University of Cyprus
Department of Mathematics and Statistics

PROSPECTUS OF UNDERGRADUATE & POSTGRADUATE STUDIES 2024-2025

The famous Platonic inscription "let no one ignorant of geometry enter" has been adopted, directly or indirectly, by all universities in the world and, appropriately, the Department of Mathematics and Statistics was one of the departments with which the University of Cyprus commenced its operation in 1992. The primary aim of the Department is the promotion of Mathematical Sciences through scientific research and teaching.

To achieve this objective, competent and highly trained scientists are needed, since they are necessary for the further cultural and economic development of Cyprus, as well as for the promotion and support of research. Offering high-quality curricula, both in mathematics and statistics at undergraduate and postgraduate levels, as well as cooperating with other universities and research centres are important steps towards achieving the Department's objective.

The undergraduate programme of studies, which was launched in September 1992, had been designed in a way that it could pave the way for postgraduate studies.

The Department of Mathematics and Statistics offers the following undergraduate degree:

- Bachelor in Mathematics and Statistics
    - Specialization in Applied Mathematics
    - Specialization in Pure Mathematics
    - Specialization in Probability/Statistics

The postgraduate programme of studies was launched in September 1997. Since then, a number of postgraduate degrees have been awarded.

At present, our Department offers 2 Master's Degree Programmes and 2 PhD programmes. The Master's degree in Data Science is offered jointly by the Department of Mathematics and Statistics, the Department of Business and Public Administration and the Department of Computer Science.

- MSc in Data Science
- MSc in Mathematical Sciences

- PhD in Mathematics
    - with specialisation in Applied Mathematics
    - with specialisation in Pure Mathematics
- PhD in Statistics

UNDERGRADUATE PROGRAMME OF STUDIES

Introduction

The undergraduate programme of studies, which was launched in September 1992, had been designed in a way that it could pave the way for postgraduate studies.

The Department of Mathematics and Statistics offers the following undergraduate degree:

- Bachelor in Mathematics and Statistics
    - Specialization in Applied Mathematics
    - Specialization in Pure Mathematics
    - Specialization in Probability/Statistics

Basic Student Attendance Information

The programmes of studies are based on credit units. The completion of 240 credit units (hereinafter: ECTS) is required for the award of degree. It is expected that 8 semesters are needed for the completion of the required ECTS. On special occasions, the duration may be extended up to a maximum of 12 semesters. The period of suspension or interruption of attendance is not included in these 12 semesters. Attendance at classes is mandatory.

The Department appoints an Academic Advisor, from among its academic staff members, for each undergraduate student, so that the latter can get advice on matters related to their studies.

Each semester students enrol in courses according to the requirements of their programme of studies. A student is considered full-time in a given semester if their total workload, in that specific semester, amounts to 27-30 ECTS. Students may enrol in courses amounting up to 38 ECTS in a given semester. Enrolment in courses amounting up to 42 ECTS is possible only after the 2nd year of studies and provided that students repeat two of the courses they had already attended.

The Vice-Rector for Academic Affairs may, exceptionally, approve enrolment in courses amounting up to 45 ECTS upon justified written recommendation of the Chairperson of the Department. Any requests regarding enrolement in courses amounting beyond 45 ECTS, which are approved by the Chairperson of the Department and the Vice-Rector for Academic Affairs, shall be submitted to the Senate for final approval.

The total workload for an undergraduate student who is also pursuing a minor programme of studies, in a given semester, may be up to 42 ECTS.

If an undergraduate student fails to fully fulfil the requirements of their programme of studies within twelve semesters, their studies are automatically terminated, while they are not awarded a Degree.
Studies are automatically terminated when an undergraduate student:

a) has not enrolled in courses (4th week of classes),
b) is graded with zero (0) in all courses in the first year of studies,
c) is graded with zero (0) in all their courses in two consecutive semesters (in the second semester onwards),
d) has not enrolled in courses following the suspension of their studies,
e) has withdrawn from all courses.

The Academic Affairs and Student Welfare Service shall inform the student in writing of their removal. The student may submit an appeal to justify their absence within 15 days. Otherwise, they will be automatically removed.

Curriculum of the Department of Mathematics and Statistics

The curriculum is divided into four levels and six groups. Level 101-199 corresponds mainly to courses of the first year of studies, level 201-299 corresponds mainly to courses of the second year of studies, level 301-399 corresponds mainly to courses of the third year of studies, and finally, level 401-499 corresponds mainly to courses of the fourth year of studies.

The six groups into which the courses are divided correspond approximately to the following areas of Mathematics: Analysis, Algebra, Geometry, Probability/Statistics, Numerical Analysis and Applied Mathematics. The second digit of the course number determines the area of mathematics that the course belongs to. The characteristic digit (2nd digit of the course number) of the six areas is 0 & 1, 2, 3, 5 & 6, 7 and 8, respectively, and they appear in Appendix A.

Each undergraduate course is usually a four-hour course (four hours per week, one of which may correspond to a recitation hour). Each course has a corresponding amount of ECTS as they appear in Appendix A.

Prospectus

The Prospectus includes the courses of the programme, along with a description of most of them, and the regulations related to obtaining the degrees offered by the Department.

TABLE A – COURSES FOR STUDENTS OF MATHEMATICS AND STATISTICS

Courses Code and Title	ECTS	Pure Mathematics	Applied Mathematics	Probability/ Statistics
MAS101 – Calculus I	8	▲	▲	▲
MAS102 – Calculus II	8	▲	▲	▲
MAS121 – Linear Algebra I	8	▲	▲	▲
MAS122 – Linear Algebra II	8	▲	▲	▲
MAS131 – Basic Mathematics I	7	▲	▲	▲
MAS132 – Basic Mathematics II	7	▲	▲	▲
MAS133 – Sets and Algebraic Structures	7	▲	▲	▲
MAS191 – Mathematics with Computers	8	▲	▲	▲
MAS201 – Multivariable Differential Calculus	7	▲	▲	▲
MAS202 – Multivariable Integral Calculus	7	▲	▲	▲
MAS203 – Ordinary Differential Equations I	7	▲	▲	▲
MAS222 – Number Theory	7			
MAS261 - Probability I	7	▲	▲	▲
MAS262 - Statistics I	7	▲	▲	▲
MAS271 – Numerical Analysis I	7	▲	▲	▲
MAS301 – Real Analysis	8	▲	▲	▲
MAS302 – Complex Variables I	7	▲	▲	▲
MAS303 – Partial Differential Equations	7	MAS(PURE)A MAS(PURE)A	MAS(APPLIED)A or MAS(PURE)	MAS(PURE)
MAS304 – Functional Analysis	7	MAS(PURE)A	MAS(APPLIED)A or MAS(PURE)	MAS(PURE)
MAS321 – Introduction to Algebra	7	▲	MAS(PURE)	MAS(PURE)
MAS331 – Classical Differential Geometry	7	▲	▲	▲
MAS350 – Stochastic Processes	7	MAS(STAT)	MAS(STAT)	▲
MAS361 – Probability II	7	MAS(STAT)	MAS(STAT)	▲
MAS362 - Statistics II	7	MAS(STAT)	MAS(STAT)	▲
MAS371 – Numerical Analysis II	7		MAS(APPLIED)A	
MAS401 – Measure Theory and Integration	7	MAS(PURE)A	MAS(PURE)	MAS(PURE)
MAS402 – Complex Analysis II***	7			
MAS403 – Ordinary Differential Equations II	7		MAS(APPLIED)B	
MAS418 – An Introduction to Fourier Analysis	7	MAS(PURE)A	MAS(PURE)	MAS(PURE)
MAS419 – Topics in Analysis***	7			
MAS420 – Approximation Theory	7		MAS(APPLIED)B	
MAS422 – Introduction to Coding Theory***	7			
MAS424 – Theory of Rings and Modules***	7			
MAS425 – Group Theory***	7			
MAS426 – Galois Theory	7	MAS(PURE)B	MAS(PURE)B	MAS(PURE)B
MAS427 – Group Representation Theory***	7			
MAS429 – Topics in Algebra***	7			
MAS431 – Introduction to Differentiable Manifolds	7	MAS(PURE)B	MAS(PURE)	MAS(PURE)
MAS432 – Introduction to Riemannian Geometry	7	MAS(PURE)B	MAS(PURE)	MAS(PURE)
MAS433 – Topology	7	MAS(PURE)B	MAS(PURE)	MAS(PURE)
MAS434 – Introduction to Algebraic Topology***	7			

MAS439 – Introduction to Algebraic Geometry***	7			
MAS451 – Linear Models I	8	MAS(STAT)	MAS(STAT)	▲
MAS452 – Linear Models II***	7			
MAS454 – Non-Parametric Statistics	7	MAS(STAT)	MAS(STAT)	▲
MAS455 – Sampling Theory***	7			
MAS456 – Time Series***	7			
MAS458 – Statistical Data Analysis	7	MAS(STAT)	MAS(STAT)	▲
MAS459 – Multivariable Analysis***	7			
MAS466 – Survival Analysis***	7			
MAS468 – Topics in Probability-Statistics I***	7			
MAS469 – Topics in Probability-Statistics II***	7			
MAS471 - Numerical Solution of Ordinary Differential Equations	7		MAS(APPLIED)B	
MAS472 - Numerical Solution of Partial Differential Equations	7		MAS(APPLIED)B	
MAS473 - Introduction to the Finite Element Method	7		MAS(APPLIED)B	
MAS481 - Applied Mathematical Analysis	7		MAS(APPLIED)B	
MAS482 - Classical Mechanics	7		MAS(APPLIED)B	
MAS483 - Fluid Dynamics	7		MAS(APPLIED)B	
MAS484 - Introduction to Mathematical Modeling ***	7			
MAS487- Topics from Applied Mathematics I***	7			
MAS488- Topics from Applied Mathematics II***	7			
MAS499 - Independent Study	7			
MAS501, MAS502, MAS503 - work placement I, II, III**	1			
MAS510- Diploma Project I◊	7			
MAS511- Diploma Project II◊	7			
MAS512-Ερευνητική Εργασία +	0			
MAS857*,MAS 858* - Mathematical Problem Solving Techniques	4			

Επεξηγήσεις

*	=	The Course does not have a typical course code since students can register for it at any time during their studies.
**	=	The students have the choice of registering in the work placement program during the summer months. The duration of the placement is 1-3 months, with 1 ECTS earned for each month of work. The ECTS earned from a work placement contribute towards the sum of 240 ECTS required for obtaining the degree. Students are allowed to do a work placement (1-3 ECTS) only once, in the summer term between either the 2nd and 3rd or the 3rd and 4th year of their studies. It is the students' responsibility to obtain the required remaining credits so that they fulfill the requirements of both the UCY and the Department.
***	=	If students from foreign Universities enrol in courses through Erasmus/UFE, these courses may be taught (in the semester they are scheduled to be offered) in the English language. In this case, students of the Department of Mathematics and Statistics shall attend the courses in English.
▲	=	Compulsory Course
◊	=	Students can register for a Diploma Project (MAS510 and MAS511) in the last two semesters of their studies, substituting restricted elective courses (MASXXX).
+	=	Students can register for a Diploma Project (MAS510 and MAS511) in the last two semesters of their studies, substituting restricted elective courses (MASXXX).

Degree Requirements

The degree of Mathematics and Statistics requires 240 ECTS obtained from the following courses:

(1) 17 Compulsory Courses for all students

1) MAS101 - Calculus I
2) MAS102 - Calculus II
3) MAS121 - Linear Algebra I
4) MAS122 - Linear Algebra II
5) MAS131 - Basic Mathematics I
6) MAS132 - Basic Mathematics II
7) MAS133 – Sets and Algebraic Structures
8) MAS191 - Mathematics with computers
9) MAS201 - Multivariable Differential calculus
10) MAS202 - Multivariable Integral calculus
11) MAS203 - Ordinary Differential Equations I
12) MAS261 - Probability I
13) MAS262 - Statistics I
14) MAS271 - Numerical Analysis I
15) MAS301 - Real Analysis
16) MAS302 - Complex variables I
17) MAS331 - Classical Differential Geometry

(2) Compulsory Course from other Departments
Course CS 031 Introduction to Programming (7 ECTS).

(3) Free Electives from other Departments.
Students are required to take 3-5 courses from other departments. These courses must belong to at least 3 different faculties. The Faculty of Pure and Applied Sciences may be one of the faculties (excluding however the courses offered by the Department MAS).

Free electives from the Athletics Department and the Language Centre are considered courses of their respective independent faculties. Only one first-level foreign language course may be considered as a free elective, unless the student completes the second-level as well, in which case both levels count.

(4) Students are required to take two English language courses.
LAN100-General Advanced English
LAN101-Academic English

(5) Restricted Elective Courses within the Department (MASXXX)

Any course which does not carry a characteristic symbol (see Table A) is a restricted elective course (MASXXX). Any Departmental course within or outside a student's specialization may count as a restricted elective course, provided that the student's specialization requirements have been fulfilled. Moreover, a student may not use the same course to cover multiple requirements of her/his specialization.

Furthermore, students may substitute restricted elective courses (MASXXX) worth up to 14 ECTS with work placement, diploma project, independent study, postgraduate courses, and a choice from a list of courses offered by other Departments according to relevant rules and regulations.

(6) Compulsory Courses accouring to the areas of specialization (Table C).

NOTES

(a) Choosing a specialization: students choose and state their specialization during their 2nd year of studies (at the beginning of the spring semester). In order to change specialization, a student needs to apply in writing to the Head of Department before the commencement of the semester during which the student desires the change to take effect.

(b) A student may complete her/his studies with more than 240 credits, depending on her/his choice of elective courses inside and outside the Department.

(c) Indicative programmes of study for the Bachelor in Mathematics with emphasis in Pure Mathematics, Applied Mathematics and the Bachelor in Mathematics and Statistics with emphasis in Probability/Statistics are given in Tables C1, C2 and C3, respectively.

(e) Reading courses are not offered at the undergraduate level. Students may enroll in an Independent Study instead.

(f) A student may not use the same course to cover multiple requirements of her/his specialization.

(g) Students may substitute restricted elective courses (MASXXX) worth up to 14 ECTS with work placement, diploma project, independent study, postgraduate courses and a choice from a list of courses offered by other Departments, as follows:

Work Placement	The students have the choice of registering in the work placement program during the summer months. The duration of the placement is 1-3 months, with 1 ECTS earned for each month of work. The ECTS earned from a work placement contribute towards the sum of 240 ECTS required for obtaining the degree. Students are allowed to do a work placement (1-3 ECTS) only once, in the summer term between either the 2nd and 3rd or the 3rd and 4th year of their studies. It is the students' responsibility to obtain the required remaining credits so that they fulfill the requirements of both the UCY and the Department. Internship program Codes: MAS501- Work Placement I (1ECTS) MAS502- Work Placement II (1ECTS) MAS503- Work Placement III (1ECTS)
Diploma Project (Two semesters)	Students can register for a Diploma Project (MAS510 and MAS511) in the last two semesters of their studies, substituting restricted elective courses (MASXXX).
Courses from other Departments	List of Courses from other Departments: *The descriptions of the courses that follow, can be found in the prospectuses of the corresponding Departments.* Department of Business and Public Administration • BPA444-Social Networks and Business • BPA446-Business Analysis: Predictive Models Department of Computer Science • CS231-Data Structures and Algorithms • CS236-Algorithms and Complexity • CS445-Digital Image Processing

	Department of Electrical and Computer Engineering • ECE220-Signal and Systems I • ECE320-Signal and Systems II • ECE326- Dynamical Systems and Control Department of Mechanical and Manufacturing Engineering • MME216-Fluid Mechanics I • MME217-Heat Transfer • MME418-Compressible Flow Department of Physics • PHY225- Quantum Mechanics I • PHY405- Cosmology and General Theory of Relativity
Postgraduate Courses	At most two restricted elective courses can, in exceptional cases, in the last year of studies, be postgraduate courses, with the approval of both the lecturer and the academic advisor. An exceptional case is defined to be a GPA of at least 8.5, in the Department's courses. It is understood that the ECTS of each course are credited only once.
Independent Study (One semester)	Students may register in MAS499 as a restricted elective course (MASXXX), during the last two semesters of their studies.

Independent Study Project (ISP) Rules– (MAS499)

General
In one of the last two semesters during their studies, students may enrol in MAS499 as a restricted elective**.**

Each ISP should demonstrate initiative, independent study and originality, in a broader sense, while It may be of a theoretical and/or applied nature. The ISP may extend or delve further into an existing theory, methods or techniques, and/or their application to specific problems.

The possible ISP topics should be related to the area of expertise of the Department's Academic Staff. Students should discuss with an academic staff member and choose a topic for their ISP . The consent of said academic member, who is also responsible for supervising the ISP (ISP Supervisor), is required for the topic to be approved. The topic, as well as the name of the ISP Supervisor academic staff member, shall be notified to the Undergraduate Studies Committee (USC) and shall be submitted to the Departmental Council for approval.

ISP Supervision
The Supervising Academic Staff Member is responsible for supervising the student carrying out an ISP. Regular meetings between the student and the Supervising Academic Staff Member are required for monitoring and controlling the ISP progress.

ISP Assessment
An ISP is evaluated by a two-member committee consisting of the Supervising Academic Staff Member and another academic staff member, called the Second Evaluator. The Supervising Academic Staff Member shall submit their recommendation regarding the establishment of the two-member committee to the USC, which shall be then forwarded to the Departmental Council for approval.

At least one week prior to the presentation date, and upon previous agreement with the student, the Supervising Academic Staff Member shall send the title, the date and time of the presentation to the Departmental Secretary for its announcement.

At least one week prior to the date of the ISP presentation, the student shall submit (either electronically or in printed form - as this is agreed between the Supervising Academic Staff Member and the student) a copy of the ISP to the two-member evaluation committee and to the Departmental Secretary.

The student shall present their work orally before the two-member committee. This presentation is open to all academic staff members and students of the Department.

Following the presentation, the Supervising Academic Staff Member, upon agreement with the Second Evaluator, shall submit a justified grade for the ISP on a special Evaluation Form, in accordance with the procedure for submitting course grades. The Departmental Council is responsible for dealing with cases of disagreement regarding the ISP grade.

The main criteria for the evaluation of an ISP are the following:

a) Quality of work (e.g., accuracy and completeness of the analysis, appropriateness of the methodology, validity of theoretical results, quality of software, possibility of extensibility, degree of connection and correlation of ideas).
b) Level of work completion
c) Extent of the student's understanding of the broader area of the ISP topic
d) Quality of the written text of the ISP (e.g, structure and organisation, clarity, ease of reading and intelligibility).

ISP Submission
Within seven working days following the successful evaluation of an ISP, the student shall submit a bound copy of their ISP to the Department. Failure to timely submit the ISP may result in delay, which will make it impossible for the student to graduate in that specific semester that is about to be completed.

ISP Requirements

Each ISP should be a complete text in chapters. This text should include an introduction to the topic, an analysis of the significance of the work, the connection of the topic to previous relevant work in the field, a review of the wider field, a description of the methodology, a presentation, classification and evaluation of the results, and, finally, conclusions and recommendations for possible extension of the work.

The form that the ISP should have been is indicated by the Supervising Academic Staff Member. ISPs that create and use software programmes must include the relevant codes and instructions in special appendices. These codes, *per se*, may not be considered as part of the written text of the ISP.

The ISP may be written in English, provided that an extended abstract in Greek will be also attached.

Grading

Following the presentation, the Supervising Academic Staff Member and the Second Evaluator jointly submit a justified grade for the ISP on the special ISP Evaluation Form.

The ISP Evaluation Form includes a separate numerical grade for each ISP Evaluation Criterion as well as their total score, which constitutes the final ISP Grade. Students who succeed in their ISP are awarded a numerical grade in accordance with the Studies Rules.

Rules for Writing a Diploma Project (DP) (MAS510 and ΜΑΣ511)

Writing a DP is not complulsory in the undergraduate programme of studies in Mathematics and Statistics. Students are required to find a Supervising Academic Staff Member to carry out a DP. Moreover, students may enrol in a DP in the last year of their studies.

A DP takes two semesters to complete and replaces 2 courses (MASXXX) of the programme of studies, while it shall be carried out by a fourth-year student within two consecutive semesters. The part of a DP carried out in the first semester is called DP I, while the part carried out in the second semester is called DP II. Both parts are carried out in the context of courses MAS510-DP I (0 ECTS) and MAS511-DP II (14 ECTS).

Fourteen credit units (14ECTS) are assigned to each DP, which are credited to the student upon successful completion of the DP.

Each DP should demonstrate initiative, independent study and originality, in a broader sense, while It may be of a theoretical and/or applied nature. The ISP may extend or delve further into an existing theory, methods or techniques and/or their application to specific problems.

DP Topics
Possible DP topics should be related to the area of expertise of the Department's Academic Staff. Students should discuss with an academic staff member and choose a topic for their DP. The consent of said academic member, who is also responsible for supervising the DP, is required for the topic to be approved.

Once the DP topic has been decided, the student should complete a special DP Registration Form. This form includes the title of the DP topic, a brief description of it, the objectives, and any specialised software/material or other resources that may be needed. The DP Registration Form shall be countersigned by the student and the consenting academic staff member. The countersigned DP Form shall be submitted to the USC by the end of the semester preceding the semester during which DP I will be carried out, as well as to the Departmental Council for approval.

Change of the DP Topic
Students may change their DP Topic (with the same or a different DP Supervising Academic Staff Member) during the registration period in the semester of enrolement in DP I. To do this, the student should resubmit the DP Registration Form so as for the Coordinator of the USC, as well as the Chairperson of the Department, to ratify the change.

The student has the right to change the subject (with the same or a different DP Supervising Academic Staff Member), only once.

DP Supervision
The Supervising Academic Staff Member is responsible for supervising the student carrying out a DP. Regular meetings between the student and the Supervising Academic Staff Member are required for monitoring and controlling the DP progress.

DP I Evaluation
During the examination period in the semester in which MAS510-DP I was carried out, the student shall submit a short report on their progress to the DP Supervising Academic Staff Member. The latter shall evaluate the student's progress and submit a Pass (P) or Fail (F) Grade. The DP I grade constitutes the student's grade in course MAS510.

Students awarded a Pass Grade may move on to enrol in course MAS511 in the very next semester and carry out DP II. Students awarded a Fail Grade must carry out DP I again, either on the same or on a different topic (with the same or a different DP Supervising Academic Staff Member). Therefore, students shall enrol again in course MAS510.

In case of failing their DP I, students may repeat the course only once.

DP II Evaluation
DP II assessment takes place at the end of the semester of the student's enrolment.

A DP is evaluated by a three-member committee consisting of the Supervising Academic Staff Member (Chairperson of the Committee) and two other academic staff members. The Supervising Academic Staff Member shall submit their recommendation regarding the establishment of the three-member committee to the USC, which shall be then forwarded to the Departmental Council for approval.

At least one week prior to the presentation date, and upon previous agreement with the student, the Supervising Academic Staff Member shall send the title, the date and time of the presentation to the Departmental Secretary for its announcement. The student shall present their work in the form of a seminar before the Supervising Academic Staff Member and the evaluators. This presentation is open to all academic staff members and students of the Department.

At least one week prior to the date of the DP presentation, the student shall submit (either electronically or in printed form - as this is agreed between the Supervising Academic Staff Member and the student) a copy of their DP to the three-member evaluation committee and to the Departmental Secretary.

DP Evaluation Criteria
The main criteria for the evaluation of a DP are the following:

a) Quality of work (e.g., accuracy and completeness of the analysis, appropriateness of the methodology, validity of theoretical results, quality of software, possibility of extensibility, degree of connection and correlation of ideas).
b) Level of work completion.
c) Extent of the student's understanding of the broader area of the DP topic.
d) Quality of the written text of the DP (e.g, structure and organisation, clarity, ease of reading and intelligibility).

DP Grading
Following the presentation, the Supervising Academic Staff Member along with the other two evaluators jointly submit a justified grade for the DP on the special DP Evaluation Form. The DP Evaluation Form includes a separate numerical grade for each DP Evaluation Criterion as well as their total score.

Students who fail their DP II are awarded a Fail Grade. These students may either repeat the procedure, enrol in DP I again but on a different topic and with a different DP Supervising Academic Staff Member, or substitute the DP with two courses MASXXX, in accordance with the Studies Rules.

The DP Grade constitutes the student's grade for course MAS511.

DP Submission
Within seven working days following the successful evaluation of a DP, the student shall submit a bound copy of their DP to the Department and the UCY Library. Failure to timely submit the DP may result in delay, which will make it impossible for the student to graduate in that specific semester that is about to be completed.

Presentation Rules of the Diploma Project

A Diploma Project (DP) should be well presented and written in English or Greek. Each DP should follow the rules below, which have been implemented in the "Sample DP" file, using the Latex software.

1. General rules

1.1 Each DP should be sent electronically in a pdf format to the Departmental Secretary, upon completion of its presentation, and deposited electronically in the Library of the University of Cyprus.

1.2 In the Cover appears:
- a. The name of the University and Department
- b. The title of DP
- c. The name of the student
- d. Supervising Academic Staff Member's name
- e. The semester of completion of the DP exactly as shown in the first page of the Sample DP that follows.

1.3 If there are any acknowledgments, they should be written in the first inside page (see Sample DP).

1.4 In the second and third inner pages (in the first and second if there are no acknowledgments), there should be a short summary of the DP in Greek and English, under the heading "Abstract" (see Sample DP). The abstract should not be more than one page.

1.5 The following pages (one or more) will contain the list of the contents of the DP, under the title "Contents". In this list, the title of each chapter and its sub-chapters (if any) and the number of their corresponding display page will appear.

1.6 The next two (or more) pages will contain the "List of Figures" and "List of Tables". In this catalog will appear its title and the number of the corresponding displayed page.

1.7 Then, the chapters of the DP follow
- a. Each chapter must start in a new page. The first line of the chapter reads Chapter <chapter number> i.e.: [Chapter 1].
- b. The title of the chapter follows i.e.: ["Title of this Chapter"]
- c. The new page restriction for chapters does not apply to the subchapters of each chapter. The title of the subchapter follows the following structure: <number of chapter> <period> <subchapter number> <2 spaces> <subchapter title> i.e.: ["1.1 Section 1 of Chapter 1"]

1.8 After the last chapter, and in a new page, the references follow under the title "Bibliography". References are listed alphabetically in ascending order of the last name of the first author. Each bibliography should be cited at least once in the text. References must be complete and have a format similar to that of the DP Sample.

1.9 Appendices (if any) should follow after the Bibliography and in a new page for each appendix.

2. Presentation of DP

2.1 Each DP is written in Latex software.

2.2 The space between lines should be 1 ½.

2.3 The margin of each page to be left should be:
Left: 3.5 cm Top: 2 cm
Right: 2 cm Bottom: 2 cm
The bottom margin, i.e. 2 cm is calculated from the last line of the page and not from the page number.

2.4 The size of the letters of the Diploma Project should be:
The Words "Acknowledgments", "Abstract", "Contents", "Chapter <chapter number>", Bibliography, Appendix: 20 boldface
Chapter title: 14 boldface
Subchapter title: 12 boldface
Text: 12 plain

2.5 Each page number will appear at the bottom right of the page in the middle. Chapter numbering is Arabic.
1. The bibliography does not need to be numbered, but must be presented in the Table of Contents. The first page of the first chapter is numbered 1 and the last page of the appendices is numbered N. The pages preceding the first page of the first chapter are either not numbered or numbered i, ii, iii, iv, …. The pages following the last page of the bibliography, i.e. the appendices, are always numbered.

2.6 Figures can be placed anywhere on the page. These are numbered sequentially within each chapter. For example, the first figure of the second chapter is numbered Figure 2.1 (Figures 2.1), the second figure of the second chapter

is numbered Figure 2.2 (Figures 2.2), the fifth figure of the third chapter is numbered Figure 3.5 (Figures 3.5). After the number it follows a very brief description of the figure.

2.7 The same applies to tables as to figures, with the only difference that the word "Figure" is replaced by the word "Table".

3. Size of DP

3.1 The number of Arabic numbered pages of the DP must be greater than 40 pages. A number of pages less than 40 is accepted by the Department upon justification by the Supervising Academic Staff Member.

3.2 The code of any programs may appear in a DP but only in an Appendix or Appendices.

List of Courses from other Departments:
The descriptions of the courses that follow, can be found in the prospectuses of the corresponding Departments.

Students may substitute restricted elective courses (MASXXX) worth up to 14 ECTS from a list of courses offered by other Departments, as follows:

Department of Business and Public Administration

- BPA444-Social Networks and Business
- BPA446-Business Analysis: Predictive Models

Department of Computer Science

- CS231-Data Structures and Algorithms
- CS236-Algorithms and Complexity
- CS445-Digital Image Processing

Department of Electrical and Computer Engineering

- ECE220-Signal and Systems I
- ECE320-Signal and Systems II
- ECE326- Dynamical Systems and Control

Department of Mechanical and Manufacturing Engineering

- MME216-Fluid Mechanics I
- MME217-Heat Transfer
- MME418-Compressible Flow

Department of Physics

- PHY225- Quantum Mechanics I
- PHY405- Cosmology and General Theory of Relativity

MINOR PROGRAMME OF STUDY IN MATHEMATICS
The minor programme in Mathematics is open to all University students, except for students enrolled in the Department of Mathematics and Statistics.

According to the University regulations, a minor programme consists of courses whose total ects is at least 60. The earliest a student can enroll to a minor programme is at the beginning of her/his third semester of studies. The requirements for the minor in Mathematics are: (a) a successful completion of nine courses which must include: MAS101, MAS102, MAS121, MAS133, MAS261, MAS262, MAS271 and (b) two additional courses worth 7 ects or 8 ects from courses within the Department of Mathematics and Statistics.

COURSES FOR OTHER DEPARTMENTS

The courses offered for other Departments (not for students from the Department of Mathematics and Statistics) and their ECTS are indicated in Table B:

TABLE B – COURSES OFFERED TO OTHER DEPARTMENTS

Course Codes	Course Title	Department	ECTS
MAS001	Mathematics I	ECO, PBA, AFN, BIO	6
MAS002	Mathematics II	PBA, AFN, BIO	6
MAS003	Elements of Complex Analysis	PHY	7,5
MAS007	History of Mathematics	MAS, "E"	5
MAS012	Calculus for Computer Scientists I	CS	5
MAS013	Calculus for Computer Scientists II	CS	5
MAS018	Introductory Mathematics I	PHY, CHE	5
MAS019	Introductory Mathematics II	PHY	5
MAS020	Introductory Mathematics II (CHE)	CHE	5
MAS025	Engineering Mathematics I	ECE, CEE, MME	5
MAS026	Engineering Mathematics II	ECE, MME	5
MAS027	Engineering Mathematics III	ECE, CEE, MME	5
MAS028	Mathematics for CEE	CEE	5
MAS029	Elements of Linear Algebra	ECE, CEE, MME CS	5
MAS030	Introduction to Probability and Statistics	ECE, CEE	5
MAS051	Indroductory Mathematics and Statistical Methods	EDU	5
MAS052	Mathematics for the Social Sciences	PSY	5
MAS055	Intoduction to Probabiity and Statistics	CS	7
MAS061	Statistical Analysis I	ECO, PBA, AFN	6

«E» = Free Elective Course

TABLE C – COMPULSORY COURSES ACCORDING TO THE AREAS OF SPECIALIZATION

Probability/Statistics	Pure Mathematics	Applied Mathematics
	Compulsory Courses from other Department (a) PHY 103 Pysics for Mathematicians	**Compulsory Courses from other Department** (a) PHY 103 Pysics for Mathematicians
Compulsory Courses within the Department a) MAS 350 Stochastic Processes b) MAS 361 Probability II c) MAS 362 Statistics II d) MAS 451 Linear Models I e) MAS 454 Non-Parametric Statistics f) MAS 458 Statistical Data Analysis g) MAS 321 Introduction to Algebra or one course from the list MAS (Pure) A or one course from the list MAS (Pure) B.	**Compulsory Courses within the Department** a) MAS 321 Introduction to Algebra b) One course from the list MAS (Pure) A c) One course from the list MAS (Pure) B d) Two courses from the list MAS(Stat)	**Compulsory Courses within the Department** a) Two courses from the list MAS (Applied) A b) Two courses from the list MAS (Applied) B c) Two courses from the list MAS (Statistics) d) MAS 321 Introduction to Algebra or one course from the list e) MAS (Pure) A or one course from the list MAS (Pure) B.

Notes:

MAS (APPLIED) A	=	(a)	MAS 303 Partial Differential Equations
		(b)	MAS 304 Functional Analysis
		(c)	MAS 371 Numerical Analysis II
MAS (APPLIED) B	=	(a)	MAS 403 Ordinary Differential Equations II
		(b)	MAS 420 Approximation Theory
		(c)	MAS 471 Numerical Solution of Ordinary Differential Equations
		(d)	MAS 472 Numerical Solution of Partial Differential Equations
		(e)	MAS 473 Introduction to the Finite Element Method
		(f)	MAS 481 Applied Mathematical Analysis
		(g)	MAS 482 Classical Mechanics
		(h)	MAS 483 Fluid Dynamic
MAS (PURE) A	=	(a)	MAS 303 Partial Differential Equations
		(b)	MAS 304 Functional Analysis
		(c)	MAS 401 Measure Theory and Integration
		(d)	MAS 418 An Introduction to Fourier Analysis
MAS (PURE) B	=	(a)	MAS 426 Galois Theory
		(b)	MAS 431 Introduction to Differentiable Manifolds
		(c)	MAS 432 Introduction to Riemannian Geometry
		(d)	MAS 433 Topology
MAS(STAT)	=	(a)	MAS 350 Stochastic Processes
		(b)	MAS 361 Probability II
		(c)	MAS 362 Statistics II
		(d)	MAS 451 Linear Models I
		(e)	MAS 454 Non-Parametric Statistics
		(f)	MAS 458 Statistical Data Analysis

Table C1: Pure Mathematics-Indicative Programme of Studies			
Semesters	**Courses Code and Title**	**ECTS**	**Total ECTS/Semester**
	MAS 121 Linear Algebra I	8	
1st Semester	MAS 131 Basic Mathematics I	7	
	MAS 133 Sets and Algebraic Structures	7	
	CS 031 Introduction to Programming	7	29
2nd Semester	MAS 101 Calculus I	8	
	MAS 122 Linear Algebra II	8	
	MAS 132 Basic Mathematics II	7	
	MAS 191 Mathematics with Computers	8	31
	MAS 102 Calculus II	8	
3rd Semester	MAS 201 Multivariable Differential Calculus	7	
	MAS 261 Probability I	7	
	MAS 271 Numerical Analysis I	7	29
4th Semester	MAS 202 Multivariable Integral calculus	7	
	MAS 203 Ordinary Differential Equations	7	
	MAS 262 Statistics I	7	
	Foreign Language Course I – LAN100	5	
	Elective Course from other departments	5	31
5th Semester	MAS 301 Real Analysis	8	
	MAS 321 Introduction to Algebra	7	
	MAS 331 Classical Differential Geometry	7	
	MAS (PURE) A	7	29
6th Semester	MAS 302 Complex Variables I	7	
	MAS (PURE) B	7	
	MAS (STAT)	7	
	Foreign Language Course II – LAN101	5	
	PHY 103 Physics for Mathematicians	5	31
7th Semester	MAS (STAT)	7	
	MAS XXX Restricted Elective Course within the Department	7	
	MAS XXX Restricted Elective Course within the Department	7	
	Free Elective Course from other departments (2 courses) *or* MAS XXX Restricted Elective Course within the Department*	8	29
8th Semester	MAS XXX Restricted Elective Course within the Department	7	
	MAS XXX Restricted Elective Course within the Department	7	
	MAS XXX Restricted Elective Course within the Department	7	
	Free Elective Course from other departments	5	
	Free Elective Course from other depart	5	31
	Total ECTS		**240**

Explanations:

MASXXX	=	Elective Course within the Department as identified at the beginning of the beginning of this prospectus
*	=	Elective Course from other departments (2courses) or MAS XXX or MASXXX + free elective from other departments (based on the rules and regulations for the free elective courses of the UOC) or MASXXX+MASXXX. The total ECTS for this must be at least 8 ects.
MAS(PURE)A	=	a) MAS 303 Partial Differential Equations b) MAS 304 Functional Analysis c) MAS 401 Measure Theory and Integration d) MAS 418 An Introduction to Fourier Analysis
MAS(PURE)B	=	a) MAS 426 Field Theory b) MAS 431 Introduction to Differentiable Manifolds c) MAS 432 Introduction to Riemannian Geometry d) MAS 433 Topology
MAS(STAT)	=	a) MAS 350 Stochastic Processes b) MAS 361 Probability II c) MAS 362 Statistics II d) MAS 451 Linear Models I e) MAS 454 Non-Parametric Statistics f) MAS 458 Statistical Data Analysis
Note: The same course may not be used to fulfil multiple requirements of a specialization.		

TABLE C2: Applied Mathematics – Indicative Programme of Studies			
Semester	**Courses Code and Title**	**ECTS**	**Total ECTS/Semester**
	MAS 121 Linear Algebra I	8	
1st Semester	MAS 131 Basic Mathematics I	7	
	MAS 133 Sets and Algebraic Structures	7	
	CS 031 Introduction to Programming	7	29
2nd Semester	MAS 101 Calculus I	8	
	MAS 122 Linear Algebra II	8	
	MAS 132 Basic Mathematics II	7	
	MAS 191 Mathematics with Computers	8	31
	MAS 102 Calculus II	8	
3rd Semester	MAS 201 Multivariable Differential Calculus	7	
	MAS 261 Probability I	7	
	MAS 271 Numerical Analysis I	7	29
4th Semester	MAS 202 Multivariable Integral calculus	7	
	MAS 203 Ordinary Differential Equations	7	
	MAS 262 Statistics I	7	
	Foreign Language Course I – LAN100	5	
	Elective Course from other departments	5	31
5th Semester	MAS 301 Real Analysis	8	
	MAS 331 Classical Differential Geometry	7	
	MAS (APPLIED) A	7	
	MAS (PURE)	7	29
6th Semester	MAS 302 Complex variables I	7	
	MAS (STAT)	7	
	MAS (APPLIED) B	7	
	Foreign Language Course II – LAN101	5	
	PHY 103 Physics for Mathematicians	5	31
7th Semester	MAS (STAT)	7	
	MAS (APPLIED) A	7	
	MAS (APPLIED) B	7	
	Elective Course from other departments (2 courses) or MASXXX Elective course within the Department*	8	29
8th Semester	MAS XXX Elective course within the Department	7	
	MAS XXX Elective course within the Department	7	
	MAS XXX Elective course within the Department	7	
	Elective Course from other departments	5	
	Elective Course from other departments	5	31
	Total ECTS		**240**

Explanations:

MASXXX	=	Elective Course within the Department as identified at the beginning of the beginning of this prospectus
*	=	Elective Course from other departments (2courses) or MAS XXX or MASXXX + free elective from other departments (based on the rules and regulations for the free elective courses of the UOC) or MASXXX+MASXXX. The total ECTS for this must be at least 8 ects.
MAS(PURE)	=	MAS 321 Introduction to Algebra *or* MAS (PURE) A *or* MAS (PURE) B
MAS(PURE)A	=	a) MAS 303 Partial Differential Equations b) MAS 304 Functional Analysis c) MAS 401 Measure Theory and Integration d) MAS 418 An Introduction to Fourier Analysis
MAS(PURE)B	=	a) MAS 426 Field Theory b) MAS 431 Introduction to Differentiable Manifolds c) MAS 432 Introduction to Riemannian Geometry d) MAS 433 Topology
MAS(APPLIED)A	=	a) MAS 303 Partial Differential Equations b) MAS 304 Functional Analysis c) MAS 371 Numerical Analysis II
MAS(APPLIED)B	=	a) MAS 403 Ordinary Differential Equations II b) MAS 420 Approximation Theory c) MAS 471 Numerical Solution of Ordinary Differential Equations d) MAS 472 Numerical Solution of Partial Differential Equations e) MAS 473 Introduction to the Finite Element Method f) MAS 481 Applied Mathematical Analysis g) MAS 482 Classical Mechanics h) MAS 483 Fluid Dynamics
MAS(STAT)	=	a) MAS 350 Stochastic Processes b) MAS 361 Probability II c) MAS 362 Statistics II d) MAS 451 Linear Models I e) MAS 454 Non-Parametric Statistics f) MAS 458 Statistical Data Analysis
Note: The same course may not be used to fulfil multiple requirements of a specialization.		

TABLE C3: Probability/Statistics – Indicative Programme of Studies			
Semester	**Courses Code and Title**	**ECTS**	**Total ECTS/Semester**
1st Semester	MAS 121 Linear Algebra I	8	
	MAS 131 Basic Mathematics I	7	
	MAS 133 Sets and Algebraic Structures	7	
	CS 031 Introduction to Programming	7	29
2nd Semester	MAS 101 Calculus I	8	
	MAS 122 Linear Algebra II	8	
	MAS 132 Basic Mathematics II	7	
	MAS 191 Mathematics with Computers	8	31
	MAS 102 Calculus II	8	
3rd Semester	MAS 201 Multivariable Differential Calculus	7	
	MAS 261 Probability I	7	
	MAS 271 Numerical Analysis I	7	29
4th Semester	MAS 202 Multivariable Integral Calculus	7	
	MAS 203 Ordinary Differential Equations	7	
	MAS 262 Statistics I	7	
	Foreign Language Course I – LAN100	5	
	Elective Course from other departments	5	31
5th Semester	MAS 301 Real Analysis	8	
	MAS 331 Classical Differential Geometry	7	
	MAS 350 Stochastic Processes	7	
	MAS 261 Probability I	7	29
6th Semester	MAS 302 Complex Variables I	7	
	MAS 362 Statistics II	7	
	MAS 458 Statistical Data Analysis	7	
	Foreign Language Course II – LAN101	5	
	Elective Course from other departments	5	31
7th Semester	MAS 454 Non-Parametric Statistics	7	
	MAS 451 Linear Models I	8	
	MAS(PURE)	7	
	MAS XXX Restricted elective course within the Department	7	29
8th Semester	MAS XXX Restricted elective course within the Department	7	
	MAS XXX Restricted elective course within the Department	7	
	MAS XXX Restricted elective course within the Department	7	
	Free elective course from other departments	5	
	Free elective course from other departments	5	31
	Total ECTS		**240**

Explanations:

MASXXX	=	Elective Course within the Department as identified at the beginning of the beginning of this prospectus
MAS(PURE)	=	MAS 321 Introduction to Algebra *or* MAS (PURE) A *or* MAS (PURE) B
MAS(PURE)A	=	a) MAS 303 Partial Differential Equations b) MAS 304 Functional Analysis c) MAS 401 Measure Theory and Integration d) MAS 418 An Introduction to Fourier Analysis
MAS(PURE)B	=	a) MAS 426 Field Theory b) MAS 431 Introduction to Differentiable Manifolds c) MAS 432 Introduction to Riemannian Geometry d) MAS 433 Topology
Note: The same course may not be used to fulfil multiple requirements of a specialization.		

COURSCES DESCRIPTION

A. COURSE DESCRIPTION FOR STUDENTS OF THE DEPARTMENT OF MATHEMATICS AND STATISTICS

MAS101 - Calculus I (8 ects)
Fundamental properties of real numbers. Sup and Inf of a set and its basic properties. Sequences, its limits, properties of converging sequences. Subsequences. Nested interval principle. Functions and their limits. Sequential approach to limits of functions. Continuity of functions. Intermediate value Theorem and Existence of Extreme values Theorem. Uniform Convergence. Derivatives, basic results. Mean value Theorem and its variations. Continuity and derivative of Inverse function. Graph of a function. L'Hôpital's Rule.

MAS102 - Calculus II (8 ects)
Required basic knowledge: MAS101
Partitions, upper and lower sums, Riemann integral on a closed interval. Basic existence theorems of integrals. Computation of volumes and areas. The Fundamental Theorems of Calculus, generalised integrals. Logarithmic and exponential functions. Basic methods of integration, integration by parts, substitution, induction formulas, integration of rational functions. Taylor's formula, computation of Taylor's formula for various basic functions. Approximation of smooth functions by polynomials, the irrationality of e. Series, comparison test, Cauchy's criterion, ratio test, nth root test, integral test, absolutely and conditionally convergent series, Leibniz's Theorem for alternating series, Abel's and Dirichlet's criteria, products of series.

MAS121 – Linear Algebra I (8 ects)
The algebra of matrices, invertible matrices. Reduced echelon form of a matrix and linear systems of equations. Vector spaces, base, dimension. Linear maps, matrix of a linear map, change of basis matrix, rank of a matrix. Determinants. The set of solutions of a linear system. Eigenvalues, eigenvectors and eigenspaces.

MAS122 – Linear Algebra II (8 ects)
Polynomial Ring. Characteristic polynomial, diagonalization, applications. Cayley-Hamilton theorem, minimal polynomial. Invariant subspaces, generalized eigenspaces. Primary decomposition theorem. Nilpotent endomorphisms, Jordan canonical form. Inner-product spaces, Gram-Schmidt method. Special matrices and their properties.

MAS131 – Basic Mathematics I (7 ects)
Functions and limits. Differentiation. Applications of differentiation, graphs, optimization problems. Integration (indefinite, definite and improper integrals), techniques of integration. Applications of integration (areas of domains in the plane, volumes of solids, arc lengths of curves and areas of surfaces of revolution). Differential equations. Complex numbers.

MAS132 – Basic Mathematics II (7 ects)
Analytic Geometry in R2: Vectors, inner product, length, distance between points. Equation for a line, tangent, vertical line to a curve. Circles, ellipses, parabolas, hyperbolas. Analytic Geometry in R3: Vectors, algebraic, geometric properties. Inner product, length, distance between points. Equation for a line (parametric-vector, cartesian format), distance of a point to a line. Regions in Euclidean space. Functions: Curves in the plane, regions between curves, curve intersections. Graphs of functions in R3, analytically and implicitly defined. Solids bounded by surfaces and intersections of surfaces. Transformations: Linear transforms, linear independence and geometric interpretation of determinant. Geometric transforms (translation, rotation, reflection, orthogonal transforms). Polar, cylindrical and spherical coordinates and regions defined in these coordinates. Curves: Curve parametrization in R2 and R3. Velocity, acceleration and tangent line. Arc length. Differentiation: Partial derivatives of multivariable functions. Tangent plane and linear approximation. Gradient and directional derivative. Integration: Double integrals over rectangles and general regions of R2.

MAS133 - Sets and Algebraic Structures (7 ects)
Set Theory: Sets, subsets. Set operations, complement, De Morgan's laws, power set. Cartesian product. Relations, equivalence relations (equivalence classes modulo m, projective space, rational numbers). Venn diagrams. Elements of propositional logic (quantifiers, negation, truth diagrams). Functions: Image of a set, inverse image. Inverse function. Composition of functions, graphs. Sets of functions. Countable sets, uncountable sets. Diagonal procedure. Reductio ad absurdum and Mathematical Induction. Well Ordering Principle and Principle of Mathematical Induction. Examples from Number Theory and other areas of mathematics for understanding the procedure for proving a statement using these methods. Number Theory: Divisibility. Greatest common factor and least common multiple. Euclidean algorithm. Fundamental Theorem of Arithmetic. Applications to polynomials. Introduction to Algebraic Structures: Binary operations. Closure of operations. Properties of closed operations. Examples (composition of functions, matrix multiplication, inverse, congruence classes). Subgroups, groups (examples from cyclic groups (complex unit roots), symmetric group). The group (Zn , +) as a quotient. Rings, fields and solving first order equations ax = b.

MAS191 – Mathematics with computers (8 ects)
MATLAB's environment. MATLAB functions. For, while and if loops. Graphics in two and three dimensions. Programming. Polynomials. Reading from and writing in files. Computer arithmetic and error propagation. Symbolic computing. Special topics and applications (solution of nonlinear algebraic equations and linear systems, eigenvalue problems, numerical integration, ordinary differential equations).

MAS201 - Multivariable Differential Calculus (7 ects)
Normed spaces: examples, Rn, equivalent norms, Cauchy-Schwartz inequality. Open and closed sets. Compactness (Heine-Borel, Bolzano- Weierstrass Theorems). Scalar and vector valued functions. Limits and continuity. Partial derivatives. Differentiability Criterion. Multivariable functions: gradient, differential, directional derivative, vector fields, divergence, curl, Laplacian operator. Vector functions of one variable: derivatives, arc length, change of parameter. Differentiation rules, chain rule, etc. Mean value Theorem. Derivatives of integrals with respect to a parameter. Taylor's Theorem. Local extrema, conditional extrema (Lagrange multipliers). Inverse and implicit function Theorems.

MAS202 - Multivariable Integral calculus (7 ects)
Integrable functions and sets, properties. Fubini's Theorem. Iterated integrals for continuous functions over a compact set (scalar functions over regions of the type $Q = I1 \times I2 \times I3 \ldots \times In$). Change of variables Theorem for linear and C1-invertible transformations. Computation of volumes, Cavalieri's principle, examples such as the sphere, cylinder and cone. Convergence theorems (interchanging limits and integrals). Transform Theorem (without proof), applications. Parametrized surfaces, partition of unity. Surface and line integrals, computing the area of a surface. Differential forms, Stokes' Theorem (Green, Gauss, Stokes), applications.

MAS203 - Ordinary Differential Equations I (7 ects)
Separable ODEs. First order ODEs and integrating factors. Picard-Lindelöf theorem. Second order ODEs with constant coefficients. The method of undetermined coefficients and the method of variation of parameters. Systems of first order ODEs.

MAS222 – Number Theory (7 ects)
Divisibility, Euclidean algorithm, linear Diophantine equations. Prime numbers and the fundamental theorem of arithmetic. Congruences and the Chinese remainder theorem. Fermat's and Wilson's theorems. Arithmetic functions and perfect numbers. Euler's theorem. Quadratic Reciprocity. Pell's equation and continued fractions.

MAS261- Probability I (7 ects)
Counting methods, combinatorics, probability measure space though σ-algebras, independence of events, random variables, cumulative distribution function, discrete and continuous random variables, mean value, multivariable distributions, multivariable normal distribution, sums of random variables, distributions of functions of random variables, covariance function, independence of random variables

through the cumulative distribution function, moment generating function, characteristic function, introduction to the law of large numbers, introduction to the central limit theorem.

MAS262 - Statistics I (7 ects)
Random samples, statistical experiments, statistics, estimation methods (e.g., method of moments, method of maximum likelihood), properties of estimators (e.g., unbiasedness, sufficiency, completeness), exponential families, Rao-Blackwell theorem, Lehmann-Scheffe theorem, Cramer-Rao variance lower bound, confidence intervals, minimum length confidence intervals, hypotheses testing, properties of tests.

MAS271 – Numerical Analysis I (7 ects)
Sources and propagation of error. Numerical solution of non-linear equations. Numerical solution of linear systems of equations. Polynomial interpolation. Numerical quadrature.

MAS301 - Real Analysis (8 ects)
Metric spaces, Normed spaces. Examples. Open and closed sets, interior and closure of a set. Accumulation points and the derived set. The Bolzano-Weierstrass Theorem. Convergence of sequences in metric spaces. Cauchy sequences. Complete metric spaces. The fixed point theorem. Compact sets in metric spaces. The Heine-Borel Theorem. Compact metric spaces. Continuous functions. Continuous and uniformly continuous functions. Continuity and compactness. Sequences and series of functions. Uniform convergence. Uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation. The metric of uniform convergence. Sufficient conditions for uniform convergence of a series of functions.

MAS302 - Complex variables I (7 ects)
Complex numbers, analytic functions, Cauchy-Riemann equations. Harmonic functions. Exponential, trigonometric and logarithmic functions. Integration, Cauchy's theorem, Cauchy's integral formulas and inequalities. Liouville theorem and the fundamental theorem of Algebra. Maximum modulus principle. Taylor and Laurent series, residues. The argument principle. Conformal mappings and Mobius transformations.

MAS303 - Partial Differential Equations (7 ects)
1st order PDEs, Non-linear 1st order PDEs, Linear PDEs of 2nd order, Elliptic, Parabolic, Hyperbolic PDEs, Separation of variables, Fourier series.

MAS304 - Functional Analysis (7 ects)
Metric and normed linear spaces, examples, series, Schauder bases, bounded linear operators, linear functionals, dual spaces. Inner product spaces, orthogonality, orthonormal sets, Bessel's inequality, Hilbert spaces, projections, orthogonal complements. Riesz Representation Theorem, orthonormal bases. Zorn's Lemma, Hahn-Banach Theorem with applications, the Principal of Uniform Boundedness with applications, the Open Mapping Theorem with applications, the Closed Graph Theorem with applications.

MAS321 - Introduction to Algebra (7 ects)
Groups, permutations and symmetric groups, cyclic groups. Subgroups and the Theorem of Lagrange. Homomorphisms and Quotient groups. Rings, integral domains and fields. Homomorphisms, ideals and quotient rings. Polynomial rings, divisibility in polynomial rings, prime and maximal ideals. Finite fields and field extensions.

MAS331 - Classical Differential Geometry (7 ects)
The Euclidean space Rn: inner product, Cauchy-Schwarz inequality, isometries. Curves in Rn: parametized cuves, length, periodic, closed cuvres. Curves in R2: curvature, Frenet equalities, winding number, isoperimetric inequality, Hopf Theorem. Curves in R3: curvature, torsion, Frenet equalities, Fundamental theorem. Surfaces in R3: regular surfaces, local parametrization, examples. Differentiable maps between surfaces, tangent space, total differential. First fundamental form, orientation, Gauss map, second fundamental form, principal curvatures, curvature lines, normal curvature, Gauss curvature, mean curvature. Integration on surfaces. Ruled, minimal surfaces, surfaces of revolution. Isometric (locally

isometric) surfaces, Christoffel symbols, Theorema Egregium (Gauss). Parallel vector fields, geodesics, geodesic curvature. Gauss-Bonnet Theorem.

MAS350 - Stochastic Processes (7 ects)
Stochastic process, stationary processes, stopping times. Markov chains, Poisson processes, Brownian motion.

MAS361 -Probability II (7 ects)
Review of basic elements from MAS 261. Stochastic independence through σ-algebras, Borel-Cantelli lemmas, Kolmogorov 0-1 laws, mean value as Lebesgue integral, basic inequalities, convergence of sequences of random variables, convergence of series of random variables, laws of large numbers, central limit theorems, conditional probability, conditional mean value, introduction to martingales, central limit theorem for martingales.

MAS362 Statistics II (7 ects)
Asymptotic properties of estimators, asymptotic efficiency, asymptotic normality, introduction to statistical decision theory (minimax estimators, Bayes estimators), asymptotic properties of tests, optimal tests, goodness-of-fit tests, tests of independence. U-statistics.

MAS371 - Numerical Analysis II (7 ects)
Brief revision of the theory of eigenvalues and eigenvectors. Positive definite matrices. Vector and matrix norms. Iterative methods for the solution of linear systems. Gershgorin bounds for eigenvalues. Numerical methods for eigenvalues and eigenvectors. Lagrange interpolation. Hermite interpolation. Divided differences at repeated points. The Newton form of the Hermite interpolation polynomial. Orthogonal polynomials. Gaussian quadrature.

MAS401 - Measure Theory and Integration (7 ects)
General revision: Sets, orderings, cardinality, metric spaces. Measures: Algebras and σ-algebras, additive and σ- additive measures, outer measures, Borel measures on the real line. Integration: measurable functions, integration of positive functions, integration of complex valued functions, Convergence Theorems, modes of convergence, product measures, the n – dimensional Lebesgue integral, integration in polar coordinates, signed measures, the Radon – Nikodym theorem, complex measures, differentiation on Euclidean space, functions of bounded variation. Lp Spaces: The basic theory, the dual of Lp, the useful inequalities, the distribution function, weak – Lp spaces, interpolation.

MAS402 - Complex Analysis II (7 ects)
Compactness and convergence in the space of analytic functions. The space of meromorphic functions. Riemann mapping theorem. Weierstrass Theorem on entire functions, analytic continuation. Elliptic functions. Riemann surfaces.

MAS403 - Ordinary Differential Equations II (7 ects)
Boundary Values Problems. Sturm-Liouville type problems. Asymptotic behaviour of nonlinear systems of ODEs: Stability. Perturbation Theory of systems of ODEs which possess periodic solutions. Perturbations of two-dimensional autonomous systems. Poincaré-Bendixson theory.

MAS418 - An Introduction to Fourier Analysis (7 ects)
Periodic functions, trigonometric polynomials, trigonometric series. Fourier series. Convergence of Fourier series. Bessel's inequality. Completness, Parseval's Theorem. The Riemann-Lebesgue Lemma. Dirichlet's Theorem. Gibbs phenomenon. Differentiation and Integration of Fourier series. Cesaro and Abel summability of Fourier series. Fejer's Theorem. Poisson's Theorem. The Fourier transform and its properties. The inversion theorem and Plancherel's identity. The convolution and its properties. Applications to partial differential equations.

MAS419 - Special Topics In Mathematical Analysis (7 ects)
Depends on the special interest of the staff member teaching it.

MAS420 - Approximation Theory (7 ects)
Normed linear spaces and inner product spaces. Bounded linear operators. Fixed Point methods. Iterative methods for linear systems. Best approximation in normed linear spaces and inner product spaces. Orthogonal polynomials.

MAS422 - Introduction to Coding Theory (7 ects)
Introduction to finite fields. Vector spaces over finite fields. Linear codes. Encoding and decoding with a linear code. Syndrome decoding. Cyclic codes. Hamming codes.

MAS424 - Theory of Rings and Modules (7 ects)
Rings and ideals. Homomorphism Theorems. Unique factorisation domains and principal ideal domains. Factor rings. Prime and maximal ideals. R-modules and homomorphisms. Finitely generated R-modules. Noetherian rings.

MAS425 - Group Theory (7 ects)
Normal subgroups, homomorphism theorems. Direct and semidirect products. Group actions. Normalizers and centralizers. Sylow theorems and p-groups. Simple groups. Finitely generated Abelian groups. Composition series and Jordan – Hölder theorem. Soluble groups.

MAS426 - Galois Theory (7 ects)
Rings, ideals, polynomial rings. Fields, field extensions, algebraically closed fields, finite fields. Normal extensions and Galois extensions. The fundamental theorem of Galois theory. Solutions of equations by radicals, ruler and compass constructions.

MAS427 – Group Representation Theory (7 ects)
Representations. FG - modules, FG - submodules, FG - homomorphisms. Maschke's Theorem and Schur's Lemma. Irreducible modules. The group algebra, the centre of the group algebra. Characters, relation between characters and representations.

MAS429 - Topics In Algebra (7 ects)
Depends on the special interest of the staff member teaching it.

MAS431 - Introduction to Differentiable Manifolds (7 ects)
Differentiable manifolds. Tangent space. Partition of unity. Sards Theorem. Vector fileds, flows. Frobenius theorem. Differential forms. Theorem of Stokes. Theorem of de Rham.

MAS432 - Introduction to Riemannian Geometry (7 ects)
Introduction to manifolds, tangent spaces and vector fields. Riemannian manifolds. Connections, geodesics, exponential map, normal coordinates, Gauss' Lemma. Hopf-Rinow Theorem. Curvature. Jacobi fields. Theorems of Bonnet-Myers, Synge-Weinstein and Hadamard-Cartan.

MAS433 – Topology (7 ects)
Topological spaces, continuous functions, connected and compact sets, product spaces, the Tychonoff theorem, separation axioms, metric spaces. Homotopy, the fundamental group, the Seifert Van Kampen Theorem, Covering spaces.

MAS434 - Introduction to Algebraic Topology (7 ects)
Homology, Cohomology. CW complexes. Homology and Cohomology of product spaces, the Eilenberg Zielber theorem and the Kunneth formula. The cohomology ring. Cup product. Poincare duality. Applications: Homology and cohomology of compact surfaces, the Jordan Brouwer separation theorem, invariance of domain.

MAS439 - Introduction to Algebraic Geometry (7 ects)
Depends on the special interests of the staff member teaching it.

MAS451 - Linear Models I (8 ects)
Simple linear regression model: estimation, confidence intervals, hypothesis testing. Multiple linear regression model: estimation, confidence intervals, hypothesis testing. Goodness of fit, residual analysis and model selection. One and two-way ANOVA.

MAS452 - Linear Models II (7 ects)
Analysis of variance with one or more fixed-effects, Analysis of variance with one or more random factors, analysis of covariance. Generalized linear models: estimation in some examples, logistic regression, asymptotic properties of estimators.

MAS454 - Non-Parametric Statistics (7 ects)
Distribution function estimation, probability density function estimation, regression function estimation, applications in R.

MAS455 – Sampling Theory (7 ects)
Sampling scheme design. Simple random sampling, stratified, systematic, cluster sampling, multistage sampling. Mean and variance estimation, ratio estimators, linear regression estimators, optimal choice of sample size, bias in survey methodology.

MAS456 – Time Series (7 ects)
Stationary processes, autocovariance function, spectral density, linear processes, ARMA processes, non-linear processes, ARCH and GARCH processes. Estimation of the mean and of the autocovariance function. Moment estimators, least squares estimators and maximum likelihood estimators of parameters. Asymptotic properties.

MAS458 - Statistical Data Analysis (7 ects)
Introduction to R, diagnostic statistics, simulation methods, Markov chain Monte-Carlo, simulation, optimization, resampling.

MAS459 - Multivariate Analysis (7 ects)
Multivariable distributions. Mean vector and covariance matrix estimation. Wishart distribution. Principal components, canonical correlation, cluster and discriminant analysis. Testing hypothesis in many dimensions.

MAS466 - Survival Analysis (7 ects)
Censored data, Truncated data. Survival function and hazard function. Nonparametric estimation of the survival function and the hazard function. Parametric models for the hazard function. Counting processes and martingales. Semiparametric Cox model. Tests for one or more populations, tests of class-K.

MAS468 - Topics in Probability and Statistics I (7 ects)
Topics from combinatorial theory, topics for sampling theory, topics from data analysis, classical problems from probability with applications to computer science, topics from design of experiments, Chi-square tests.

MAS469 - Topics in Probability and Statistics II (7 ects)
Stochastic processes/ fields, sample path properties, the notions of stationarity and ergodicity, covariance functions, variograms, spectra, predictions method, kriging.

MAS471 - Numerical Solution of Ordinary Differential Equations (7 ects)
Brief revision of initial and boundary value problems for ordinary differential equations. Stability of initial and boundary value problems for difference equations. One-step methods for initial value problems. Runge-Kutta methods. Multistep methods for initial value problems. Shooting methods and finite difference for boundary value problems.

MAS472 - Numerical Solution of Partial Differential Equations (7 ects)
Brief revision of initial/boundary and boundary value problems for partial differential equations. One-dimensional parabolic equations. Explicit method, implicit method and Crank-Nicolson method. Stability analysis. Two-dimensional parabolic equations. Hyperbolic equations. CFL condition. The Wendroff, Lax-Wendroff and leap frog methods. Explicit and implicit methods for the one dimensional wave equation. Elliptic equations. The five-point and nine-point methods for the Poisson equation. Non-rectangular regions. Robin boundary conditions.

MAS473 – Introduction to the Finite Element Method (7 ects)
Variational formulation of elliptic problems. Methods of Galerkin and Ritz. Basis functions and discretization. Error bounds. Applications and examples. Finite elements for parabolic equations.

MAS481 – Applied Mathematical Analysis (7 ects)
Calculus of variations. Laplace transforms. Fourier analysis. Special functions. Integral equations.

MAS482 - Classical Mechanics (7 ects)
Newton's laws. Central forces. Moving coordinate systems. Kepler's laws. Systems of particles. Plane motion of rigid bodies. Space motion of rigid bodies. Lagrange's equations.

MAS483 - Fluid Dynamics (7 ects)
Introduction to vector and tensor calculus. Continuity and momentum equations in various coordinate systems. Laminar incompressible flows amenable to analytical solution. Steady-state and transient flows and applications. Streamfunction and Stokes flow. Boundary layer. Non-Newtonian flows.

MAS484 - Introduction to mathematical modelling (7 ects)
Emphasis is given on the role of mathematical modeling as a tool for learning and understanding mathematical techniques. The applications come from various disciplines, such as discrete dynamical systems, graphs and networks, and linear programming. In this course various software packages are used extensively.

MAS487 - Special Topics in Applied Mathematics I (7 ects)
Depends on the special interest of the staff member teaching it.

MAS488 - Special Topics in Applied Mathematics II (7 ects)
Depends on the special interest of the staff member teaching it.

MAS499 - Independent Study (7 ects)
In depth study of a research topic with sufficient elements of initiative, self-study, and originality under the guidance of a member of the academic staff

MAS501, MAS502, MAS503 - Work Placement I, II, III (one course per month of work) (1 ects each)
Work placement, the responsibilities will be assigned by the hosting institution under the supervision of the academic supervisor.

MAS510 – Diploma Project I (7 ects)
In depth study of a research topic with sufficient elements of initiative, self-study and originality under the guidance of a member of the academic staff

MAS511 – Diploma Project II (7 ects)
In depth study of a research topic with sufficient elements of initiative, self-study and originality under the guidance of a member of the academic staff

MAS512 – Summer Research Project (0 ects)
At the completion of the 2nd year of study, students may enroll in an undergraduate research project.

MAS857, MAS858 - Methods for Solving Mathematical Problems (4 ects)
The course is intended for undergraduate students who are interested in solving mathematical problems and at the same time aims to prepare students participating in mathematical Olympiads. This course will be different from the other courses of the Department which are focusing on a specific area of mathematics. Emphasis will be on problem-solving techniques, cultivation of creative thinking. and successful presentation of solutions.

Course Descriptions for other Departments

MAS001 - Mathematics | (6 ects)
Introduction: Real numbers – Inequalities – Absolute value – Equation of a straight line, circle and parabola, Functions: Kinds of functions – Graph of a function – Inverse function – inverse trigonometric functions – Exponential and Logarithmic functions, Limit and Continuity:Limit of a function – Continuity of a function - Intermediate-Value Theorem –Limits and Continuity trigonometric, Exponential and Logarithmic functions, The Derivative: The derivative function – techniques of differentiation – Implicit differentiation- differentiation of inverse function – parametric equations, Applications of the Derivative:Increasing and decreasing functions – Relative extrema – Absolute extrema - Graphing of a function – Newton's method – Rolle's theorem – Mean value theorem, Integration: The indefinite integral – the definite integral – the fundamental theorem of calculus – Average value of a function, Principles of integral evaluation: Integration by parts – integration by substitution – integration of rational functions by partial fractions

MAS002 - Mathematics || (6 ects)
Applications of integrals: Area between two curves – volumes by slicing- volumes by cylindrical shells– length of a plane curve – area of surface revolution, Improper integrals: L' Hopital rules, Sequencies, Infinite series: Convergence tests – alternating series, Power series: Maclaurin and Taylor series – convergence – differentiation and integration of power series, Differential equations: First order differential equations – Second order linear differential equations, Linear Algebra: Systems of linear systems – Matrices -Determinants – Vectors – Vector spaces – Eigenvalues and eigenfunctions

MAS003 - Course Title Complex Analysis for Physicist (7,5 ects)
Complex Numbers, analytic (holomorphic) functions and Cauchy-Riemann equations. Harmonic functions. Exponential, logarithmic and trigonometric functions Integrals, Cauchy Theorem. Cauchy integral formula. Morera and Liouville's Theorems. Maximum principle. Fundamental Theorem of Algebra. Taylor and Laurent series. Residue calculus Conformal mappings and Mobius transformations. Applications to problems from physics and engineering.

MAS007 - History Of Mathematics (5 ects)
The understanding of infinite and the destiny of Cantor. Foundations: Lost and Found. Prime Number Theorem and Riemann Hypothesis. Roots of equations: The search for a non-existent formula. Archimedes, Newton and Gauss. The mathematics of ancient Greeks. The non-existent "Nobel Prize in Mathematics" and other prizes. Recent sensational developments.

MAS012 - Calculus for Computer Scientists I (5 ects)
Introductory notions. Functions. Limits and Continuity. Derivatives and applications. Integrals. Indefinite and definite integrals. Fundamental theorems of Calculus. Integration techniques.

MAS013 - Calculus for Computer Scientists II (5 ects)
Power series, Taylor and Maclaurin Series, Analytic functions, Indefinite and definite integrals, Geometric applications, Area, Volume Length of a curve, Improper integrals.

MAS018 - Introductory Mathematics I (5 ects)
Introduction: Real numbers – Inequalities – Absolute value – Equation of a straight line, circle and parabola, Functions: Kinds of functions – Graph of a function – Inverse function – inverse trigonometric functions – Exponential and Logarithmic functions, Limit and Continuity: Limit of a function – Continuity of a function - Intermediate-Value Theorem – Limits and Continuity trigonometric, Exponential and Logarithmic functions, The Derivative: The derivative function – techniques of differentiation – Implicit differentiation- differentiation of inverse function – parametric equations, Applications of the Derivative: Increasing and decreasing functions – Relative extrema – Absolute extrema - Graphing of a function – Newton's method – Rolle's theorem – Mean value theorem, Integration: The indefinite integral – the definite integral – the fundamental theorem of calculus – Average value of a function, Principles of integral evaluation: Integration by parts – integration by substitution – integration of rational functions by partial

fractions, Applications of integrals, Area between two curves – volumes by slicing- volumes by cylindrical shells – length of a plane curve – area of surface revolution, Improper integrals, L' Hopital rules,
Sequencies, Infinite series: Convergence tests – alternating series, Power series: Maclaurin and Taylor series – convergence – differentiation and integration of power series

MAS019 - Introductory Mathematics II (5 ects)
VECTORS: Rectangular coordinates in 3-space – Vectors – Dot product – Cross product – parametric equations of a line – planes in 3-space -Cylindrical and spherical coordinates, VECTOR-VALUED FUNCTIONS: Calculus of vector-valued functions – change of parameter – Arc length – Unit tangent and normal vectors – Curvature – Motion along a curve, FUNCTIONS OF TWO VARIABLES: Limits and continuity – partial derivatives – Differentiability – the chain rule – Directional derivative – Tangent planes – Maxima and minima of functions of two variables – Lagrange multipliers, LINEAR ALGEBRA: Systems of linear systems – Matrices -Determinants – Vectors – Vector spaces – Inner product spaces - Eigenvalues and eigenfunctions – Linear transformations

MAS020 – Introductory Mathematics II (Chemistry) (5ECTS)
Differential equations of first order – Linear differential equations of second order – Special forms of differential equations - Complex numbers and their properties – Polar and exponential forms –
Applications of complex numbers – Relations between trigonometric and hyperbolic functions – Functions of two variables – Limits and continuity – Partial derivatives – Maxima and minimum – Double integrals – Introduction to Linear Algebra - Systems of linear equations – Matrices – Determinants – Vectors – Vector spaces – Eigenvalues and Eigenvectors

MAS025 - Mathematics for Engineers I (5 ects)
The real number system. Complex numbers (definition, elementary operations). Sequences of real numbers and limits. Real functions of one variable, limits, continuity. Hyperbolic, trigonometric functions. Derivatives of functions of one variable, tangent to a curve. Applications of derivatives. Mean value theorem, monotonicity, extrema, asymptotes. L'Hôpital's rule. Riemannian integral.
Fundemental Theorem of Calculus. Indefinite integrals. Integration techniques (substitution, integration by parts, partial fractions, trigonometric substitution, etc). Applications of integrals, calculation of area, volume and length of a curve. Real number series. Convergence criteria. Power series. Series and Taylor's theorem.

MAS026 - Mathematics for Engineers II (5 ects)
Functions of many variables. Partial derivatives. Gradient, divergence, and curl. Curves. Double and triple integrals. Change of variables. Jacobians. Polar, cylindrical, and spherical coordinates. Line and surface integrals. Green, Stokes, and Gauss theorems. Applications.

MAS027 – Mathematics for Engineers III (5 ects)
Ordinary differential equations. Separable equations. Exact equations. Integrating factors. Solutions of linear and non-linear 1st order differential equations. 2nd order differential equations. Fundamental solutions of homogeneous equations. Non-homogeneous equations. Undetermined coefficients and variation of parameters. Series solutions. Applications of ordinary differential equations. Linear systems of differential equations. Laplace transforms.

MAS028 – Mathematics for CEE (5ects)
Introduction to Differential equations: Basic definitions. First order differential equations (Separable, homogeneous, linear, exact equations). Second order linear differential equations (Homogeneous equations with constant coefficients, non-homogeneous: method of undetermined coefficients, Euler equation). Calculus: Vector-valued functions (Calculus of vector-valued functions, arc length, unit tangent and normal vectors). Functions of two variables (Partial derivatives, chain rule, directional derivative and gradients, maxima and minima of functions of two variables). Multiple integrals (Double integrals, double integrals over nonrectangular regions, double integrals in polar coordinates, triple integrals). Line and surface integrals.

MAS029 - Linear Algebra elements (5 ects)
Linear spaces, linear independency, base, dimension, inner product spaces. Linear systems of equations, matrices, determinants, eigenvalues, eigenvectors. Gram-Schmidt normalisation. Introduction to Analytic Geometry.

MAS030 - Introduction to Probability and Statistics (5 ects)
Descriptive statistics, measures of central tendency and variation, probability, exponential families of distributions, point estimation, sufficiency, completeness, confidence intervals for the mean, for the variance, for the difference of two means, for the ratio of variances, hypothesis testing, null hypothesis, alternative hypothesis, type I and type II error, tests for the mean with large or small samples, tests for comparing means and variances, linear regression, analysis of variance.

MAS051 – Introductory Mathematics and Statistical Methods (5 ects)
Real numbers and their properties, factorization, fractions, equations of first and second orders, application of equations, linear inequalities, absolute values, sequences and sums, probability, urn models, survey sampling methods, data graphical representations, scale measurements, **c**enter, shape, and spread of distributions, measures of dispersion, hypothesis testing, confidence intervals, correlation (optional)**.**

MAS052-Mathematics for the Social Sciences (5 ects)
Review of Algebra **-** Sets of Real Numbers, Some Properties of Real Numbers, Exponents and Radicals, Operations with Algebraic Expressions, Factoring, Fractions, Linear Equations, Quadratic Equations. *Applications and More Algebra* - Applications of Equations, Linear Inequalities, Applications of Inequalities, Absolute Value, Summation Notation, Sequences. *Functions and Graphs* - Functions, Special Functions, Combinations of Functions, Inverse Functions, Graphs in Rectangular Coordinates, Symmetry, Translations and Reflections, Functions of Several Variables. *Lines, Parabolas, and Systems* - Lines, Applications and Linear Functions, Quadratic Functions, Systems of Linear Equations, Nonlinear Systems, Applications of Systems of Equations. *Exponential and Logarithmic Functions* - Exponential Functions, Logarithmic Functions, Properties of Logarithms, Logarithmic and Exponential Equations. *Matrix Algebra* - Matrices, Matrix Addition and Scalar Multiplication, Matrix Multiplication, Solving Systems by Gaussian Elimination, Inverses. *Linear Programming (optional)* - Linear Inequalities in Two Variables, Linear Programming, The Simplex Method, Artificial Variables, Minimization, The Dual Problem. *Introduction to Probability and Statistics* - Basic Counting Principle and Permutations, Combinations and Other Counting Principles, Sample Spaces and Events, Probability, Conditional Probability and Stochastic Processes, Independent Events, Bayes Formula. *Additional Topics in Probability* - Discrete Random Variables and Expected Value, The Binomial Distribution, Markov Chains. *Limits and Continuity* - Limits, Continuity, Continuity Applied to Inequalities. *Continuous Random Variables* - Continuous Random Variables, The Normal Distribution, The Normal Approximation to the Binomial Distribution

MAS055 - Introduction to Probability and Statistics (7 ects)
Probability, conditional probability, Bayes theorem, classical problems of probability (such as balls in bins, birthday problem), random variables, distributions (discrete and continuous), independence, expected values, applications (coupon collector's problem), probability inequalities (Jensen's inequality, Markov's inequality, Chebychev's inequality, Chernoff bounds), introduction to stochastic processes, Markov chains, applications, random walks, Poisson process, statistics, point estimation, confidence intervals, hypothesis testing, correlation, linear regression.

MAS061 - Statistical Analysis I (6 ects)
Descriptive Statistics, Probability (basic notions, conditional probability Bayes rule} Combinatorics, distributions, Central limit theorem, statistics, decision theory (confidence intervals, hypothesis testing, comparison between populations), etc.

POSTGRADUATE PROGRAMMES OF STUDY

Introduction

The postgraduate programme of studies was launched in September 1997. Since then, a number of postgraduate degrees have been awarded. At present, our Department offers 2 Master's Degree Programmes and 2 PhD programmes. The Master's degree in Data Science is offered jointly by the Department of Mathematics and Statistics, the Department of Business and Public Administration and the Department of Computer Science.

Diploma of Specialisation

- Master in Data Science
- Master in Mathematical Sciences

Doctoral Diploma

- PhD in Mathematics:
  - specialization in Applied Mathematics
  - specialization in Pure Mathematics
- PhD in Statistics

Admission to Postgraduate Programmes

The number of postgraduate students to be admitted is announced separately for each specific programme at the Master's or Doctorate level.

To apply for a Postgraduate Programme of Studies, an accredited university degree is required. It is expected that by the end of the week preceding the registration week the applicants will have obtained their accredited university degree or a certificate of attendance.

Criteria for Evaluation and Ranking of the Candidates

The Criteria for Evaluation and Ranking of the Candidates are the following:

- Prior university training in an appropriate field of study and a transcript of the degree. Appropriate fields of study are Mathematics, Statistics or other related subjects such as Computer Science, Physics, Engineering, etc.
- Recommendation letters (at least two) from university professors
- Personal interview (if necessary)
- Other qualifications, such as exams, awards, distinctions, etc.
- Sufficient knowledge of the English language (recommended)

Candidates with insufficient knowledge of mathematics will be required to attend a number of undergraduate courses, in addition to those required by the regulations of the Department.

POSTGRADE PROGRAMMES OF STUDY – MASTER DEGREES

General Rules
The postgraduate Master's level programs lead to the award of the "Magister Scientiae" title (Master's Degree). The award of a Master's Degree is approved by the Departmental Board.

For each new-entrant graduate student, the Department appoints an Academic Advisor.

For the award of a Master's Degree, a minimum of three (3) semesters of studies is required. The maximum duration of studies is eight (8) semesters.

Master's Thesis Regulations
The Master's Thesis (MT) is compulsory in the Master's program in Mathematical Sciences, and requires the student to find a supervisor. Students can enroll in the MT after the first semester of their studies.

Each MT should contain sufficient initiative, self-contained study and originality in the broadest sense. It may have a theoretical and/or applied character. The MT may be an extension, or deepening of theory knowledge, methods or techniques and/or their application to specific problems.

The Coordinator of the Postgraduate Studies Committee (MT Coordinator) coordinates the whole process of preparing and evaluating the MTs.

Choice of Topic for the MT
Possible topics for the MT should relate to the department faculty's areas of expertise, which may be found on the faculty's individual web pages. The students discuss with a faculty member and choose a topic for the preparation of the MT. Securing a topic for the MT requires the consent of the faculty member who is also the supervisor of the MT.

Supervision of MT
The supervision of the student who prepares the MT is left to the supervising professor. The monitoring and control of the MT's progress is carried out through regular meetings of the student with the supervising professor.

Evaluation of MT
The MT is evaluated by the supervising professor and two other members of the academic faculty of the University of Cyprus, who are assigned as evaluators. The list of Evaluators is submitted through the Postgraduate Studies Committee to the Departmental Board for approval. The Coordinator prepares the Program of MT Presentations that take place during the exam period.

At least one week before the presentation date of the MT, the student submits to the Department four copies of the MT (for the Department's archive, the supervisor, and the two Evaluators). The student presents his work in the form of a seminar before the supervisor and the evaluators, according to the Program of MT Presentations. The presentation is open to all members of the faculty and the students of the Department.

After the presentation, the supervising professor in agreement with the evaluators submits a documented grade for the MT. The Departmental Board deals with cases of disagreement as to the grade of the MT.

The main evaluation criteria for a MT are the following:

- Quality of work (e.g. accuracy and completeness of analysis, relevance of methodology, validity of theoretical results, software quality, extendibility, degree of connection and cohesion of ideas).
- Degree of work completion.
- Degree of understanding of the broader area of the MT's topic by the student.
- Quality of MT's written text (e.g. structure and organization, clarity, ease of reading and understanding).

The MT are graded as: Excellent, Very Good, Good, and Failure.

Automatic Termination of Studies

A postgraduate (Master level) student's studies are automatically terminated, without the award of a Master's degree, if:

- upon completion of eight semesters of studies in total, he has not fully met the requirements of the program of study he is attending. Most certainly, semesters during which the student has cancelled or suspended his studies, do not count as part of those eight semesters.
- the preparation of a Master's level Postgraduate Thesis is a mandatory requirement of the student's program of study and the student has failed to successfully defend his thesis for the **second** time.
- he has not enrolled in courses for two consecutive semesters and any attempts for written communication with him from the University's part have not yielded any result.

MASTER IN DATA SCIENCE

The Master's degree in Data Science is offered jointly by the Department of Mathematics and Statistics, the Department of Business and Public Administration and the Department of Computer Science. Data Science is concerned with extracting knowledge from large volumes of data and, nowadays, it constitutes a field of key strategic importance for modern organisations, creating a growing need for highly skilled data scientists. This programme aims at providing students with a strong understanding of basic and advanced methods in statistical inference, machine learning, data visualisation and data mining, which are essential skills for a data scientist.

More information can be found on the programme's website: http://www.datascience.cy.

MASTER IN MATHEMATICAL SCIENCES

Programme offer suspension for the academic year 2023-2024

Rules

To obtain a master's degree in Mathematical Sciences, successful completion of 90 ECTS is required. Each course corresponds to 10 ECTS and the Master's Thesis to 30 ECTS.

Every postgraduate student must complete a Master's Thesis. A student may choose whether to work on a thesis in Pure or Applied Mathematics.

The Masters Thesis has the following codes:

MAS801–Master's Thesis in Applied Mathematics I (30 ECTS) or
MAS802-Master's Thesis in Pure Mathemtics I (30 ECTS)
MAS600.1–Continuation of Master's Thesis in Applied Mathematics II (0 ECTS) – if needed

INDICATIVE PROGRAM OF STUDIES PER SEMESTER Master in Mathematical Sciences			
FALL SEMESTER			
1 Compulsory Course	10	10	
2 Elective Courses	10	20	**30 ects**
SPRING SEMESTER			
1 Compulsory Course	10	10	
2 Elective Courses	10	20	**30 ects**
FALL SEMESTER			
Master Thesis	30	30	**30 ects**
Total ECTS			**90 ects**

LIST OF COMPULSORIES AND ELECTIVE COURSES

2 compulsory courses (one of each group)	**4 elective courses from the following list:**	
Group A – One of the following: MAS601 – Measure Theory and Integration MAS606 – Function Theory of One Complex Variable MAS632 – Riemannian Geometry MAS625 – Group Theory MAS626 – Galois Theory **Group B – One of the following:** MAS603 – Partial Differential Equations MAS671 – Numerical Solution of Ordinary Differential Equations MAS682 – Classical Mechanics	MAS601 – Measure Theory and Integration MAS602 – Fourier Analysis MAS603 – Partial Differential Equations MAS604 – Functional Analysis MAS605 – Second Order Elliptic Partial Differential Equations MAS606 – Function Theory of One Complex Variable MAS607 – Function Theory of Several Complex Variables MAS608 – Second Order Evolution Partial Differential Equations MAS609 – Stochastic Analysis MAS610 – Stochastic Processes MAS611 – Harmonic Analysis MAS612 – Measure and Probability MAS613 – Ordinary Differential Equations MAS617 – Topics in Mathematical Analysis I MAS618 – Topics in Mathematical Analysis II MAS619 – Topics in Mathematical Analysis III MAS620 – Approximation Theory MAS621 – Numerical Linear Algebra MAS622 – Coding Theory MAS623 – Number Theory MAS624-Introduction to Commutative Algebra MAS625 – Group Theory MAS626 – Field and Galois Theory MAS632 – Riemannian Geometry MAS633 – General Relativity	MAS 627 Group Representation Theory I MAS628 – Group Representations II MAS629 – Topics in Algebra I MAS630 – Topics in Algebra II MAS631 – Differential Topology MAS634 – Algebraic Topology I MAS635 – Lie Groups and Algebras MAS636 – Algebraic Topology II MAS637 – Spectral Geometry MAS638 – Spin Geometry MAS639 – Algebraic Geometry MAS640 – Topics in Geometry I MAS641 – Topics in Geometry II MAS660 – Probability Theory MAS671 – Numerical Solution of Ordinary Differential Equations MAS672 – Numerical Solution of Partial Differential Equations MAS673 – Finite Element Methods MAS677 – Topics in Numerical Analysis I MAS678 – Topics in Numerical Analysis II MAS679 – Topics in Numerical Analysis III MAS682 – Classical Mechanics MAS683 – Fluid Dynamics MAS684 – Scientific Computing with MATLAB MAS687 – Topics in Applied Mathematics I MAS688 – Topics in Applied Mathematics II MAS689 – Topics in Applied Mathematics III
Note: Courses will be offered according to the capacities of the Department. Furthermore, the semester in which courses are offered may vary.		

COURSES DESCRIPTION

MAS601 - Measure theory and Integration
Metric spaces. σ- algebras, measures, outer measures. Borel measures on the real line. Measurable functions. Integration. General convergence theorems. Signed measures. Product measures n-dimensional Lebesque integral. The Radon Nikodym Theorem. Lp spaces.

MAS602 - Fourier Analysis
The Schwarz space. Fourier transform. Plancherel's formula. Convergence of Fourier series and integrals. Applications in partial differential equations. Distributions. Tempered distributions, compactly supported distributions. Sobolev spaces.

MAS603 - Partial Differential Equations
First order quasi-linear equations, the method of characteristics. Classification and normal forms. Existence theorem of Cauchy- Kovalevskaya and uniqueness theorem of Holmgren. Distributions and weak solutions. Hyperbolic theory, characteristics, propagation of singularities. Wave equation in one, two and three space dimensions. Conservation laws and shock waves. Elliptic theory, Laplace and Poisson equations, fundamental solutions, harmonic functions. Variational formulation of elliptic boundary value problems. Parabolic theory, heat equation, parabolic initial/boundary value problems.

MAS604 - Functional Analysis
Compact operators. Spectral theory. Self adjoint operators. Closed and orthonormal operators. Spectral theorem. Semigroups.

MAS605 - Second Order Elliptic Partial Differential Equations
Laplace equation, fundamental solutions, Green's function, maximum principle, Poisson kernel, Harmonic functions and their properties, Harnack inequalities, equations with variable coefficients, Dirichlet problem, existence and regularity of solutions.

MAS606 - Function Theory of One Complex Variable
Basic facts about complex numbers and complex functions of one complex variable. Differentiation. Cauchy-Riemann equations and holomorphic functions. Elementary holomorphic functions and power series. Complex integration and the Cauchy Theorem. Applications of Cauchy Theorem. Meromorphic functions and residues. Laurent series. Geometric Theory and Analytic Continuation. Conformal mappings.

MAS607 - Function Theory of Several Complex Variables
Basic facts about holomorphic functions of several complex variables. Power series and multi-circular domains. Laurent and Hartogs series. Division Theorem and different type of convexities. Integral representations of holomorphic functions of several complex variables (Bochner-Martinelli, Cauchy -Fantappie and Bergman-Weil formulas). Chirstoffel- Darboux kernels and applications to several complex variables.

MAS613 - Ordinary Differential Equations
Existence theorems: Picard- Lindelöf and Cauchy-Peano. Uniqueness theorem when Lipschitz condition is satisfied. Smooth dependence of solutions on parameters. Extensibility of solutions. Linear systems, fundamental solution matrix, systems with periodic coefficients. Stability of nonlinear systems. Poincaré-Bendixson theory.

MAS617, 618, 619 - Topics in Mathematical Analysis I, II, III
Topics in Real Analysis, Complex Analysis or Differential Equations, depending on the special interests of the faculty member teaching the course.

MAS 620 - Approximation Theory
Introduction to Normed spaces and Linear Operators, Theorems of Stone-Weierstrass, Spaces of Functions, Best Approximation, Chebyshev Theorem, Degree of Approximation by Trigonometric and Algebraic Polynomials, Wavelet orthonormal basis, Non linear Wavelet Approximation

MAS 621 - Numerical Linear Algebra
Elements of matrix analysis, vector and matrix norms. Factorization and least - squares methods. Stability. Direct and iterative methods for the solution of linear systems. Methods for calculating eigenvectors and eigenvalues.

MAS622 - Coding Theory
Finite fields. Linear codes, syndrome decoding. Cyclic codes. BCH codes and Reed – Solomon codes. MDS codes. Permutation decoding.

MAS623 - Number Theory
Introduction to algebraic number theory. Quadratic reciprocity, Gauss and Jacobi sums. Field extensions, finite fields, ideal classes. Quadratic and cyclotomic fields. Applications to Diophantine equations.

MAS624 - Introduction to Commutative Algebra
Rings and Ideals. Modules. Localization of rings and modules. Primary decomposition. Integral extensions of rings. Noetherian and Artinian rings. Completion of a ring. Dimension.

MAS625 - Group Theory
Examples of groups, subgroups. Generators and relations. Direct and semi-direct products. Group actions. Sylow theorems and p-groups. Composition series and Jordan-Hölder theorem. Solvable and nilpotent groups.

MAS626 - Field and Galois Theory
Polynomial rings. Field extensions, splitting fields. Separable extensions, normal extensions. The fundamental theorem of Galois theory. Roots of unity and cyclotomic polynomials. Solution by radicals and the Abel-Ruffini theorem.

MAS627 - Group Representation Theory I
Representations. FG-modules, FG-submodules and FG-homomorphisms. Maschke's Theorem and Schur's Lemma. Irreducible module. The group algebra, the centre of the group algebra. Characters, relation between characters and representations. Character tables. Frobenius reciprocity theorem.

MAS628 - Group Representation Theory II
Semi-simple rings, construction of irreducible R – modules. Splitting fields. Clifford's theorem. Mackey Decomposition Theorem. Representations and characters of finite groups. Representations of compact groups.

MAS629 - Topics in Algebra I
Topics from algebra

MAS630 - Algebraic Geometry
Algebraic sets and the Hilbert-Nullstellensatz theorem. Affine, projective and quasiprojective varieties, morphisms, products. Local properties. Smooth and singular points. Tangent space. Dimension. Divisors on algebraic curves, Riemann-Roch theorem. Bezout's theorem. Elliptic curves. The group structure of an elliptic curve

MAS631 – Differential Topology
Differentiable manifolds. Tangent space. Partition of unity. Regular points. Sard's theorem. Vector fields and flows. Frobenius Theorem. Differential forms. Stokes' Theorem. De Rham's Theorem.

MAS632 - Riemannian Geometry
Riemannian manifolds. Geodesics, exponential map, normal coordinates. Gauss lemma. Theorem of Hopf- Rinow. Curvature. Jacobi fields. Theorems of BonnetMyers, Synge-Weinstein and Hadamard - Cartan. Homogeneous and symmetric spaces.

MAS633 - General Relativity
Lorentz geometry. Special relativity. Newton spacetime, Minkowski spacetime. Lorentz transformation. Einstein equations. Special solutions (Schwarzschild).

MAS634 - Algebraic Topology I
Fundamental group, Van Kampen theorem, Covering spaces, Homology and Cohomology, The Mayer Vietoris sequence, Excision, Relation between homology and fundamental group.

MAS635 - Lie Groups and Lie Algebras
Differentiable manifolds. Tangent spaces and vector fields. Lie Groups. Exponential function. Homogeneous spaces. The Campbell-Hausdorf formula. Ado's Theorem. Lie algebras. Ideals and homomorphisms. Solvable and nilpotent Lie algebras. Semisimple Lie algebras. Root systems. Compact Lie groups.

MAS636 - Algebraic Topology II
Obstruction theory. Bundles and K- theory. Bordism. Spectral sequences. Characteristic classes.

MAS637 - Spectral Geometry
Laplace operator. Minimax principle. Isoparametric inequalities. Heat kernel.

MAS638 - Spin Geometry
Clifford algebras. Spin groups and representations. Spin structures. Spin connection. Spin manifolds. Dirac operator. Bochner formula. Lichnerowicz's Theorem.

MAS640, MAS641 - Topics in Geometry I, II
Topics from Differential Geometry, Algebraic Geometry and Algebraic Topology. Depends on the special interests of the staff member teaching it

MAS650 – Mathematical Statistics
Univariate and multivariate random variables, distribution function, joint and conditional distribution, independence, moments. Special parametric families of distributions. Estimation. Methods of finding estimators. Properties of estimators, sufficiency, unbiasedness, consistency. Comparison of estimators. Confidence Intervals. Hypothesis testing. Simple and composite hypothesis, power function. Methods of constructing tests. Properties of tests, unbiasedness, consistency. Comparison of tests. Hypothesis testing and confidence intervals.

MAS653 – General Linear Models
Linear and multiple regression, residuals and model selection procedures, diagnostics. Analysis of variance and non-linear regression. Design of experiments, completely randomized designs, designs with two or more factors with interactions. Block designs, split plot and nested designs.

MAS654 – Nonparametric Statistics
Order statistics and their distributions. Tolerance regions. Rank and sign tests for one and two populations. Goodness of fit tests (Kolmogorov – Smirnov, Lilliefors, Shapiro – Wilks). Siegel – Tukey and Kruskal – Wallis tests. Normal and Savage scores. Fisher exact test for 2x2 contingency tables. Mantel – Haenszel test for contingency tables. Kaplan– Meier estimator of the survival function. Jonckheere – Terpstra and page test for ordered alternatives. Nonparametric correlation coefficients (Spearman, Kendall) and measures of agreement.

MAS655 – Survey Sampling
Survey design, sampling and nonsampling errors, simple random sampling, stratified sampling, systematic sampling, cluster sampling, ratio estimators, regression estimators, determination of optimal sample size, bias in survey sampling, modern techniques of survey sampling. Special techniques for human populations in cases of stigmatizing characteristics.

MAS656 – Time Series Analysis
Stochastic processes, weak and strong stationarity. Trend and seasonal behavior of time series. Sample autocorrelation function and sample partial autocorrelation function. Prediction. Parametric families of stochastic processes. ARMA, ARIMA and SARIMA models. Properties, estimation and examples. ARCH and GARCH processes, properties of estimators and examples.

MAS657 – Statistical Analysis of Discrete Data
Types of discrete data. Contingency tables and inference (testing independence and homogeneity). Measures of association. Loglinear models for contingency tables. Logit models. Distribution and Inference for categorical data. Asymptotic theory of goodness-of-fit X2 tests. Logistic regression.

MAS658 - Statistical Simulation and Data Analysis
Introduction to R, diagnostic statistics, simulation methods, Monte-Carlo, simulation, optimization, bootstrap and resampling techniques.

MAS659 – Multivariate Analysis
Random vectors, measures of center and variation in multivariate moments. Multivariate normal distribution. Tests for normality. Estimation of the mean vector and the variance analysis, independence, multivariate – covariance matrix. Wishart and Hotelling distributions. Statistical inference. Union – Intersection Test. Confidence regions. Multivariate analysis of variance and multivariate regression analysis. Least squares method and Wilks distribution. Analysis of covariance. Principal components, Factor analysis, Discriminant analysis, Cluster analysis.

MAS660 - Probability Theory
Measure spaces and σ-algebras, independence, measurable functions and random variables, distribution functions, Lebesgue integral and expectation, convergence concepts, law of large numbers, characteristic functions, central limit theorem, conditional probability, conditional expectation, martingales, central limit theorem for martingales.

MAS661, MAS662, MAS663 – Topics in Statistics I, II, III
Topics from probability theory, statistical theory and their applications, such as categorical time-series, non-parametric and semi-parametric statistics, U-statistics, Bootstrap methods, survival analysis, wavelets and their applications in statistics and time-series analysis, analysis of spatial data, analysis of functional data.

MAS665 - Computational Statistics
Numerical linear algebra: Multiple regression, Cholesky decomposition, diagnostics and colinearity, principal components and eigenvalue problems. Nonlinear statistical methods: Maximum likelihood estimation, Newton-Raphson and related methods, multivariate data and the Newton Raphson method, optimization techniques (unconditional and under constraints) EM algorithm. Numerical Integration and Approximation: Newton-Coates method, spline interpolation, Monte Carlo integration, general approximation methods. Probability Density Estimation: Histogram, linear and non-linear smoothing, splines. Bootstrap.

MAS666 – Biostatistics
Definition of epidemiology and types of epidemiological studies. Descriptive statistics: graphical and numerical methods for medical data. Measures of association and correlation. Measures of risk and rate. Inference for mean, proportions indicators and coefficients of correlation. Nonparametric tests (Fisher's exact test, McNemar test, etc.). Diagnostic methods, sensitivity and specificity. Numerical methods in clinical epidemiology, ROC curves. Meta - analysis. Censored data. Survival and hazard functions. Nonparametric estimation (Kaplan – Meier and Nelson – Aalen estimators). Methods of comparison of two survival functions (Log – rank, Breslow Peto – Peto tests). Semiparametric estimation (Cox proportional hazards model, partial likelihood). Parametric estimation (exponential, Weibull, log – logistic and lognormal models, proportional odds model). Frailty models.

MAS671 - Numerical Solution of Ordinary Differential Equations
One-step methods and multistep methods for the numerical solution of initial value problems for first order systems of ordinary differential equations. Runge – Kutta methods. Finite difference methods for the numerical solution of two-point boundary value problems.

MAS672 - Numerical Solution of Partial Differential Equations
Finite difference approximations. Numerical solution of the heat equation. Convergence and stability. ADI methods. Numerical solution of the wave equation. The Courant – Friedrichs – Lewy condition. Numerical solution of the Poisson and biharmonic equations.

MAS673 - Finite Element Methods
Sobolov spaces. Ritz-Galrkin approximation. Variational formulation of elliptic boundary value problems. Finite element spaces. Polynomial approximation in Sobolev spaces. N-dimensional variational problems. Multigrid finite element methods.

MAS677, MAS678, MAS679 - Topics in Numerical Analysis I, II, III
Topics in Computational Mathematics and Approximation Theory.

MAS682 - Classical Mechanics
Lie Groups and Lie Algebras. Equations of motion (Newton, Lagrange). Poisson structures, Integrable systems, Lax pairs, bi – Hamiltonian systems. Symmetries of Differential Equations, Noether Theorem.

MAS683 - Fluid Dynamics
Equations of motion. Steady or transient viscous flows. Stokes flows. Non- Newtonian and viscoelastic flows.

MAS684 - Scientific Computing with MATLAB
Introduction to MATLAB. Data and function approximation. Linear Systems. Eigenvalues and Eigenvectors. Ordinary Differential Equations. Numerical Methods for boundary value problems.

MAS687, ΜΑΣ688, MAS689 - Topics in Applied Mathematics I, II, II
Topics from Applied Mathematics.

MAS697, MAS698, MAS699 - Topics in Differential Equations I, II, III
Topics in differential equations.

POSTGRADUATE PROGRAMMES OF STUDIES – DOCTORAL PROGRAMMES

The Department of Mathematics and Statistics offers Doctoral programmes which lead to the following degrees:

- Ph.D. in Mathematics
  - – Specialisation in Applied Mathematics
  - – Specialisation in Pure Mathematics
- Ph.D. in Statistics

General Rules

The duration of study will be at least 6 semesters, with a maximum duration of studies 16 semesters.

The Doctoral program consists of 240 ECTS, where at least 60 ECTS correspond to courses and at least 120 ECTS correspond to research.
The remaining workload concerns the comprehensive examination, the preparation and the presentation of the research proposal, as well as the writing of the Doctoral Dissertation.

For the fulfillment of a PhD Degree, the requirements are:

- Successful completion of at least 60 ECTS at the postgraduate level. Partial or complete exemption may be given by the Departmental Council provided the doctoral student already has a Master Degree.
- Successful completion of a written Comprehensive Examination (CE).
- Successful presentation of a research proposal in front of a three-member committee.
- Successful completion of an original Doctoral Dissertation which includes substantial contributions to the candidate's field.
- Successful defence of the Doctoral Dissertation in front of a five-member committee.
- Approval of the University Senate.

Course Requirements
The Doctoral program consists of 240 ECTS, where at least 60 ECTS correspond to courses and at least 120 ECTS correspond to research.

A doctoral candidate who is at the research (or dissertation) stage, must carry a semester load equivalent to 30 ECTS. It is the student's responsibility to enroll in the appropriate courses.

Comprehensive Examination (CE)
Candidates must successfully complete the written CE upto the seventh semester of study. The nature and procedure of the CE is determined by the individual areas of study, as explained below.

The CE for the PhD in Statistics consists of three (3) CEs. Once the candidate successfully completes the three (3) CE, he/she may proceed to the Dissertation stage of their studies. If the candidate fails in one of the exams then he/she may attempt to re-take it during the next CE period. Failure to pass the CE a second time will automatically amount to the termination of the candidate's PhD studies.

The CE for Pure and Applied Mathematics consists of two, three-hour written examinations. Once the doctoral candidate successfully completes both parts of the CE, he/she may proceed to the Doctoral

Dissertation stage of their studies. If the candidate succeeds only in one part of the CE, then he/she may attempt to re-take the unsuccessful part during the next CE period. If the candidate fails both parts, then he/she will be given one more chance to pass the CE during the next CE period. The CE is written and corrected by the department's faculty who specialize in the chosen areas.

The CEs take place on the last Wednesday in September and on the first Wednesday of October, of each Fall semester. They, also take place on the last Wednesday of January and the first Wednesday of February of each Spring semester.

Failure to pass the CE a second time will automatically amount to the termination of the candidate's doctoral studies.

Research Advisor (RA)

For a candidate to start working towards their dissertation, a research advisor must be appointed. Usually, this happens immediately following the successful completion of the CE and must be approved by the Departmental Council. The role of the RA is to guide the candidate's research.

It is the candidate's responsibility to choose an RA after talking to the faculty members of the department and coming to an agreement with a particular faculty member. In the event that the candidate fails to find a faculty member willing to serve as an RA, then the candidate's doctoral studies are terminated.

Submission of a Research Proposal

During the semester in which he/she will submit his research proposal, the student is also enrolled in the course code ΜΑΣ774.

Once the candidate has found a RS, a research proposal must be presented in front of a three-member committee. PhD students submit their research proposal to the three-member Committee, which is appointed by the Departmental Council at the suggestion of the Department's Graduate Programmes' Committee and the student's RS.

The three-member committee is composed of:

- The student's Research Supervisor (Chair of the Committee)
- A faculty member of the Department
- A faculty member of the Department or of another UCY Department in a related scientific discipline or faculty member from another university or research center.

The three-member committee may consist of academic staff of any rank, provided that at least one faculty member of the Committee is at the rank of Associate Professor or Professor.
The research proposal is presented upto four semesters after passing the comprehensive examination (CE).

The candidate must submit a written research proposal, clearly indicating what the original and scientific contributions of the research are going to be. The decision of the three-member committee is then submitted to the Departmental Council through which all the faculty members of the department may be informed of the outcome.

The proposal for a PhD dissertation is graded as Pass or Fail. Each student has two opportunities to present the proposal. Incomplete is not given as a grade for the proposal.

Completion of the Dissertation

The Dissertation and its presentation may be completed not earlier than the sixth semester of study from the student's enrollment in the PhD Programme, and only after the CE and ECTS requirements have been successfully completed.

The maximum allowed time for completing all the requirements for the Doctoral Degree is 8 (academic) years.

The dissertation must include substantial research findings as well as elements that clearly indicate the candidate's contribution. The research findings must be original and of high quality as to merit publication in international research journals.

Defense of the Dissertation
During the semester in which he/she will defend the dissertation, the student is also enrolled in the course code ΜΑΣ775.

The Dissertation must be defended before a five-member committee which is appointed by the Departmental Council at the suggestion of the Department's Graduate Programmes' Committee and the student's Research Supervisor. The five-member committee is composed of:

- Three faculty members of the Department of Mathematics & Statistics, one of them being the candidate's RS.
- One member of another university or research center.
- One faculty member from another (relevant) department of The University of Cyprus or from another university or research center.

The five-member committee may consist of academic staff of any rank, provided that at least one faculty member of the Committee is at the rank of Associate Professor or Professor.

The coordinator of the five-member committee must be a faculty member from the University of Cyprus, excluding the candidate's RS.

The Dissertation defense consists of three stages:

- A 30-45 minute public lecture (presentation)
- Discussion of the results with the committee members
- Deliberation of the committee in order for their suggestion(s) to be decided and written in a report

Each committee member, except the candidate's RS, must submit an evaluation of the dissertation to the committee coordinator, indicating whether the candidate's results merit a defense. Preliminary comments may also be given at this point. These reports/evaluations are then circulated among all committee members and are included in the committee's final report (as an appendix). The decision of whether the candidate will defend their dissertation is made by majority vote.

If the committee's final decision is positive, but under the provision that certain changes must be made in the dissertation, then these must be made prior to submitting it to the University Senate. Moreover, the committee (or its representative) must certify that the required changes were made and when the revised dissertation was submitted.

The committee's written report, which is submitted to the Chairperson of the Department of Mathematics and Statistics, lists in detail all the necessary changes (if any) and the time allowed for these to be made.

If the defense of the dissertation is not successful, the candidate has the right to request a second defense. The provisions pertaining to the second defense are decided by the committee and put in writing.

If the recommendation of the five-member committee is not unanimous, the Senate may return it back to the Department and ask the Departmental Council to appoint two (2) additional external examiners who will be asked to express their opinion on the dissertation. The suggestions of the two (2) new external members will be submitted to the Departmental Chair. Then the Chair will forward their suggestions to the Departmental Council and subsequently to the Senate for final approval.

If the Examining Committee suggests changes or improvements, the Senate will give its final approval for the doctoral degree only after the RS confirms in writing that the suggestions of the Examining Committee have been implemented.

The Departmental Chair must forward the report of the Examining Committee to the Dean of the Graduate School together with the necessary documentation and a copy of the dissertation.

If the dissertation is rejected, the candidate has the right to ask for the repetition of the process one more time. The terms of the new submission are determined in writing by the committee.

Structure of Dissertation
You may find the relevant information about the format for the production, the structure, the writing and submission of the Dissertation from the Graduate School.

The Library of the University of Cyprus may give you directions about the submission of the Dissertations to the Library.

Ex Officio Termination of Studies
The course of study of a student is terminated *ex oficio*, without the award of a PhD in Statistics in the following cases:

- The student has completed a total of sixteen semesters of studies; Provided that semesters during which the student's studies were suspended, are not in the sixteen semesters.
- The student has completed seven semesters of studies and has failed the comprehensive examination offered by the programme of study. The semesters during which the student's studies were suspended, are not counted in the seven semesters.
- The student has failed for a second time to defend the Dissertation.
- He/she has had two failures at the research or writing stage. In such a case, a decision is required by the Department Board and the approval of the Dean of the School of Postgraduate Studies.

He/she has not enrolled for courses for two successive semesters and attempts by the University to contact them have failed. In such a case, a decision is required by the Department Board and the approval of the Dean of the School of Postgraduate Studies.

DOCTORAL DEGREE IN STATISTICS

For obtaining a PhD in Statistics, apart from the general prerequisites for attendance at the Department, the requirements are the following:

1. **Postgraduate Courses**
   Successful completion of 60 ECTS of course work at postgraduate level, in accordance with the provisions of the programme of studies of the Department. Students with a Master degree are partially or fully exempted from this requirement.

   The 60 ECTS should include:
   - At least 10 ECTS in Statistical Simulation and Data Analysis (MAS658)
   - At least 10 ECTS in Probability Theory (MAS660)
   - At least 10 ECTS in Statistical Theory (MAS670)

   In case of failing a postgraduate course, PhD students may attend the course one more time. Provided that the course is compulsory, a second failure entails the student's automatic termination of studies.

   In accordance with the University of Cyprus rules, an undergraduate course from any University Department may be included in the compulsory courses of the PhD programmes.

   Additional Requirement for PhD Students
   Enrolment in the Seminar for at least six semesters. Zero (0) ECTS are assigned to each seminar.

   Seminars Codes and Title
   - MAS751 – Seminars in Applied Statistics (PhD) I
   - MAS752 - Seminars in Applied Statistics (PhD) II
   - MAS753 - Seminars in Applied Statistics (PhD) III
   - MAS754 - Seminars in Applied Statistics (PhD) IV
   - MAS755 - Seminars in Applied Statistics (PhD) V
   - MAS756 - Seminars in Applied Statistics (PhD) VI

2. **Successful completion of a written Comprehensive Examination (CE).**
   Successful completion of the following CEs with a grade of at least 7.5 in each exam:
   - CE in Statistical Simulation and Data Analysis (MAS758) – 0 ECTS
   - CE in Probability Theory (MAS760) – 0 ECTS
   - CE in Statistical Theory (MAS770) – 0 ECTS

   The CE in Probability Theory (MAS760) and Statistical Theory (MAS770) correspond to the final exams for MAS660 and MAS670.

   The CE in Statistical Simulation and Data Analysis (MAS758) is comprised of an open lecture on a project involving statistical data analysis and computations. The project will be assigned during the semester and the student will have a maximum of 4 weeks to complete the relevant analysis.

   CEs are graded as Pass/Fail. Students must succeed in CEs up to the 7^{th} semester of their studies.

3. Successful presentation of a research proposal before a three-member committee.

4. Successful completion of a Dissertation which includes substantial contributions to the candidate's field.

5. Successful defense of the Dissertation in front of a five-member committee.

6. Approval of the University Senate.

PhD Program in Statistics - Indicative Program of Studies		
Obligations	**ECTS per course**	**Total**
Teaching Part (partial or full recognition of a Master's degree)		At least 60
4 Research Stages	30	120
2 Writing Stages	30	60
3 Comprehensive Examinations	0	0
Submission of proposal for Dissertation	0	0
Defense of Dissertation	0	0
TOTAL		**240 ECTS**

SYLLABUS FOR THE COMPREHENSIVE EXAMINATION (CE) IN STATISTICS
Comprehensive Examination (Compulsory)

MAS758- Comprehensive Examination in Statistical Simulation and Data Analysis
A project involving data analysis and statistical computations is assigned during the semester and should be completed within 4 weeks. The CE corresponds to a presentation of the project during the semester that is open to the faculty members and the PhD students.

MAS760 - Comprehensive Examination in Probability Theory
Axiomatic foundation, Measure theoretic probability, measure theory and integration, σ-algebras, monotone classes, events, probability spaces, stochastic independence, 0-1 laws, the Borel-Cantelli lemmas. Random variables, distribution of a random variable, continuous and discrete random variables, distribution of a function of a random variable, random vectors. Expectation of a random variable, expected value and independence, expected value as the integral with respect to a probability measure, properties of integration, moments, probability inequalities, conditional expectation. Limit theorems. Modes of convergence of a sequence of random variables, uniform integrability, convergence of moments, moment generating functions, characteristic functions, theorems of continuity and inversion, infinite divisibility laws and stable laws, central limit theorem, weak and strong laws of large numbers. Martingales and random walks, properties of random walk, limit theorems, definition and properties of martingales, martingale inequalities, convergence criteria, weak and strong laws of large numbers for martingales, central limit theorem for martingales.

Bibliography

- P. Billingsley: Probability and Measure, Wiley , 2nd Edition, 1986
- Y. S. Chow and H. Teicher: Probability Theory, Springer - Verlag, 2nd, Edition,1988
- K. L. Chung: A Course in Probability Theory, Academic Press, 1974
- J. L. Doob :Stochastic Processes, Wiley, 1953
- W. Feller: An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., 1968, Vol. 2, 2nd Ed., Wiley, 1971.

MAS770 – Comprehensive Examination in Statistical Theory
Estimation theory, random sample, statistic, families of distributions, exponential families. Estimators (maximum likelihood, least squares, moment estimators, Bayes estimators). Properties of estimators, unbiasedness, sufficiency, consistency. Unbiased estimators of uniformly minimal variance, Fisher information, Cramer – Rao inequality. Rao – Blackwell Theorem and Theorem of Lehmann – Scheffe. Theory of testing statistical hypothesis, decision theory, simple and composite hypothesis, test statistics, properties of tests. Neyman – Pearson lemma, uniformly most powerful tests. Likelihood ratio tests. Hypothesis testing and confidence intervals. Goodness-of-fit tests, tests of independence.

Bibliography

- Lehmann, E. L. and G. Casella, Theory of Point Estimation. Springer, 2nd Edition, 1998.

- Lehmann, E. L. and J. Romano, Testing Statistical Hypothesis. Springer, 3rd Edition, 2005.
- Lehmann, E. L., Elements of Large-Sample Theory, Springer, 1988.
- Rao, C.R., Linear Statistical Inference and its Applications. John Wiley, 1973.
- Serfling, R., Approximation Theorems of Mathematical Statistics. Wiley, 1980.
- Van der Vaart, A. W., Asymptotic Statistics. Cambridge University Press, 1998.

Course Description

MAS658 - Statistical Simulation and Data Analysis
Introduction to R, diagnostic statistics, simulation methods, Monte-Carlo, simulation, optimization, bootstrap and resampling techniques.

MAS660 – Probability Theory
Measure spaces and σ-algebras, independence, measurable functions and random variables, distribution functions, Lebesgue integral and expectation, convergence concepts, law of large numbers, characteristic functions, central limit theorem, conditional probability, conditional expectation, martingales, central limit theorem for martingales.

MAS670 – Statistical Theory
Stochastic convergence, estimation, asymptotic properties of estimators, efficiency, testing hypotheses, asymptotic properties and efficiency of testing procedures, convergence in metric spaces, empirical processes.

Moreover, the following courses may be offered as restrictive electives within the Department and students may enrol in them to deepen their knowledge in the relevant fields.

MAS650-Mathematical Statistics (10ECTS)
MAS653-General Linear Models (10 ECTS)
MAS654-Nonparametric Statistics (10 ECTS)
MAS655-Survey Sampling (10ECTS)
MAS656-Time Series Analysis (10 ECTS)
MAS657-Analysis of Discete Data (10ECTS)
MAS659-Multivariate Analysis (10 ECTS)
MAS661-Topics in Statistics I (10 ECTS)
MAS662-Topics in Statistics II (10 ECTS)
MAS663- Topics in Statistics III (10 ECTS)
MAS665-Computational Statistics (10 ECTS)
MAS666-Biostatistics (10 ECTS)

DOCTORAL DEGREE IN MATHEMATICS (PURE MATHEMATICS)

For obtaining a PhD in Mathematics (Pure Mathematics), apart from the general prerequisites for attendance at the Department, the requirements are the following:

1. **1. Postgraduate Courses**
   Successful completion of at least 60 ECTS at the postgraduate level. (Partial or complete exemption may be given by the Departmental Council provided the doctoral student already has a master's degree)

2. **Successful completion of a written Comprehensive Examination (CE)**

The candidate must complete the CE requirement up to the 7th semester of their studies. The CE consists of two three-hour written examinations. The CE is based on two out of the three areas (Analysis, Algebra, Geometry – syllabi are given below) that the candidate chooses.

Once the doctoral candidate successfully completes both parts of the CE, he/she may proceed to the Doctoral Dissertation stage of their studies.

If the candidate succeeds only in one part of the CE, then he/she may attempt to re-take the unsuccessful part during the next CE period. If the candidate fails both parts, then he/she will be given one more chance to pass the CE during the next CE period.

The CE is written and corrected by the department's faculty who specialize in the chosen areas. A passing score on the CE amounts to a minimum of 50% of the total points.

Failure to pass any part of the CE a second time will automatically amount to the termination of the candidate's doctoral studies.

3. Successful presentation of a research proposal in front of a three-member committee upto 4 semesters after the successful completion of the CE.

4. Successful completion of an original Doctoral Dissertation which includes substantial contributions to the candidate's field.

5. Successful defence of the Doctoral Dissertation in front of a five-member committee.

6. Approval of the University Senate.

Doctoral Program in Mathematics (Pure Mathematics) Indicative Program of Studies		
Obligations	**ECTS per course**	**Total**
Teaching Part (partial or full recognition of a Master's degree)		At least 60
4 Research Stages	30	120
2 Writing Stages	30	60
Comprehensive Examinations (2 three-hour exams)	0	0
Submission of proposal for Doctoral Dissertation	0	0
Defense of Doctoral Dissertation	0	0
TOTAL		**240ECTS**

SYLLABUS FOR THE COMPREHENSIVE EXAMINATION (CE) IN PURE MATHEMATICS
Comprehensive Examination (Compulsory)

Choice of 2 from the following 3 areas:

- MAS780- Comprehensive examination in Analysis – 0 ECTS
- MAS781- Comprehensive examination in Algebra – 0 ECTS
- MAS782- Comprehensive examination in Geometry – 0 ECTS

Choice of 2 out the following 3 areas

MAS780- Comprehensive examination in Analysis
Structure and properties of real numbers, continuity, differentiability, Riemann integrability. Metric spaces, compactness, connectedness, Bolzano-Weierstrass theorem, Heine-Borel theorem, Baire category theorem, uniform continuity, convergence of sequences and series of functions. σ-Algebras, outer measures, Borel and Lebesgue measures, measurable functions, Lebesgue dominated convergence theorem, monotone convergence theorem, Fatou's lemma. Signed measures, Radon-Nikodym theorem, product measures, Fubini's theorem. The complex plane, stereographic projection. Möbius transformations. Elementary analytic functions. Cauchy-Riemann equations, harmonic functions. Cauchy's integral formula and theorem, Morera's theorem. Liouville's theorem. Fundamental theorem of algebra. Taylor and Laurent series, residues. Maximum Measure Principle. Schwarz's lemma, the Argument Principle, Rouche's theorem, conformal mapping, the Riemann mapping theorem.

Bibliography:
Royden, H. L. Real Analysis, New York, Mackmillan
Rudin, W. Principles of Mathematical Analysis
Rudin W. Real and Complex Analysis, New York, McGraw-Hill
John B. Conway, Functions of one complex variable, Springer Verlag
L. V. Alfors, Complex Analysis, McGraw-Hill
A.I. Markushevich, Theory of Functions, Chelsea
Ralph Boas, Invitation to Complex Analysis, McGraw Hill
Useful courses: MAS 601, 606

MAS781- Comprehensive examination in Algebra
Groups and homomorphisms, Lagrange's theorem. Direct and semi-direct products. Cyclic, dihedral and symmetric groups. Free groups, generators and relations, finitely generated Abelian groups. Group actions. Sylow's theorem and p-groups. Simple groups, composition series. Solvable groups. Rings and homomorphisms. Ideals. Polynomial rings. Factorization in commutative rings. Modules and exact sequences. Extensions of fields, splitting field of a polynomial, separable extensions, normal extensions. Fundamental theorem of Galois theory. Roots of unity and cyclotomic polynomials. Solvability by radicals. Symmetric functions and Abel's theorem.

Bibliography:
I. Herstein, Topics in Algebra, N.Y. Wiley
T. Hungerford, Algebra, Springer-Verlag
J. Rotman, An Introduction to the theory of groups, Fourth Edition, Springer-Verlag
P. Cameron, Introduction to Algebra, Oxford University Press
Useful courses: MAS 625, 626

MAS782- Comprehensive examination in Geometry

Topological and differentiable manifolds, basic examples and properties. Fundamental group. Tangent spaces. Partitions of unity. Normal values. Vector fields, flows. Frobenius' theorem. Differentiable forms. Stokes' theorem. Riemannian manifolds. The Riemannian connection and exterior differential forms. Geodesic curves, exponential mapping, normal coordinates, Gauss' Lemma. Hopf-Rinow theorem. Curvature. Gauss-Bonnet theorem. Hadamard-Cartan theorem.

Bibliography:

Bothby, W. An introduction to differentiable manifolds and Riemannian Geometry, Academic Press
M. Do Carmo, Riemannian Geometry, Birkhauser
J. M. Lee, Riemannian Geometry, Springer

Useful courses: MAS 631, 632

DOCTORAL DEGREE IN MATHEMATICS (APPLIED MATHEMATICS)

For obtaining a PhD in Mathematics (Applied Mathematics, apart from the general prerequisites for attendance at the Department, the requirements are the following:

1. **Postgraduate courses**
   Successful completion of at least 60 ECTS at the postgraduate level. (Partial or complete exemption may be given by the Departmental Council provided the doctoral student already has a master's degree)

2. **Successful completion of a written Comprehensive Examination (CE)**

   The candidate must complete the CE requirement up to the 7th semester of their studies.

   The CE consists of two three-hour written examinations. The first written examination must be in Analysis (syllabus is given below). The second is based on one of the four areas (Applied Mathematics, Numerical Analysis, Partial Differential Equations, Numerical Solution of Ordinary Differential Equations – syllabi are given below) from which the doctoral candidate chooses 1 out of the 4 areas.

   Once the doctoral candidate successfully completes both parts of the CE, he/she may proceed to the Doctoral Dissertation stage of their studies. If the candidate succeeds only in one part of the CE, then he/she may attempt to re-take the unsuccessful part during the next CE period. If the candidate fails both parts, then he/she will be given one more chance to pass the CE during the next CE period.

   The CE is written and corrected by the department's faculty who specialize in the chosen areas. A passing score on the CE amounts to a minimum of 50% of the total points.

   Failure to pass any part of the CE a second time will automatically amount to the termination of the candidate's doctoral studies.

3. Successful presentation of a research proposal in front of a three-member committee up to 4 semesters after the successful completion of the CE.

4. Successful completion of an original Doctoral Dissertation which includes substantial contributions to the candidate's field.

5. Successful defence of the Doctoral Dissertation in front of a five-member committee.

6. Approval of the University Senate.

Doctoral Program in Mathematics (Applied Mathematics) Indicative Program of Studies		
Obligations	**ECTS per course**	**Total**
Teaching Part (partial or full recognition of a Masters degree)		At least 60
4 Research Stages	30	120
2 Writing Stages	30	60
Comprehensive Examinations (2 three-hour exams)	0	0
Submission of proposal for Doctoral Dissertation	0	0
Defense of Doctoral Dissertation	0	0
TOTAL		**240ECTS**

SYLLABUS FOR THE COMPREHENSIVE EXAMINATION (CE) IN APPLIED MATHEMATICS

Comprehensive Examination (Compulsory)

- MAS780- Comprehensive examination in Analysis – 0 ECTS (Compulsory)
- Choice of 1 from the following 4 areas:
  - MAS783- Comprehensive examination in Applied Mathematics – 0 ECTS
  - MAS784- Comprehensive examination in Partial Differential Equations – 0 ECTS
  - MAS785- Comprehensive examination in Numerical Analysis – 0 ECTS
  - MAS786- Comprehensive examination in Numerical Solution of Ordinary Differential Equations – 0 ECTS

MAS780- Comprehensive examination in Analysis

Structure and properties of real numbers, continuity, differentiability, Riemann integrability. Metric spaces, compactness, connectedness, Bolzano-Weierstrass theorem, Heine-Borel theorem, Baire category theorem, uniform continuity, convergence of sequences and series of functions. σ-Algebras, outer measures, Borel and Lebesgue measures, measurable functions, Lebesgue dominated convergence theorem, monotone convergence theorem, Fatou's lemma. Signed measures, Radon-Nikodym theorem, product measures, Fubini's theorem. The complex plane, stereographic projection. Möbius transformations. Elementary analytic functions. Cauchy-Riemann equations, harmonic functions. Cauchy's integral formula and theorem, Morera's theorem. Liouville's theorem. Fundamental theorem of algebra. Taylor and Laurent series, residues. Maximum Measure Principle. Schwarz's lemma, the Argument Principle, Rouche's theorem, conformal mapping, the Riemann mapping theorem.

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Royden, H. L. Real Analysis, New York, Mackmillan
Rudin, W. Principles of Mathematical Analysis
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John B. Conway, Functions of one complex variable, Springer Verlag
L. V. Alfors, Complex Analysis, McGraw-Hill
A.I. Markushevich, Theory of Functions, Chelsea
Ralph Boas, Invitation to Complex Analysis, McGraw Hill

Useful courses: MAS 601, 606

<u>Choice of 1 out the following 4 areas:</u>

MAS783- Comprehensive examination in Applied Mathematics

Lie groups and algebras, Equations of Motion (Newton, Lagrange), Poisson structures, Integrable systems, Lax pairs, Bi-Hamiltonian systems, Symmetries, Noether's theorem, variational calculus, integral equations.

Bibliography:

- P. Olver Applications of Lie Groups to Differential Equations, Second Edition, Springer-Verlag, New York, 1993.
- F.B. Hildebrand, Methods of Applied Mathematics, Dover, 1992
- Course notes from MAS 481 and 682.

MAS784- Comprehensive examination in Partial Differential Equations

First order partial differential equations, Second order partial differential equations: Wave Equation, Heat Equations, Harmonic functions. Initial boundary value problems, Fourier series, Green's functions, Maximum Principle.

Bibliography:

- G. D. Akrivis, D. Dougalis, Partial Differential Equations (University Publications).
- W. A. Strauss, Partial Differential Equations: An Introduction (Chapters 1–7).
- L. Evans, Partial Differential Equations (Chapter 2 and Chapter 3: Sections 3.1, 3.2).

MAS785- Comprehensive examination in Numerical Analysis

Numerical solution of nonlinear equations. Vector and matrix norms. Solution of linear systems (direct and iterative methods). Calculation of eigenvalues and eigenvectors. Interpolation (Lagrange and Hermite). Numerical integration (Newton – Cotes, Gauss).

Bibliography:

- E. Süli and D. Mayers, An Introduction to Numerical Analysis, Cambridge Univ Press, 2003.
- K. Atkinson: An Introduction to Numerical Analysis, Wiley, New York, 1978.
- G. D. Akrivis, D. Dougalis: Introduction to Numerical Analysis, University Publications, Crete, 1997.

MAS786- Comprehensive examination in Numerical Solution of Ordinary Differential Equations

Single and multistep methods and Runge-Kutta methods for the numerical solution of initial value problems for ordinary differential equations. Finite Difference Methods for ordinary differential equations. Finite Element Methods for ordinary differential equations.

Bibliography:

- L. Fox and D. F. Mayers: Numerical Solution of Ordinary Differential Equations, Chapman and Hall (London, 1987).
- Iserles: A First Course in the Numerical Analysis of Differential Equations, Cambdrige Univ Press, 1996.
- G. D. Akrivis, D. Dougalis: Numerical Methods for Ordinary Differential Equations, University Publications, Crete, 2006.
- Johnson: Numerical solution of partial differential equations by the finite element method, Cambridge Univ Press, 1994.
- G. D. Akrivis: Finite Element Methods, University Lectures, Cyprus, 2005.