



UNIVERSITÀ
DI CAMERINO

School of Science and Technology

**Master of Science (M.Sc.) Degree Course in
Mathematics and Applications**

(Classe LM-40)

STUDENT GUIDE

2-year program
ECTS 120

Teaching Location:

City CAMERINO

Address VIA MADONNA DELLE CARCERI 9

Academic Year 2010-2011

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2. Presentation

The Laurea Magistrale in Mathematics and Applications aims to consolidate the education in mathematics of his graduates by providing a broad range of advanced courses in algebra, geometry, analysis and mathematical physics, such training accompanied by a significant logical rigor, but also aims to develop the student ability to develop and use methods and mathematical models applied in various fields. The course is designed to give the student the choice between a course in which are accentuated the fundamental aspects of mathematics and a path where more attention is paid to issues related to applications.

Graduates in Laurea Magistrale in Mathematics and Applications will be able to:

- continue the program study and research in PhD programs in Mathematics and Applied Mathematics;
- exercise functions of high responsibility in the communication of mathematics and science;
- carry out high responsibility functions in the construction and development of computational mathematical models in various application areas such as environmental, health, finance, services and public administration.

To this end, the course includes

- learning activities that are characterized by high logical rigor and a level of abstraction, especially on specialized topics of mathematics;
- may provide computational and computer lab activities, especially dedicated to the knowledge of computer applications, programming languages and computing;
- may, in relation to specific targets, include outside activities such as internships in companies and laboratories, and study visits at other Italian and European universities, even in the framework of international agreements;

3. Learning outcomes

The main characteristics of graduates of the Laurea Magistrale in Mathematics and Applications at the University of Camerino are:

- a solid preparation in mathematics and in the methods of this discipline;
- a thorough knowledge of the scientific method;
- advanced computational and data competence;
- high language skills;
- specialist knowledge of mathematics, also contextualized to other sciences and fields of application.

The preparation of the final thesis is an important element. In this period the student, under the guidance of a professor will pursuing a research activity on a topic of particular interest and relevance in mathematics basic or applied.

The course is organized by tying a portion of the offer to courses of institutional nature with the objective of an expansion and completion of the student mathematics culture.

Moreover, in-depth courses re provided which are devoted to the study of advanced topics in different fields of mathematics, with a focus on topics of current research points in mathematics.

Knowledge and understanding

- Have advanced knowledge in the field of classical and modern mathematics in the areas of analysis, geometry, algebra and logic, statistics and probability, mathematical physics, numerical analysis and operations research.
- Knowing in detail the scientific method.
- Have capacity of abstraction, particularly in developing logical theories and their formal relations.
- Have advanced computational and computer science expertise.

These results are acquired through lectures, classroom exercises, individual study and home assignments. The verification of the results is carried out through midterm examinations and written or oral exams at the end of teaching activity.

Applying knowledge and understanding

- Formalize mathematical problems of high difficulty formulated in natural non-mathematical language identifying structural components and applying the more appropriate mathematical techniques.
- Analyze and solve complex problems, even in applicative contexts.
- Demonstrate familiarity with abstract thinking and the logical development of formal theories.
- Produce demonstrations of theorems not identical to those known in the literature but clearly related applying similar demonstration schemes.
- To build mathematical models to analyze real-world situations in the economic/financial fields using specific solution algorithms.
- Formulate complex problems optimizing the solution and interpreting it in the new original contexts.

These results are acquired through classroom exercises, individual study, home assignments, laboratory activities, work group experience. The verification of the results is carried out through midterm examinations and written or oral exams at the end of teaching activity.

Making judgements

- To possess relational and decisional capabilities, and to be able to work in autonomy, taking scientific and organizational responsibility.
- Build and develop logical arguments identifying assumptions and conclusions and evaluate the potential of these.
- Validate, recognizing the correctness, a demonstration or individuate mathematical errors or incomplete results and propose corrections or additions.
- Generalize known mathematical results.

These results are primarily acquired through individual study, preparation of seminars and of the final thesis. The verification is done primarily through seminar presentations and final discussion of the thesis.

Communication skills

- Communicate to specialists in the field and to non-specialists the problems and methods of mathematics.
- Present the results of his/her research activity, scientific literature search both to a specialized audience and to a non-specialist public.
- Use fluently in written and oral form, at least one European Union language besides Italian, with reference to disciplinary vocabularies.

These results are acquired through the preparation of seminars in English language and the preparation of the final thesis. The verification of the results is obtained through the seminars and at the final thesis defense.

Learning skills

- Identify and acquire by themselves even complex techniques and scientific methodologies to be used in the workplace in collaboration with experts from other disciplines
- Read and learn a subject of mathematical literature.
- Identify, through bibliographic research, the scientific frontier in the different areas of mathematics.
- Continue, even through the reading of advanced scientific articles in Italian and International journals, a study in specific areas of mathematics

These results are acquired through personal study, home assignments, preparation of seminar, reading advanced math and scientific articles in Italian and English and internships experience.

The verification of the results is obtained through written and/or oral exams at the end of teaching and seminar presentation.

4. Required knowledge for access

Students who wish to Laurea Magistrale in Mathematics and Applications must be in possession of a diploma or other degree, which is recognized as eligible in accordance with the legislation in force.

To access the Laurea Magistrale program, it is required that students have already acquired at least 30 credits in basic mathematics, in addition to possession of a certificate of proficiency in the English language at least level B1 or have acquired at least 3 credits in the English language in University level courses.

Students wishing to enroll the Laurea Magistrale in Mathematics and Applications, regardless of previous studies, must

know and understand the calculus in one and more variables, linear algebra and the fundamentals of basic mathematics; moreover, they must also be able to read and understand advanced math texts and read research articles in mathematics.

For students from courses other than degrees in Mathematics may be identified personalized study paths, always respecting the laws in force and ensuring the achievement of educational goals of the Master. The possession of these skills by the student, which is the prerequisite for entry to the Master of Science in mathematics, will be determined by a specific commission. The Commission's assessment must reflect the curriculum of the student (where appropriate integrated program of training activities) and can include an oral interview.

5. ***Employment areas for graduates and professional job***

Graduates in Laurea Magistrale in Mathematics and Applications will be able to:

- continue the program study and research in PhD programs in Mathematics and Applied Mathematics;
- exercise functions of high responsibility in the communication of mathematics and science;
- carry out high responsibility functions in the construction and development of computational mathematical models in various application areas such as environmental, health, finance, services and public administration.

The course is also the second stage of a study program that continuing with the PhD program, or a training specific program for teaching, leads to job opportunities in the roles of teachers in secondary and post-secondary school and University lecturer and professor.

Graduates in Mathematics will have access to the following study programs:

- PhD programs
- School of Specialization for Teaching or similar in order to achieve the teaching qualification;
- Second-level University Masters.

The course prepares the professions of

- Mathematicians, statisticians and related professionals
- Researchers, graduates technicians.

6. ***Organization of the Teaching Program***

University Credits (CFU)

The acquisition of skills and knowledge by students is recorded as university credits (CFU). Credits represent the task of learning, including individual study, practice exercises and laboratory work, that required to be done by the students for obtaining the Laurea Magistrale in Mathematica and Applications

The average workload of a year by a student engaged in full-time university studies and have adequate initial preparation is set in 60 credits.

To achieve the Laurea Magistrale in Mathematics and Applications, the student must have acquired 120 credits.

Normally, the teaching activities maintain a ratio of 1 to 3 between frontal lecturing and individual study.

The articulation in four semesters of the Laurea Magistrale in Mathematics and Applications and its total duration (two years) are indicative and used as a reference in the course organization. However, the student could achieve those credits and the corresponding title in less than two years.

A credit corresponds to a standard load of 25 hours of work. As a way of illustration, a credit may correspond to 7 hours of frontal lecturing in classroom, or 6 hours of lecturing and 2 hours of exercise. These values may vary depending on the type of instruction, for example, in the case of laboratory activities, or where the exercise is a replacement for individual work, a credit could correspond to 10 hours of guided work and more 15 hours of personal study. Finally, a credit would be 25 hours of student workload in the preparation of the final thesis.

Evaluation modality and Timetable

A review of the skills acquired in training every single (or groups of them) is through the assessment of a written and / or an All activities leading to the acquisition of credits must be evaluated. The assessment is carried out by special committees chaired by the responsible of the educational activity. The assessment tests can be conducted in writing and / or orally, or other procedures suited to a particular type of activity can be utilized. In some cases, there could also be a midterm exam, for which participation is optional for the student and any negative result will not preclude admission to the final exam. For courses subdivided into modules, evidence verifying preparation of the students can be carried out at the end of each module.

Unless otherwise indicated, learning activities are evaluated by a mark out of thirty, with the possibility of the additional recognition of "lode" (with praise). For the credits for work experience or internship, verification of attendance is required and a report on the activities countersigned by the teacher / supervisor. The evaluation can be expressed with only two possible grades: "satisfactory" or "not satisfactory".

Teaching is divided into 2 semesters according to the following calendar:

Teaching for Semester I: October 4 2010 – January 28 2011.

Session I Exams: January 31 2011 – February 26 2011

Teaching for Semester II: February 28 2011– June 10 2011

Session II Exams: June 13 2011 – July 30 2011

Session III Exams: September 1 2011 – October 1 2011.

Study plans

| I YEAR | | | | | | |
|--------|--|-----|--|-------------|----------|-------------------|
| N | Teaching Activity | CFU | Modules | CFU and SSD | Typology | Mark or pass/fail |
| 1 | Analisi funzionale (*) | 6 | | MAT/05 | b | Mark |
| 2 | Geometria Superiore (*) | 12 | Varietà Differenziabili Geometria Differenziale | MAT/03 | b | Mark |
| 3 | Logica, Numeri e Crittografia (*) | 12 | Logica Matematica Numeri e Crittografia | MAT/01 | b | Mark |
| 4 | Probabilità e Processi Stocastici (**) | 12 | Probabilità Processi Stocastici | MAT/06 | b | Mark |
| 5 | Meccanica Superiore (**) | 12 | Sistemi Dinamici Sistemi Complessi | MAT/07 | b | Mark |
| 6 | Insegnamento Affine (Gruppo B) 1 | 6 | | | c | Mark/pass-fail |
| 7 | Insegnamento Libero 1 | 6 | | | d | Mark/pass-fail |
| 8 | Insegnamento Affine (Gruppo A) 1 | 6 | | | c | Mark |
| 9 | Insegnamento Affine (Gruppo A) 2 | 6 | | | c | Mark |

| II YEAR | | | | | | |
|---------|--|------|--|-------------|----------|-------------------|
| N | Teaching Activity | CFUi | Modules | CFU and SSD | Typology | Mark or pass/fail |
| 1 | Analisi superiore (*) | 6 | | MAT/05 | b | Mark |
| 2 | Matematica per le Applicazione 3 | 12 | Metodi numerici per le equazioni differenziali | MAT/08 | b | Mark |
| | | | Ottimizzazione combinatoria | MAT/09 | | |
| 3 | Insegnamento Affine (Gruppo B) 2 | 6 | | | c | Mark |
| 4 | Insegnamento Libero 2 | 6 | | | d | Mark |
| 5 | Insegnamento Affine (Gruppo A) 3 | 6 | | | c | Mark/pass-fail |
| 6 | Prova Finale e Ulteriori attività formative (art.10, comma 5, Ulteriori conoscenze linguistiche 0 - 6 lettera d) | 30 | | | e | Mark |

In the 2 years, the students must acquire 24 credits among the teaching activities marked by (*)

In the 2 years, the students must acquire 24 credits among the teaching activities marked by (**)

(#)

- a** attività formative di base
- b** attività formative caratterizzanti
- c** attività formative affini o integrative
- d** attività formative a scelta dello studente
- e** per la prova finale e per la conoscenza della lingua straniera
- f** altre (ulteriori conoscenze linguistiche, abilità informatiche e relazionali, stage etc.)
- g** ambito aggregato per crediti di sede
- s** Tirocinio

The list of activities (Group A and Group B) offered for the academic year 2009/2010 is shown below. Students may also choose to achieve 6 CFU (Group A) conducting study or research (Independent Study and Research) under the supervision of a responsible teacher. This activity cannot be combined in any way with the final preparation of the thesis, even if it is conducted under the supervision of the advisor of the final thesis. Before the start of this activity, students must submit, in accordance with the teacher and agree a program of study and research. Such a program must be validated by the Class. To this activity training will be given a grade in 30th. The composition of the examination Committee will be defined by the class.

| Teaching activities (Gruppo A) | | |
|----------------------------------|-----|---------|
| Academic Year 2010-2011 | | |
| Attività formativa | CFU | Settore |
| Calcolo parallelo | 6 | MAT/08 |
| Didattica della matematica | 6 | MAT/04 |
| Problemi inversi ed applicazioni | 6 | MAT/05 |
| Geometria 4 | 6 | MAT/03 |
| Teoria ergodica | 6 | MAT/07 |
| Independent Study and Research | 6 | MAT/* |

| Attività Affini (Gruppo B) | | |
|-----------------------------|-----|----------------|
| (lista parziale) | | |
| Attività formativa | CFU | Settore |
| Computazione Quantistica | 6 | FIS/02 |
| Computabilità e complessità | 6 | INF(01 |
| Grafica computazionale | 6 | ING- IND/06 |
| Sistemi per l'automazione | 12 | ING-INF/04 |

Students can choose activities (particularly for the Group B) by choosing courses from the Lauree Magistrali in classes LM-17 and LM-18 not listed above. The appropriateness of this proposal with the final preparation student will be assessed by the class that will then allow the choice of the student.

Final exam and title acquisition

Objective of the final exam is to check the ability of students to present and discuss a mathematical topic orally and in writing, with clarity and mastery. The work, whether theoretical or experimental, will develop the critical abilities of the student and take place under the guidance of a advisor, usually a member of the Faculty appointed by the Chairman.

The student can start the preparation of the final thesis only after having acquired at least 60 credits. The final exam consists of public discussion of written paper, and it is addressed to assess the general preparation of the student.

The degree, expressed in 110th with the possibility of the additional recognition of "lode" (with praise), evaluates the student's curriculum, his preparation and scientific achievements by the end of their course of study. The exam will be taken in front of a special Committee constituted in accordance with the University rules.

7. Course timetable

Annex A contains the information on the courses offered in academic year 2010-2011

- for new students and are at the 1st year
- for students that started in 2009 and are now at their 2nd year

Annex A

| |
|---------------|
| Year 1 |
|---------------|

| Attività formativa | Modulo | SSD attività | Semestre | Tipologia attività (*) | CFU | n. ore lez. | ore eserc | ore lab | Docente Cognome | Docente Nome | Scuola di appartenenza |
|-----------------------------------|-------------------------|--------------|----------|------------------------|-----|-------------|-----------|---------|-----------------|-----------------|------------------------|
| Analisi funzionale | | MAT/05 | I | b | 6.0 | 42 | | | Giannoni | Fabio | Scienze e tecnologie |
| Geometria superiore | Varietà differenziabili | MAT/03 | I | b | 6.0 | 42 | | | Spiro | Andrea | Scienze e tecnologie |
| Geometria superiore | Geometria differenziale | MAT/03 | II | b | 6.0 | 42 | | | Spiro | Andrea | Scienze e tecnologie |
| Logica, numeri e crittografia | Logica matematica | MAT/01 | I | b | 6.0 | 42 | | | Toffalori | Carlo | Scienze e tecnologie |
| Logica, numeri e crittografia | Numeri e crittografia | MAT/01 | II | b | 6.0 | 42 | | | Toffalori | Carlo | Scienze e tecnologie |
| Meccanica superiore | Sistemi dinamici | MAT/07 | II | b | 6.0 | 42 | | | Mangiarotti | Luigi | Scienze e tecnologie |
| Meccanica superiore | Sistemi complessi | MAT/07 | I | b | 6.0 | 42 | | | Isola | Stefano | Scienze e tecnologie |
| Probabilità e processi stocastici | Probabilità | MAT/06 | I | b | 6.0 | 42 | | | Bernabei | Maria Simonetta | Scienze e tecnologie |
| Probabilità e processi stocastici | Processi stocastici | MAT/06 | II | b | 6.0 | 42 | | | Thaler | Horst | Scienze e tecnologie |
| Calcolo parallelo | | MAT/08 | I | c | 6.0 | 42 | | | Misici | Luciano | Scienze e tecnologie |
| Didattica della matematica | | MAT/04 | I | b | 6.0 | 42 | | | | | |
| Problemi inversi ed applicazioni | | MAT/05 | I | c | 6.0 | 42 | | | Maponi | Pierluigi | Scienze e tecnologie |
| Geometria 4 | | MAT/03 | II | c | 6.0 | 42 | | | Piergallini | Riccardo | Scienze e tecnologie |
| Teoria ergodica | | MAT/07 | I | c | 6.0 | 42 | | | Isola | Stefano | Scienze e tecnologie |
| Computabilità e complessità | | INF/01 | I | c | 6.0 | 42 | | | Toffalori | Carlo | Scienze e tecnologie |
| Grafica computazionale | | ING-IND/06 | II | c | 6.0 | 42 | | | Maponi | Pierluigi | Scienze e tecnologie |
| Computazione quantistica | | FIS/02 | I | c | 6.0 | 42 | | | Mancini | Stefano | Scienze e tecnologie |
| Sistemi per l'automazione | | ING-INF/04 | I | c | 6.0 | 42 | | | Corradini | Maria Letizia | Scienze e tecnologie |

Year 2

| Attività formativa | Modulo | SSD attività | Semestre | Tipologia attività (*) | CFU | n. ore lez. | ore eserc | ore lab | Docente Cognome | Docente Nome | Scuola di appartenenza |
|----------------------------------|--|--------------|----------|------------------------|-----|-------------|-----------|---------|-----------------|---------------|------------------------|
| Calcolo parallelo | | MAT/08 | I | c | 6.0 | 42 | | | Misici | Luciano | Scienze e tecnologie |
| Didattica della matematica | | MAT/04 | I | b | 6.0 | 42 | | | | | |
| Problemi inversi ed applicazioni | | MAT/05 | I | c | 6.0 | 42 | | | Maponi | Pierluigi | Scienze e tecnologie |
| Geometria 4 | | MAT/03 | II | c | 6.0 | 42 | | | Piergallini | Riccardo | Scienze e tecnologie |
| Teoria ergodica | | MAT/07 | I | c | 6.0 | 42 | | | Isola | Stefano | Scienze e tecnologie |
| Computabilità e complessità | | INF/01 | I | c | 6.0 | 42 | | | Toffalori | Carlo | Scienze e tecnologie |
| Grafica computazionale | | ING-IND/06 | II | c | 6.0 | 42 | | | Maponi | Pierluigi | Scienze e tecnologie |
| Computazione quantistica | | FIS/02 | I | c | 6.0 | 42 | | | Mancini | Stefano | Scienze e tecnologie |
| Sistemi per l'automazione | | ING-INF/04 | I | c | 6.0 | 42 | | | Corradini | Maria Letizia | Scienze e tecnologie |
| Analisi superiore | | MAT/05 | I | b | 6.0 | 42 | | | Giambò | Roberto | Scienze e tecnologie |
| Matematica per le Applicazione 3 | Metodi numerici per le equazioni differenziali | MAT/08 | II | b | 6.0 | 42 | | | Maponi | Pierluigi | Scienze e tecnologie |
| Matematica per le Applicazione 3 | Ottimizzazione combinatoria | MAT/09 | I | b | 6.0 | 42 | | | De Leone | Renato | Scienze e tecnologie |

Legend:

- (*)
- a introductory course
 - b core course
 - c supplementary course
 - d elective course
 - e for the final exam and for knowledge of a foreign language
 - f other (additional language skills, computer skills, internship/work experience stage etc.)
 - s stage