, Strini G. (2005), Principles of Quantum Computation and Information.
    Vol I: Basic Concepts. World Scientific, Singapore.
    Vol II: Basic Tools and Special Topics. World Scientific, Singapore.
11. Bernstein E., Vazirani U. (1997), Quantum Complexity Theory. SIAM J. Comput. 26, 1411-1473.
12. Chen G., Brylinsky R, editors (2002), Mathematics of Quantum Computation, Chapman and Hall/VRC, Florida, USA.
13. Feynman R.P. (1967), Quantum Mechanical Computers. Foundations of Physics, 16, 507-531.
14. Ingarden R.S. (1976), Quantum Information Theory. Rep. Math. Physics 10,

43-72.
15. Nielsen A.M., Chuang I.L. (2000), Quantum Computation and Quantum Information. Cambridge University Press, Cambridge UK.
16. Ohya M., Petz D. (2004), Quantum Entropy and its Use. 2nd Printing, Springer, Berlin.
17. Vitanyi P. M. B. (2001), Quantum Kolmogorov Complexity based on Classical Descriptions. IEEE Transactions on Information Theory 47, 2464-2479.

Instructors: I. Antoniou, C. Panos

SM.06 Sampling and Statistical Processing
G-MDUD2 0748
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: *Part 1*: Sampling and its applications in Social and Economic Issues, Methods and Techniques of Sampling, Surveys from A to Z.
Part 2: Preparation of a questionnaire and checking of its reliability. Kinds of questions and specialization of their use. From the questionnaire data to the e-files via random variables and coding of answers. Elaboration of the filled data.
Part 3: Some issues of Sampling of specific content, like: “Searching for linear trend of sampling data”, “searching for periodicities of data”, “Creating equation of probabilities (2nd degree model) from two-dimensional data, etc.”, “Coefficient of Variation and its applications, e.g. symmetric model of probability density function”.

References

1. Farmakis N. (2009), Introduction to Sampling, Christodoulidis, Thessaloniki. (in Greek).
2. Farmakis N. (2009), Survey and Ethics, Christodoulidis, Thessaloniki. (in Greek).
3. Javeau C. (2000) Questionnaire Based Survey, Typothito, G. Dardanos, Athens (Greek translation)
4. Cochran W. (1977) Sampling Techniques, John Wiley, New York.

Instructor: N. Farmakis

SM.10 Optimal Control Theory (see TCS-CST track, Course B.8)

SM.16 Information Theory, Entropy and Complexity
G-MDUD2 -860
3h/h, 13 weeks, 10 credits
Elective

Description: Information and entropy, uncertainty and variety, interdependence, mutual information and correlation. Information sources. Stochastic processes, dynamical systems and chaos. Entropy and innovation. Communication channels. Coding, cryptography and security. Network entropy and data analysis by networks.

Syntactic and semiological processing. Quantum information and applications to networks.

References

Systems and Complexity:

1. Antoniou I. 1991, "Information and Dynamical Systems", p221-236 in "Information Dynamics", ed. Atmanspacher H., Scheingraber H., Plenum, New York
2. Antoniou I., Christidis Th., Gustafson K. 2004, "Probability from Chaos", Int. J. Quantum Chemistry 98,150-159
3. Devaney R. 1992, A First Course in Chaotic Dynamical Systems. Theory and Experiment, Addison-Wesley, Reading, Massachusetts
4. Honerkamp J. 1994, Stochastic Dynamical Systems: Concepts, Numerical Methods, Data Analysis, Wiley, New York
5. Honerkamp J. 1998, Statistical Physics. An Advanced Approach with Applications, Springer, Berlin.
6. Katok A., Hasselblatt B. 1995, Introduction to the Modern Theory of Dynamical Systems, Cambridge University Press, Cambridge, UK
7. Meyers R. (Ed.) 2009, Encyclopedia of Complexity and Systems Science, Springer, New York.
8. Skiadas Christos, Skiadas Charilaos 2009, Chaotic Modelling and Simulation. Analysis of Chaotic Models, Attractors and Forms, CRC Press, London
9. Sinai Ya. 1989, Kolmogorov's Work on Ergodic Theory, Annals of Probability 17, 833-839

Probability and Statistics:

1. Billingsley P. 1985, Probability and Measure, Wiley, New York
2. Cox R. 1961, The Algebra of Probable Inference, John Hopkins Press, Baltimore.
3. Doob J.L. 1953 Stochastic Processes, Wiley, New York.
4. Epstein R. 1977, The Theory of Gambling and Statistical Logic, Academic Press, London
5. Feller W. 1968, An Introduction to Probability Theory and Its Applications I, Wiley, New York
6. Feller W. 1971, An Introduction to Probability Theory and Its Applications II, Wiley, New York
7. Ferguson T. 1997, Mathematical Statistics: a Decision Theoretic Approach, Academic Press
8. Gardiner C. 1983, Handbook of Stochastic Methods for Physics, Chemistry and the Natural Sciences, Springer, Berlin
9. Gheorghe A. 1990, Decision Processes in Dynamic Probabilistic Systems, Kluwer, Dodrecht
10. Whittle W. 2000, Probability via Expectation, 4th ed., Springer, Berlin
11. Van Kampen N. 1981, Stochastic Processes in Physics and Chemistry, North-Holland, Amsterdam

Information and Entropy:

1. Applebaum D. 2008, Probability and Information. An Integrated Approach 2nd ed, Cambrigre Univ. Press, Cambridge, UK.
2. Ash, R. 1965, Information Theory, Wiley; Dover, New York 1990
3. Billingsley P. 1965, Ergodic Theory and Information, Wiley, New York
4. Blum L., Cucker F., Shub M., Smale S. (1998) Complexity and Real Computation, Springer, New York.
5. Cover T.,Thomas J. 2006, Elements of Information Theory, Wiley, New York
6. Cucker F., Smale S. 2001, On the Mathematical Foundations of Learning, Bull. Am. Math. Soc. 39, 1-49
7. Frieden R. 2004, Science from Fisher Information: A Unification, Cambridge University Press, Cambridge.
8. Kakihara Y. 1999, Abstract Methods in Information Theory, World Scientific, Singapore
9. Khinchin A. 1957, Mathematical Foundations of Information Theory, Dover, New York.
10. Kullback S. 1968, Information Theory and Statistics, Dover, New York.
11. Li M., Vitanyi P. 1993, An Introduction to Kolmogorov Complexity and its Applications, Springer. New York
12. MacKay D. 2003, Information Theory, Inference, and Learning Algorithms, Cambridge, UK.
13. Rényi A. 1961, On Measures of Entropy and Information, Proc. 4th Berkeley Symposium on Mathematics, Statistics and Probability, University of California Press, p 547-561
14. Renyi A. 1984, A Diary in Information Theory, Wiley, New York.
15. Reza F. 1961, An Introduction to Information Theory, McGraw-Hill, New York
16. Rohlin V. 1967, Lectures on the Entropy Theory of Measure Preserving Transformations, Russ. Math. Surv. 22, No 5,1-52
17. Shannon C.,Weaver W. 1949, The Mathematical Theory of Communication, Univ. Illinois Press, Urbana.
18. Yaglom A.,Yaglom I. 1983, Probability and Information, Reidel, Dordrecht.

Digital Communication, WWW:

1. Negroponte N. 1995, Being Digital, Hodder London. Ελλην. Μεταφρ. Εκδ. Καστανιώτης, Αθηνα, 2000
2. Dertouzos M. 1997, What Will Be? How the World of Information Will Change Our Lives, Harper Collins, New York. Ελλην. Μεταφρ. Εκδ. Γκοβοστη 1998.
3. Dertouzos M. 2001, The Unfinished Revolution : How to Make Technology Work for Us—Instead of the Other Way Around,Harper Collins, New York. Ελλ. Μεταφρ. Εκδ. Λιβανη, Αθηνα, 2001
4. Berners-Lee T, Fischetti M. 1997, Weaving The Web , Harper Collins, New York. Ελλην. Μεταφρ. Εκδ. Γκοβοστη , Αθηνα, 2002.

5. Shadbolt N., Hall W., Berners-Lee T. 2006, The Semantic Web Revisted

<u>*Networks:*</u>

1. Antoniou I., Tsompa E. 2008, Statistical Analysis of Weighted Networks, Discrete Dynamics in Nature and Society 375452 doi:10.1155/2008/375452.
2. Baldi P., Frasconi P. and Smyth P., 2003, Modeling the Internet and the Web, Wiley, West Sussex.
3. Barabasi A.-L. 2002, Linked: The new Science of Networks, Perseus, Cambridge Massachussetts.
4. Boccaletti S., Latora V., Moreno Y., Chavez M., Hwang D.-U., 2006, Complex networks: Structure and dynamics, Physics Reports, 424, 175 – 308.
5. Bondy J. and Murty U. 2008, Graph Theory, Springer.
6. Bollobas B., 1985, Random Graphs, Academic Press, London.
7. Brandes U., Erlebach T. 2005, Network Analysis, Springer-Verlag Berlin Heidelberg.
8. Dehmer M. 2008, Information-Theoretic Concepts for the Analysis of Complex Networks, Applied Artificial Intelligence 22, 684–706
9. Dehmer M., Mowshowitz A. 2011, A history of Graph EntropyMeasures, Information Sciences 181, 57-78
10. De Nooy W., Mrvar A., Batagelj V., 2007, Explanatory Social Network Analysis with Pajek, Cambridge University Press, NY.
11. Dorogovtsev S., Mendes G. , 2003, Evolution of Networks, Oxford Univ. Press, UK.
12. Easley D. and Kleinberg J., 2010, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, Cambridge University Press.
13. Li J., et.al. 2008, Network Entropy Based on Topology Configuration and Its Computation to Random Networks, Chin. Phys. Letters 25, 4177-4180
14. Rosen K. et al., 2000, Handbook of Discrete and Combinatorial Mathematics, CRC Press, USA.
15. Sole R. and Valverde S. 2004, Information Theory of Complex Networks: Evolution and Architectural Constraints, Lect. Notes Phys. 650, 189-204
16. Tutzauer F. 2007, Entropy as a measure of centrality in networks characterized by path-transfer flow, Social Networks 29, 249–265

<u>*Quantum Entropy, Information and Networks:*</u>

1. Bernstein E., Vazirani U. 1997, Quantum Complexity Theory, SIAM J. Comput. 26, 1411-1473.
2. Chen G., Brylinsky R. , editors 2002, Mathematics of Quantum Computation, Chapman and Hall/VRC, Florida, USA.
3. Gnutzman S., Smilansky U. 2006, Quantum graphs: applications to quantum chaos and universal spectral statistics, Adv. Phys. 55 527-625
4. Mahler G., Weberruss V. 1995, Quantum Networks. Dynamics of Open Nanostructures, Springer-Verlag, Berlin
5. Ohya M., Volovich I. 2011, Mathematical Foundations of Quantum

Information and Computation and Its Applications to Nano- and Bio-systems, Springer, Berlin.

Instructor: I Antoniou

Semester C

Master's Degree Dissertation
G-MDUD3 0700
13 weeks, 30 credits

M. Sc. Course in «Theoretical Computer Science and Control and System Theory»

Semester: A

A.10 Formal Language Theory
B.05 Geometric Control Theory
B.10 Convex Optimization

Semester: B

A.11 Quantum Information and Processing
A.12 Cryptography
B.03 Numerical Methods with Applications to the Solution of ODEs and PDEs
B.09 Multivariable Control Systems
B.10 Optimal Control Theory
B.12 Predictive Control
B.15 Robust Control

Semester: C

Master's Degree Dissertation

DESCRIPTION OF COURSES

Semester A

A.10 Formal Language Theory
G-MDUDI
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Words. Infinite words and ω-languages. Automata over infinite words, with Büchi and Muller acceptance conditions. ω-Recognizable languages. Closure properties of ω-recognizable languages. The complement of an ω-recognizable language. Monadic second-order logic. The expressive equivalence of sentences from monadic second- order logic and automata over infinite words. Application of automata over infinite alphabets to model-checking.
Instructor: G. Rahonis

B.5 Geometric Control Theory
G-MDUD2 0673
3h/w, 13 weeks, 10 credits
Elective
Description: Elements of differential geometry: manifolds, tangent bundles, vector fields and differential form. Control system formulations, distributions and fibrations. Controllability and analysis of reachable sets. Lyapunov stability theory, index theory for vector fields, Hopf theorem. Singular perturbations. Feedback equivalence and linearization. Aspects of global control design.
References

1. H. Khalil: *Nonlinear Systems,* Prentice Hall, 2001
2. S. Sastry: *Nonlinear Systems, Analysis, Stability and Control*, Springer 1999.
3. M. Vidyasagar: *Nonlinear Systems Analysis,* Prentice Hall 1978, SIAM 2001.
4. E. Kappos: *Global Controlled Dynamics, A Geometric and Topological Analysis,* web 2008.

Instructor: E. Kappos

B.10 Convex Optimization
G-MDUD1 0850
3h/w, 13 weeks, written exams, 10 credits
Elective
Description: Introductory notions. *Theory:* convex sets, convex functions, convex optimisation problems in automatic control. *Applications:* solution of convex optimisation problems in robust control, LMI methods, bilinear matrix inequality methods. *Algorithms:* development of algorithms for the solution of convex optimisation problems, interior point algorithms, software.
References

1. Stephen Boyd, Lieven Vandenberghe: Convex Optimization, Cambridge University Press 2004
2. Edwin K. P. Chong, Stanislaw H. Zak, An Introduction to Optimization, 4th Edition, Wiley 2013
3. Giuseppe C. Calafiore, Laurent El Ghaoui, Optimization Models, Cambridge University Press 2014

Instructor: O. Kosmidou

Semester B

A.11 Quantic Information and Computation
G-MDUD1 0751
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Mathematical Foundation of Quantum Theory. Quantum Information and Von Neumann Entropy. Boole Algebras and Classical Gates. Quantum Logic and Quantum Gates. Quantum Algorithms. Quantum Teleportation and Cryptography. Realization of Quantum Computers. Perspectives of Quantum Information.

References:

Selected References on Quantum Theory:

1. Alicki R., Fannes M., Quantum Dynamical Systems, Oxford University Press, Oxford U.K.
2. Bohm A. 1993, Quantum Mechanics, Foundations and Applications, 3d ed, Springer, Berlin.
3. Fock V.A. 1986, Fundamentals of Quantum Mechanics Mir Publishers, Moscow.
4. Jammer M. 1974, The Philosophy of Quantum Mechanics, Wiley, New-York.
5. Jauch J.M. 1973, Foundations of Quantum Mechanics, Addison-Wesley, Reading, Massachussetts
6. Mackey G.W. 1957, Quantum Mechanics and Hilbert Space, American Mathematical Monthly 64, 45-57.
7. Mackey G.W. 1963, The Mathematical Foundations of Quantum Mechanics, Benjamin, New York.
8. Prugovecki E. 1981, Quantum Mechanics in Hilbert Space, Academic Press, New York.
9. Von Neumann J. 1932, Mathematical Foundation of Quantum Mechanics, Princeton Univ. Press, New Jersey.

Selected References on Quantum Theory Information and Quantum Computing:

1. Benenti G., Casati G., Strini G. 2005, Principles of Quantum Computation and Information,Vol.I: Basic Concepts, World Scientific, Singapore.
2. Benenti G., Casati G., Strini G. 2005, Principles of Quantum Computation and Information, Vol.II: Basic Tools and Special Topics, World Scientific, Singapore.
3. Bernstein E., Vazirani U. 1997, Quantum Complexity Theory, SIAM J. Comput. 26, 1411-1473.
4. Chen G., Brylinsky R. , editors 2002, Mathematics of Quantum Computation, Chapman and Hall/VRC, Florida, USA.
5. Feynman R.P. 1967, Quantum Mechanical Computers, Foundations of Physics, 16, 507-531.

6. Ingarden R.S. 1976, Quantum Information Theory, Rep. Math. Physics 10, 43-72.
7. Nielsen A.M., Chuang I.L. 2000, Quantum Computation and Quantum Information, Cambridge University Press, Cambridge UK.
8. Ohya M., Petz D. 2004, Quantum Entropy and its Use, 2nd Printing, Springer, Berlin.
9. Vedral V. 2010 Decoding Reality. The Universe as Quantum Information, Oxford University Press, Oxford, UK
10. Vitanyi P. M. B. 2001, Quantum Kolmogorov Complexity based on Classical Descriptions, IEEE Transactions on Information Theory 47, 2464-2479.

Instructors: I. Antoniou, C. Panos, C. Daskalogiannis

A.12 Cryptography
G-MDUD1 0840
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Classical Cryptosystems - Perfect Security - Feedback Shift Register - Basic Computational Number Theory - RSA Cryptosystem - Rabin Cryptosystem - Primality Testing - Factorization Methods - Discrete Logarithm - Diffie-Hellman Protocol - ElGamal Cryptosystem - Okamoto-Uchiyama Cryptosystem - Digital Signatures - Cryptographic Protocols.

Remark: The basic concepts of Linear Algebra, Algebraic Structures and Number Theory are needed for the aforementioned course.

References

1. D. Stinson, Cryptography – Theory and Practice, Boca Raton, Florida, CRC Press (2002).
2. G. Zémor, Cours de Cryptographie, Paris, Cassini (2002).
3. B. Schneier, Applied Cryptography, J. Wiley and Sons (1996).
4. N. Koblitz, A course in Number Theory and Cryptography, New-York, Berlin, Heidelberg, Springer-Verlag (1987).
5. J. A. Buchmann, Introduction to Cryptography, New-York, Berlin, Heidelberg, Springer-Verlag (2001).
6. N. P. Smart, Cryptography, McGraw Hill; Boston (2003).
7. E. Bach, J. Shallit, Algorithmic Number Theory, Vol 1, MIT Press (1997).
8. S.Y.Yan, Number Theory for Computing, Berlin, Heidelberg, Springer-Verlag (2002).

Instructor: D. Poulakis.

B.3 Numerical Methods with Applications to Ordinary and Partial Differential Equations
G-MDUD2 0853
3h/w, 13 weeks, written exam. 10 credits
Elective

Description: Initial and boundary value problems. Numerical methods for the solution of ordinary differential equations with initial and boundary conditions.

Methods of single step and multiple step, stability, predictor-corrector methods, stiff ODE. Linear and non-linear methods. Shooting. Linear and non-linear methods of finite differences. Variational techniques. Finite difference methods for elliptic, parabolic and hyperbolic problems. Introduction to the finite element method.

References

1. Faires J. Douglas & Burden L. Richard, (1993). Numerical Methods, PWS-KENT Publ. Comp.
2. Lapidus Leon, Seinfeld H. John, (1971). Numerical Solution of Ordinary Differential Equations, Academic Press Inc.
3. Smith G.D., (1965, 1969, 1974). Numerical Solution of Partial Differential Equations, Oxford Univ. Press.
4. Mitchell A.R. & Griffiths D.F., (1980). The Finite Difference Method in Partial Differential Equations, John Wiley & Sons

Instructor: M. Gousidou-Koutita

B.9 Multivariable System Theory
G-MDUD1 0843
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: Real rational vector spaces and rational matrices, polynomial matrix models of linear multivariable systems, pole and zero structure of rational matrices at infinity, dynamics of polynomial matrix models. Proper and Ω-stable rational functions and matrices, feedback system stability and stabilization, some algebraic design problems.

References

1. Callier F.M. and Desoer C.A., (1982), Multivariable feedback systems, Springer-Verlag, New York.
2. Gohberg I., Lancaster P. and Rodman L., (1982), Matrix Polynomials, Academic Press, New York.
3. Kucera V., Analysis and Design of Discrete Linear Control Systems, Prentice Hall International Series in Systems and Control Engineering.
4. Rosenbrock H.H., (1970), State-space and Multivariable Theory, Nelson-Wiley.
5. Vardulakis A.I, (1991), Linear Multivariable Control: Algebraic Analysis and Synthesis Methods, Wiley.

Instructor: A-I. Vardoulakis.

B.10 Optimal Control Theory
G-MDUD1 0844
3h/w, 13 weeks, written exams, 10 credits
Elective

Description: The optimal control problem, basic mathematical notion from the variational calculus, minimization of functionals, Euler-Lagrange equation, minimization of functional under constraints, optimal control of continuous or discrete time systems with or without state/input constraints, the minimum principle of Pontryagin, the linear quadratic (LQ) regulation and tracking problem, the Riccati equation, minimum time control, Hamilton-Jacobi-Bellman theory: exact and approximate solutions, convexification, dynamic programming, state observation in a stochastic environment, Kalman filter, the linear quadratic Gaussian (LQG) problem, applications to practical problems (energy-efficient buildings, traffic control, robotics, intelligent web.)

References

1. Burl J.B. (1998). *Linear Optimal Control: H_2 and H_∞ Methods*. Addison-Wesley.
2. Lewis F.L. (1995). *Optimal Control.* 2nd edition. John Wiley and Sons; New York.
3. Donald E. Kirk (1970), *Optimal Control Theory : An Introduction*, Prentice Hall.
4. D. S. Naidu, (2003), *Optimal Control Systems*, CRC Press.
5. A. Sinha, 2007, *Linear systems : optimal and robust control*, CRC Press
6. Karampetakis N., (2009), *Optimal Control of Systems*, Εκδόσεις Ζήτη. (in Greek)
7. Kyventidis Th. (2001), *Variational Calculus*, Ziti, Thessaloniki. (in Greek).

Instructor: N. P. Karampetakis, G. Tsaklidis

B.12 Predictive Control
G-MDUD2 0848
3h/w, 13 weeks, written exam., credits 10
Elective

Description: Review of control concepts. Introduction to the analysis of discrete systems: discrete transfer functions, z-transform, conversion to analog signals, definition of stability, sampling systems, sample analysis, discrete PID, controller parametrizations. Discrete optimal control systems: linear quadratic control, guidance and regulation problems. Optimal state and model parameter estimation: controllability/observability, Kalman filter estimators (linear and nonlinear), model prediction. Predictive control -- systems with constraints: constrained optimization, numerical solution, applications. Predictive control – stability, robustness: process model uncertainties, disturbance model uncertainties, stability and robustness. Predictive control – nonlinear systems: constrained optimization, numerical solution, applications. Numerical optimization in predictive control systems: parametrization of control actions, discretization of dynamical systems, numerical optimization methods.

Bibliography:

Rossiter J.A., “Model Based Predictive Control – A Practical Approach”, CRC Press, 2005.

Camacho E.F., and C. Bordons, “Model Predictive Control”, Springer, 1999. Kouvaritakis B., and M. Cannon, “Non-Linear Predictive Control: Theory & Practice”, IEE Publishing, 2001.

Maciejowski, J., “Predictive Control with Constraints”, Pearson Education POD, 2002.

Kwon W.H., and S. Han, “Receding Horizon Control – Model Predictive Control for State Models”, Springer, 2005.

Instructor: P. Seferlis

B.15 Robust Control
G-MDUD2 0848
3h/w, 13 weeks, written exam., credits 10
Elective

Description: Introductory notions of uncertain systems and robust control. Mathematical descriptions of uncertainty, additive and multiplicative uncertainty. Robustness analysis. Design of robust systems. LQG methods. LMI methods. Design of robust controllers using state observers. Multiple model methods. Robust pole assignment. Robust control of multi-objective functions. H_∞ methods. Applications.

References:

1. J. Ackermann, “Robust Control: Systems with Uncertain Physical Parameters”, Springer Verlag, 1993.
2. B.R. Barmish, “New Tools for Robustness of Linear Systems”, McMillan, 1994.
3. S.P. Bhattacharya, H. Chapellat and L.H. Keel, “Robust Control: The Parametric Approach”, Prentice Hall.
4. G.E. Dullerud and F. Paganini, “A Course in Robust Control Theory”, Springer, 2000.
5. R.S. Sanshez – Pena and M. Sznaier, “Robust Systems – Theory and Applications”, Wiley, 1998.
6. Κοσμίδου Όλγα, Εύρωστος έλεγχος δυναμικών συστημάτων, Εκδόσεις Γκιούρδας, Β., ISBN: 960-387-826-X, 2009.

Instructor: O. Kosmidou

<u>Semester C</u>

Master’s Degree Dissertation
G-MDUD3 0800
13 weeks, 30 credits