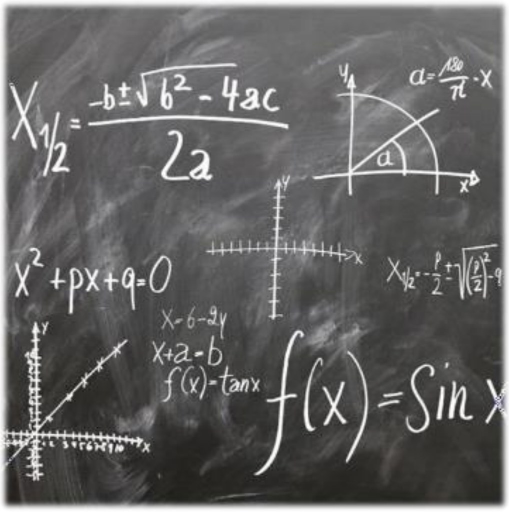
Università degli Studi di Napoli Federico II

BACHELOR'S DEGREE IN
COMPUTER ENGINEERING

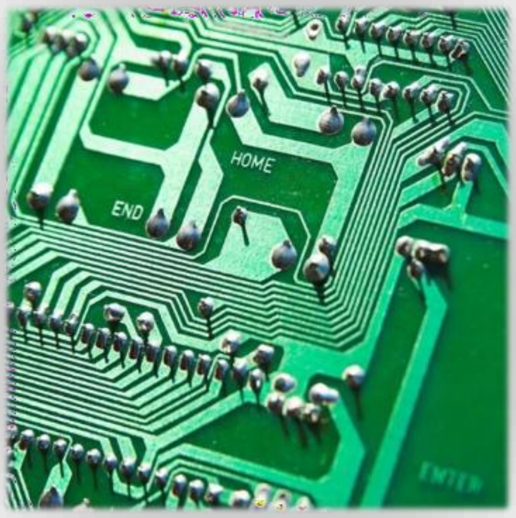
Scuola Politecnica e delle Scienze di Base

Department of Electrical Engineering and Information technology

What students will learn



A solid training in the basic disciplines: mathematical analysis, physics, geometry and algebra, basic computer science.



A broad training in related disciplines typical of the cultural background of an information engineer: electrical engineering, electronics, electrical and electronic measurements.

A wide and in-depth training in the characterizing engineering disciplines: computer science, automation, telecommunications..

The course in brief

The aim of the Bachelor’s Degree in Computer Engineering is to train an engineer with professional skills in the areas of processing systems, software applications, data and telematic systems, able to fit into very differentiated production realities characterized by rapid evolution.

The Bachelor graduate in Computer Engineering must, in general, be able to carry out activities in the design, implementation, management and operation of information processing systems. More specifically, the specific educational objectives of the degree in Computer Engineering is to provide graduates with professional skills - in the areas of processing systems, software applications and telematic systems – for:

the definition of project specifications and implementation of applications;

the sizing, management and maintenance of systems and applications;

the management of the introduction of technological innovations related to information technologies in the production realities – very differentiated – in which it will be called to operate.

The Bachelor graduate in Computer Engineering will have to combine basic, methodological and technical knowledge with professionalizing skills; he/she may work in teams with master's degree graduates, depending on the complexity of the project.

During this course of study the student will learn the following:

a solid training in the basic disciplines: mathematical analysis, physics, geometry and algebra, basic computer science;

a solid training in the related and characterizing disciplines typical of the cultural baggage of an information engineer: electrical engineering, electronics, telecommunications, automation and electrical and electronic measurements.

a wide and in-depth training in the disciplines of computer engineering: processing architectures, design and development of software systems, databases, basic software and network applications.

Website

ACADEMIC YEAR 2024/2025

Job opportunities

The specific preparation of the computer engineers makes them among the most sought-after professionals on the labor market, offering job placement opportunities in multiple and varied areas of hardware and software production, such as:
manufacturing, service and public administration industries; companies in the design and production of electronic equipment and systems; automation industries;
companies operating in the area of information systems and computer networks; IT service companies of the public administration; IT service companies.

In these areas, the duties of a software engineer are as follows:
development of corporate IT systems, both for the software part and for the data part;
development of embedded systems and basic software;
design and development of multimedia and artificial intelligence applications; design and development of telematics and Web applications.

The Bachelor’s Degree in Computer Engineering finds a natural completion in the Master's Degree in Computer Engineering.

Admission procedure

As for all the Degree Courses in Engineering of the University of Naples Federico II, there is a non-selective but mandatory orientation test. The test (TOLC-I) is provided by the CISIA Interuniversity Consortium with a uniform structure throughout the country and is based on a multiple choice questionnaire on topics of Mathematics, Science, Logic and Verbal Comprehension.

The TOLC can be taken online from February to November of each year. If the result of the test is negative, enrolment is allowed but there is a training debt to be filled.
For more information see the dedicated page of the Polytechnic School and Basic Sciences: admission to courses.

The website of the CISIA Interuniversity Consortium:
home tolc.

Final exam

The Bachelor's Degree in Computer Engineering is obtained after having taken a final exam to which only students that have obtained all the credits provided in their study plan (excluding those relating to the final exam itself) are admitted. The Study Programme has set up an automatic system to support students in the choice, management and final drafting of the final exam (all information can be found at the following link: Degree N46.

The test consists in the discussion of a report, which focuses on training activities carried out as part of one or more courses or internship activities.

The final exam is taken by the Candidate before a Commission chaired by the Coordinator of the Study Programme and consists in the discussion of the work carried out with the members of the Commission.

At the end of the presentation, each teacher can address comments to the candidate, related to the topic of the thesis work.The thesis discussion lasts 5 minutes.

Contacts

Didactic Coordinator of the Study Programmes in Computer Engineering:
Prof. Domenico Cotroneo
Department of Electrical Engineering and Information Technologies
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Contact person of the Degree Course for the ERASMUS+ Program:
Prof. Simon Pietro Romano
Department of Electrical Engineering and Information Technologies – Tel. 081/7683823 – email: spromano@unina.it

Contact person of the Degree Course for internships:
Prof. Antonio Pescapè
Department of Electrical Engineering and Information Technologies Tel. 081/7683856 – email: pescape@unina.it

Contact person for Orientation:
Prof. Michela Gravina
Department of Electrical Engineering and Information Technologies
Email: michela.gravina@unina.it

Study plan

Visit the following link to see all the information on the study plan, the assignment of course teachers and further information.

First year courses

Course name	Sem.	CFU	SSD	TEA (*)	Prerequisites
Analisi matematica I	I	9	MAT/05	A	
Fisica generale I	I	6	FIS/01	A	
Fondamenti di informatica	I	9	ING-INF/05	A	
Geometria e algebra	II	6	MAT/03	A	
Analisi matematica II	II	6	MAT/05	A	Analisi matematica I
Fisica generale II	II	6	FIS/01	A	Fisica generale I
Calcolatori elettronici	II	9	ING-INF/05	B	
Lingua inglese	II	3		E	

Second year courses

Course name	Sem.	CFU	SSD	TEA (*)	Prerequisites
Metodi matematici per l'ingegneria	I	8	MAT/05	A	Analisi matematica II Geometria e algebra
Fondamenti di circuiti	I	9	ING-IND/31	C	Analisi matematica I
Teoria dei segnali	I	9	ING-INF/03	B	Analisi matematica I
Programmazione	II	9	ING-INF/05	B	Fondamenti di informatica
Teoria dei sistemi	II	9	ING-INF/04	B	Fisica generale II
Elettronica I	II	9	ING-INF/01	C	Analisi matematica II Fisica generale II

Third year course

Course name	Sem.	CFU	SSD	TEA (*)	Prerequisites
Fondamenti di misure	I	6	ING-INF/07	C	Fondamenti di circuiti
Ulteriori conoscenze: laboratorio di misure	I	3		F	
Basi di dati	I	9	ING-INF/05	B	Fondamenti di informatica
Sistemi operativi	I	9	ING-INF/05	B	Programmazione Calcolatori elettronici
Reti di calcolatori	I	9	ING-INF/05	B	Calcolatori elettronici
Ingegneria del software	II	10	ING-INF/05	B	Programmazione Basi di dati
Controlli automatici	II	9	ING-INF/04	B	Teoria dei sistemi Metodi matematici per l'ingegneria
Courses of autonomous choice		15		D	
Final exam (Thesis)	II	3		E	

Table A of courses of autonomous choice

Course name	SSD	Sem.	CFU	TEA (*)	Prerequisites	Source course
Elementi di Intelligenza artificiale	ING-INF/05	II	6	D	Programmazione	
Sistemi multimediali	ING-INF/05	II	6	D	Basi di dati	
Tecnologie Informatiche per l'Automazione Industriale	ING-INF/04	II	6	D	Programmazione	
Campi Elettromagnetici	ING-INF/02	II	9	D		
Advanced Computer Programming	ING-INF/05	II	9	D	Programmazione	

*TEA (Type of Educational Activity)
A = Base
B = Characterising
C = Related or Supplementary
D = Activities of your choice
E = Final exam and language skills
F = Further training activities

Calendar of educational activities

	Start	End
1st teaching period	16/09/2024	20/12/2024
Mandatory **ordinary** exams	**1 exam in January and 1 in February**	
2nd teaching period	05/03/2025	13/06/2025
Mandatory **ordinary** exams	**1 exam in June, 1 in July and 1 in September**	
Mandatory **recovery** exams	1 exam in the period 10/03/25-31/03/25 and 1 exam in the period 20/10/25-14/11/25	

COURSE DETAILS

"ADVANCED COMPUTER PROGRAMMING"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Programmazione.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course aims at providing students with advanced knowledge and expertise related to concurrent and distributed programming, introducing the tools to develop and debug multithreading and network applications using Java and Python, and introducing the concept of middleware and of the different solutions used in industry, focusing on both the message- oriented and service-oriented models, with application on real technology.
The course also introduces the concepts and tools for web-application development, from both the fornt-end and back-end perspective.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student needs to demonstrate to know and understand the problems concerning concurrent and distributed programming, mainly in Java and Python, as well as the characteristics of the different middleware technologies.
The course provides students with knowledge and methodological, theoretical and practical tools needed to recognize, analyze and resolve problems related to the development of multithreading and network applications, allowing the students to master the development of advanced software projects in Java and Python.

Applying knowledge and understanding

The student needs to show ability to solve problems related to the concurrent and distributed programming, using the methodological, theoretical and practical competences concerning the advanced computer programming introduced during the course, in order to develop multithreading and network software projects in Java and Python.

COURSE CONTENT/SYLLABUS

Concurrent and network programming in Java.

Java overview and collection classes. Concurrent programming in java. Threads in java, states of a threads, threads pool.Synchronization in Java. Java monitor and the package java.util.concurrent of Java 1.5. Build automation tool and Java debugging. Generic programming, reflection and annotation Java.
Network programming on Java network. The java.net package. Socket TCP in Java: Socket and ServerSocket classes. Socket UDP in Java: DatagramSocket and DatagramPacket classes. Server multithread. Remote objectabstraction. Proxy-Skeleton.

Middleware models.

Definition and properties of the middleware level. Enterprise Application Integration (EAI). Remote Procedure Call (RPC),Message Oriented (MOM), Transaction Processing (TP), Tuple Space (TS), Remote Data Access (RDA), Distributed Object(DOM), Component model (CM), web services, microservices.

Object oriented model.

Java Message Service (JMS) specification, client and provider. Point-to-point and publish-subscribe communication. Modellodi programmazione JMS. Messaggi JMS ed aspetti avanzati.

Service model and web-app application development.

Introduction to SOAP and RPC service. RESTful Web Services, resource and Uniform Resource Identifier (URI). RESTful services and HTTP methods. RESTful Web Services development with Java framework and web-app development with HTML, Javascript and front-end development framework.

The Python language.

Data type, control statements, argument passing, data collection, file, functions, modules and debugging in Python. Object-oriented programming in Python: classes, objects, inheritance, polymorphism, abstract classes. Concurrent and network programming in Python: multithreading, synchronization, socket. Multi-language integration example. Data

Science in Python.

READINGS/BIBLIOGRAPHY

- Slides of the course.
- Books:
  - B. Eckel, *"Thinking in Java".*
  - L. H. Etzkorn, *"Introduction to Middleware - Web Services, Object Components, and Cloud Computing".*
  - Semmy Purewal, *"Learning Web App Development".*
  - Craig Walls, *"Spring in Action".*
  - Allen B. Downey, *"Think Python".*
  - Mark Lutz, *"Programming Python".*
- Training material.
- On-line resources.

TEACHING METHODS

Lectures and practical exercises.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	Computer-based coding exam

In case of a written exam, questions referto:	**Multiple choice answers**	
	Open answers	
	Numerical exercises	

b) Evaluation pattern:

The written exam performance is binding to have access to the oral exam. Midterm evaluations could be scheduled in place of the written exam.

COURSE DETAILS

"ANALISI MATEMATICA I"

SSD MAT/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): I

SEMESTER (I, II): I

CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None.

PREREQUISITES (IF APPLICABLE)

The mathematical content of secondary school curricula.

LEARNING GOALS

Provide the fundamental concepts, in view of applications, related to infinitesimal, differential and integral calculus for real functions of a real variable; to acquire adequate skills of logical formalization and conscious operational ability.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge of the notions (definitions, statements, demonstrations if provided by the program) related to infinitesimal, differential and integral calculus for the real functions of a real variable and the calculation tools developed, and be able to understand related topics by elaborating the acquired notions.

Applying knowledge and understanding

The student must demonstrate to be able to apply what has been learned in the resolution of verification exercises developed by the teacher, in principle related to topics such as: fields of existence, limits of sequences and functions, numerical series, function studies, definite and indefinite integration.

COURSE CONTENT/SYLLABUS

(0.5 CFU) Sequences and series of functions.

Punctual and uniform convergence; punctual and uniform Cauchy convergence criteria. Theorems on the continuity of the uniform limit, of passage to the limit under the sign of integral and derivative. Absolutely convergent and totally convergent series; Cauchy criteria for series; Total convergence and uniform convergence. Continuity theorems of the uniform sum of a series, of integration by series and derivation by series. Taylor series: developability and remarkable developments. Analytical functions.

(2 CFU) Differential calculus for functions of several variables.

Topology elements. Euclidean distance; Definition of around. Internal points, external points, border points. Open and closed sets; accumulation points and isolated points. Limited sets; Bolzano–Weierstrass theorem. Compactness and characterization of compacts. Convexity and connection. Functions of several variables: limits, continuity and relative properties; Weierstrass theorem. Partial derivatives; differentiability and differential theorem; directional derivatives and gradient; derivation of compound functions. Zero-gradient functions in a connected open. Higher-order derivatives and Schwarz's theorem. Lagrange's theorem. Taylor's formula of the first and second order. Relative extremes: necessary condition of the first order. Relative extremes of functions of two variables: necessary condition of the second order, sufficient condition of the second order. Search for absolute maxima and minima of continuous functions in compact sets of the plane. Relative extremes of functions of three variables: sufficient conditions. Positively homogeneous functions, Euler's theorem. Implicit functions. Local equivalence of a plane curve with a graph. Dini's theorem for equations of the type $f(x,y)=0$. Constrained maxima and minima of functions of two variables. Theorem on Lagrange multipliers.
Regular and generally regular curves: tangent line; oriented curves. Length of a curve, rectification of regular curves. Curvilinear abscissa The curvature of a planar curve. Curvilinear integral of a function.
Double integrals on normal domains. Integrability of continuous functions. Reduction formulas for double integrals. Change of variables in double integrals. Triple integrals; reduction formulas; change of variables. Rotation solids and Guldino's theorem.

(0.5 CFU) Curves.

Regular and generally regular curves: tangent line; oriented curves. Length of a curve, rectification of regular curves. Curvilinear abscissa The curvature of a planar curve. Curvilinear integral of a function.

(0.5 CFU) Multiple integrals.

Double integrals on normal domains. Integrability of continuous functions. Reduction formulas for double integrals.

Change of variables in double integrals. Triple integrals; reduction formulas; change of variables. Rotation solids and Guldino's theorem.

(0.5 cfu) Surfaces.
Regular surfaces: tangent plane; adjustable surfaces; surfaces with edge; closed surfaces. The area of a surface. Rotation surfaces and Guldino's theorem. Surface integral of a function. Flow integrals of a vector field. Divergence theorem in R_3.

(1 CFU) Linear differential forms.
Exact differential forms and conservative fields. Curvilinear integral of a linear differential form. Criterion of integrability of differential forms. Closed differential forms. Poincaré's lemma. Radial shapes. Homogeneous shapes. Gauss-Green formulas in the plan. Divergence theorem in the plane. Stokes formula in the plan. Closed differential forms in simply connected open planes. Differential forms in space. Irrotational fields. Stokes formula in R3. Closed differential forms in simply connected open spaces.

(1 CFU) Differential equations.
Cauchy problem for differential equations of order *n*: theorems of existence and local and global uniqueness. General integrals; particular integrals, singular integrals. Linear differential equations of order *n*: **theorem on the general integral of a** homogeneous equation, Wronsky's theorem, theorem on the general integral of a complete equation. First-order linear equations; linear equations with constant coefficients. Method of variation of constants. Separable variable equations. Equations of the form y'=f(y/x). Bernoulli equations. Equations of the form y''=f(x,y')

READINGS/BIBLIOGRAPHY
SEE THE TEACHER'S WEBSITE

TEACHING METHODS
The lessons will be frontal, and about a third of the lessons will be exercised.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	X
	Open answers	X
	Numerical exercises	X

COURSE DETAILS

"ANALISI MATEMATICA II"

SSD MAT/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE “REGOLAMENTO”)

Analisi matematica I.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

Fornire i concetti fondamentali, in vista delle applicazioni, relativi al calcolo differenziale e integrale per le funzioni reali di più variabili reali, **e alle equazioni differenziali ordinarie**; fare acquisire abilità operativa consapevole.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge of the notions (definitions, statements, demonstrations if foreseen by theprogram) related to infinitesimal, differential and integral calculus for real functions of several real variables and the calculation tools developed, and be able to understand related topics by elaborating the acquired notions.

Applying knowledge and understanding

The student must demonstrate to be able to apply what has been learned in the resolution of verification exercises developed by the teacher, in principle related to topics such as: sequences and series of functions, limits and studiesof functions of several variables, multiple integration, ordinary differential equations and Cauchy problems.

COURSE CONTENT/SYLLABUS

(0.5 CFU) Sequences and series of functions.

Punctual and uniform convergence; punctual and uniform Cauchy convergence criteria. Theorems on the continuity ofthe uniform limit, of passage to the limit under the sign of integral and derivative. Absolutely convergent and totally convergent series; Cauchy criteria for series; Total convergence and uniform convergence. Continuity theorems of theuniform sum of a series, of integration by series and derivation by series. Taylor series: developability and remarkable developments. Analytical functions.

(2 CFU) Differential calculus for functions of several variables.

Topology elements. Euclidean distance; Definition of around. Internal points, external points, border points. Open andclosed sets; accumulation points and isolated points. Limited sets; Bolzano–Weierstrass theorem. Compactness and characterization of compacts. Convexity and connection. Functions of several variables: limits, continuity and relative properties; Weierstrass theorem. Partial derivatives; differentiability and differential theorem; directional derivatives and gradient; derivation of compound functions. Zero-gradient functions in a connected open. Higher-order derivatives and Schwarz's theorem. Lagrange's theorem. Taylor's formula of the first and second order. Relative extremes: necessary condition of the first order. Relative extremes of functions of two variables: necessary condition of the second order, sufficient condition of the second order. Search for absolute maxima and minima of continuous functions in compact sets of the plane. Relative extremes of functions of three variables: sufficient conditions.

Positively homogeneous functions, Euler's theorem. Implicit functions. Local equivalence of a plane curve with agraph. Dini's theorem for equations of the type f(x,y)=0. Constrained maxima and minima of functions of two variables. Theorem on Lagrange multipliers.

Regular and generally regular curves: tangent line; oriented curves. Length of a curve, rectification of regular curves.Curvilinear abscissa The curvature of a planar curve. Curvilinear integral of a function.

Double integrals on normal domains. Integrability of continuous functions. Reduction formulas for double integrals. Change of variables in double integrals. Triple integrals; reduction formulas; change of variables. Rotation solids and Guldino's theorem.

(0.5 CFU) Curves.

Regular and generally regular curves: tangent line; oriented curves. Length of a curve, rectification of regular curves. Curvilinear abscissa The curvature of a planar curve. Curvilinear integral of a function.

(0.5 CFU) Multiple integrals.

Double integrals on normal domains. Integrability of continuous functions. Reduction formulas for double integrals. Change of variables in double integrals. Triple integrals; reduction formulas; change of variables. Rotation solids andGuldino's theorem.

(0.5 cfu) Surfaces.

Regular surfaces: tangent plane; adjustable surfaces; surfaces with edge; closed surfaces. The area of a surface. Rotation surfaces and Guldino's theorem. Surface integral of a function. Flow integrals of a vector field. Divergencetheorem in R^3.

(1 CFU) Linear differential forms.

Exact differential forms and conservative fields. Curvilinear integral of a linear differential form. Criterion of integrability of differential forms. Closed differential forms. Poincaré's lemma. Radial shapes. Homogeneous shapes. Gauss-Green formulas in the plan. Divergence theorem in the plane. Stokes formula in the plan. Closed differential forms in simply connected open planes. Differential forms in space. Irrotational fields. Stokes formula in R^3. Closed differential forms in simply connected open spaces.

(1 CFU) Differential equations.

Cauchy problem for differential equations of order *n*: theorems of existence and local and global uniqueness. Generalintegrals; particular integrals, singular integrals. Linear differential equations of order *n*: **theorem on the general integral of a** homogeneous equation, Wronsky's theorem, theorem on the general integral of a complete equation.

First-order linear equations; linear equations with constant coefficients. Method of variation of constants. Separable variable equations. Equations of the form y'=f(y/x). Bernoulli equations. Equations of the form y''=f(x,y').

READINGS/BIBLIOGRAPHY

SEE THE TEACHER'S WEBSITE

TEACHING METHODS

The lessons will be frontal, and about a third of the lessons will be exercised.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	X
	Open answers	X
	Numerical exercises	X

COURSE DETAILS

"BASI DI DATI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Fondamenti di informatica.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course presents the main methodologies for the design of a relational database and the fundamental characteristics of database system technologies and architectures. Downstream of this module, students must have acquired concepts related to data modeling in software systems, the characteristics of an information and computersystem, the characteristics of a transactional system, the use of SQL (Structured Query Language) and SQL immersedin programming languages and the physical organization of a database system.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The training course aims to provide students with the basic knowledge related to relational databases, as well as those related to technologies and architectures of database systems. In addition, all the methodological and technological tools will be provided to support the design of relational databases and those for their management through the use of SQL language and DBMS (DataBase Management System) software. In particular, these tools will allow students, on the one hand, to know how to create and administer a database system, on the other, to configureit in the most appropriate way to support the applications that interact with it.

Applying knowledge and understanding

The training course is aimed at transmitting the methodological and operational skills and tools necessary to concretely apply the knowledge related to relational databases and SQL language for the creation and management ofdatabase systems. In particular, the student must demonstrate to be able to design, create, populate and query a relational database, as well as to manage its implementation through the use of a DBMS.

COURSE CONTENT/SYLLABUS

Part Prima: Relational databases (6 CFU)

1. Computer systems. Information and computer systems. Databases and management systems (DBMS).
2. The relational model. Relationships and tables. Databases and integrity constraints. Defining data in SQL.
3. The Relationship Entity model. Design of databases. Entities, associations, and attributes. Conceptual design and examples. From the conceptual scheme to the relational scheme. Review of schemes. Translation into the logical model.
4. The Advanced Relationship Entity model. Inheritance: superclasses and subclasses. Hierarchies of generalization and specialization. Resolving hierarchies.
5. Operations. Set operations. Changing the status of the database. Relational operations in procedural and declarative form (SQL). Selection, Projection, Join. Renaming and use of variables. Aggregation and grouping functions. Set and nested queries. Views. SQL query syntax. The complete syntax of Insert, Update, and Delete.
6. Normal forms. Redundancies and anomalies in the modification of a relationship. Functional dependencies. Functional constraints and dependencies; Full dependencies. The three normal forms and decomposition techniques. The normal form of Boice and Codd.
7. SQL and programming languages. ODBC, JDBC, triggers.

Part Two: Technology of a DBMS (3 CFU)

1. Physical design of a database. Physical organization and query management. Access Structures.
2. Query handler.

3. Transactions. Reliability control and concurrency control.
4. Distributed database technology. Replicated databases.Notes on object-oriented databases. Directional databases.

READINGS/BIBLIOGRAPHY

Textbook:

- Chianese, Moscato, Picariello, Sansone. "*Sistemi di basi di dati ed applicazioni*". Apogeo Education-Maggioli Editore. Settembre 2015.

Course slides and supplementary material.

SEE WEBSITE OF THE TEACHER OF THE SUBJECT

TEACHING METHODS

The teacher will use lectures for about 60% of the total hours, and in addition computer exercises, both assisted andpersonal, to practically deepen the theoretical aspects through the tools introduced, and in-depth seminars for the remaining hours. Everything will be supported by multimedia teaching material available online.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	X
only oral	
project discussion	X
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	

The written test contains, in addition to exercises, also theoretical questions.

b) Evaluation pattern:

The written test weighs about 90% on the final evaluation, while the project workweights about 10%.

COURSE DETAILS

"CALCOLATORI ELETTRONICI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II): II
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE “REGOLAMENTO”)
None.

PREREQUISITES (IF APPLICABLE)
Basic knowledge of programming languages and fundamental algorithms to manage elementary data structures.

LEARNING GOALS
Provide methodological tools for the analysis and synthesis of elementary machines for information processing (combinatorial and sequential logical networks). Design fundamental elementary machines.
Present the fundamentals of the architecture of von Neumann electronic computers, the repertoire of operatingcodes and programming in assembly language.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding
The student must demonstrate knowledge and understanding of the problems related to the design of elementary machines with particular reference to elementary machines for elementary and arithmetic applications, sequential machines (registers, counters, flip flops). He must also demonstrate knowledge of the architectures of computers andtheir subsystems, including processor operation, how to communicate with memory, memory sizing, and connectionto various input and output devices.

Applying knowledge and understanding
The student must demonstrate to be able to design and develop elementary combinatorial networks, arithmetic combinatorial networks, sequential remains.
It must also be able to develop simple assembler language programs for the management of elementary data structures (vectors, stacks,...).

COURSE CONTENT/SYLLABUS
Analysis and synthesis of combinatorial networks. Minimization of fully and incompletely specified Boolean functions. Maps of Karnaugh. Quine-McCluskey method. Synthesis of combinatorial networks in NAND and NOR logic.Delays and hazard problems in combinatorial networks.
Elementary combinatorial networks. Multiplexer and de-multiplexer. Encoder and decoder. Equality controllers.
Elementary arithmetic machines: adders, subtractors, comparators.
Analysis and synthesis of sequential networks. Models for the timing and structure of synchronous and asynchronous sequential networks. Flip-flop: generalities, RS flip-flops with NOR ports. Flip-flop latch and edge-triggered. Flip-flop D. Switching flip-flop. Flip-flop T and JK. Logs. Serial and parallel loading. Scrolling registers. **Design methodology of synchronous networks**. Synchronous and asynchronous counters. Connecting counters.Sequence recognizers. Bus and transfers between registers.
The electronic computer: subsystems and architecture**.**
The processor. Processor algorithm. The role of the control unit. Accumulator processors and general register processors. Addressing techniques. Encoding instructions.
The central memory. Processor-memory interface. Organization of the memory system.
Connecting memory modules. Static and dynamic RAM memories. Interconnection systems and buses. Interruption mechanism. Processor protections and controls. I/O management through polling and interruptions. The I/O subsystem.
Machine language and assembler language. Correspondence between high-level languages and machine language.Motorola 68000 processor assembler language. Assembly directives.
In-memory allocation of programs.
MC68000 processor simulator. Assembly and execution of assembler language programs. Subprograms in assemblerlanguage. Techniques for passing parameters to machine language procedures.

READINGS/BIBLIOGRAPHY

Textbooks, supplementary handouts, software tools:

- G. Conte, A. Mazzeo, N. Mazzocca, P. Prinetto, "*Architettura dei calcolatori*", Città Studi Edizioni, 2015.
- C. Bolchini, C. Brandolese, F. Salice, D. Sciuto, "*Reti logiche*", Apogeo Ed., 2008.
- B. Fadini, N. Mazzocca, "*Reti logiche: complementi ed esercizi*", Liguori Editore, 1995.
- Handouts and presentations provided by teachers related to theoretical and applicative topics covered in the course.

TEACHING METHODS

The course includes about 70% of lectures in which theoretical topics are addressed, while the remaining 30% is reserved for practical lessons and exercises concerning the development of combinatorial machines, synchronous machines and development of assembler language programs.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

The exam includes a preparatory written test that includes exercises on analysis and design of combinatorialnetworks, sequential networks, development of an assembler program.

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

b) Evaluation pattern:

COURSE DETAILS

"CONTROLLI AUTOMATICI"

SSD ING-INF/04

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: LUIGI VILLANI
PHONE: 081-7683861
EMAIL: LUIGI.VILLANI@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Teoria dei sistemi, Metodi matematici per l'ingegneria.

PREREQUISITES (IF APPLICABLE)

Basic knowledge of analysis of linear dynamical systems with continuous time and discrete time. Use of Laplace, Zeta and Fourier transforms and software tools for the analysis and simulation of dynamical systems.

LEARNING GOALS

The course aims to introduce students to the design of feedback control laws for dynamical systems and illustrate their possible applications. In particular, the main methodologies for the synthesis of linear control systems, both analog and digital, are deepened. At the end of the course the student will be able to design linear controllers, alsowith the help of software tools for the analysis, design and simulation of control systems.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The training course intends to provide the methodological tools to understand the fundamental principles of automatic control and the effects of feedback on the dynamic characteristics of linear systems or systems made so after linearization. The main methodologies for designing feedback control, both analog and digital, in the time domain and in the transformed domains will be introduced. This knowledge will allow students to understand the main problems associated with the use of different synthesis methods, depending on the requirements and characteristics of the processes to be controlled.

Applying knowledge and understanding

The acquired knowledge will allow students to formalize the specific requirements of a control system in the time domain and in the transformed domains. On the basis of these specifications and the characteristics of the process tobe controlled, students will be able to make design choices, i.e. to design the control law using different synthesis methods. Matlab/Simulink software will be used to support controller synthesis and performance verification.

COURSE CONTENT/SYLLABUS

- Fundamental properties of feedback control systems: specific to a time-domain control system .
- Reachability and controllability in continuous time and discrete time. Checking to a state of balance with state feedback . Output adjustment with assignment of eigenvalues and profit.
- Notes on the analog realization and on the digital realization of a control system. Sampled data system. Output regulator with integral action and status feedback in continuous time and discrete time.
- Observability in continuous time and discrete time. State observer . Eigenvalue separation and output feedback control .
- Analysis of systems with output feedback: accuracy at steady state and type of a system, response in transitory.
- Analysis of the closed loop by the method of the place of the roots. Design of control systems with place of roots in continuous time and discrete time. Typical regulator structures. Control of unstable processes.
- Frequency-domain analysis of continuous-time systems : stability and robustness with the Nyquist criterion. Margins of stability.
- Sensitivity functions. Links between the time-domain response, the open-loop harmonic response function, and sensitivity functions.
- Design of frequency domain control systems with the ring function method. Correcting networks.
- Design of digital controllers for discretization and directly in the discrete-time domain with the The method of assigning the model.
- Problems of realization of the digital control: structuring of the control algorithm, anti-aliasing filtering, considerations on the choice of the sampling period.

- PID controllers: performance analysis in the frequency domain and notes on experimental calibrationmethods.
- Advanced control systems: Smith predictor, cascade control, mixed control schemes with feedback andfeedforward.

READINGS/BIBLIOGRAPHY

G. Celentano, L. Celentano, "*Elementi di Controlli Automatici vol. III*", Edises, 2015
P. Bolzern, R. Scattolini, N. Schiavoni, "*Fondamenti di Controlli Automatici*", McGraw-Hill, 4/ed, 2015Notes and video recordings of the lessons

TEACHING METHODS

a) Lectures for 70% of the total hours,
b) Classroom exercises , also through the use of softwareMATLAB/SIMULINK (https:www.mathworks.com/) for approximately 30% of total hours .

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Numerical exercises	X

b) Evaluation pattern:

COURSE DETAILS

"ELEMENTI DI INTELLIGENZA ARTIFICIALE"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER:
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Programmazione.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course aims to provide the basic methodologies and techniques to understand and address the problems ofArtificial Intelligence.

Students will acquire the theoretical foundations related to intelligent agents, their interaction with the surrounding environment; problem solving, research strategies and research with opponents. You will learn about game theory methods and techniques, great, imperfect real-time decisions, games that include random elements, and the state ofthe art of gaming programs.

Students will acquire the fundamental concepts of first-order logic, inference and deduction; master the methods and techniques of logical programming and language of the ProLog logical paradigm; uncertain knowledge and reasoning to establish how to act under uncertainty. They will be introduced to the concepts behind probabilistic reasoning and machine learning.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course aims to provide students with the necessary knowledge to understand and analyze problem solutionsbased on Artificial Intelligence techniques.

Tools will be provided to master both theory and methodologies for solving problems and solution-finding strategies,as well as elements of logical programming. The knowledge that underpins probabilistic reasoning and machine learning will be introduced.

Applying knowledge and understanding

The course is aimed at transmitting the methodological and operational skills and tools necessary to apply the knowledge of Artificial Intelligence techniques, as well as to promote the ability to use the methodological tools acquired for the realization of solutions based on Artificial Intelligence techniques. The proposed techniques andmodels will be applied during the course to specialized domains.

COURSE CONTENT/SYLLABUS

Part I: Introduction to Artificial Intelligence

Intelligent agents: Agents and environments, the concept of rationality, the nature of environments, the structure ofagents

Part II: Troubleshooting

Solve problems with search: Problem solver agents, Example problems, Search for solutions, Uninformed search strategies, Broad search, Uniform cost search, In-depth search, Depth search Depth research Iterative deep search, Bidirectional search, Comparison of uninformed search strategies, Avoid repetition in states, Search with partial information.

Informed search: Informed or heuristic search strategies, Best-first greedy or "greedy" search, A* search, Heuristic search with limited memory, Local search algorithms and optimization problems, Hill-climbing search, Simulated annealing, Local-beam search, Genetic algorithms.

Search with opponents: Games, Best decisions in games, The minimax algorithm, Alpha-beta pruning, Real-time imperfect decisions, Games that include random elements, The state of the art of game programs.

Part III: Knowledge and reasoning

Logical agents: Knowledge-based agents, The world of wumpus, Logic, Propositional calculus, Reasoning schemes inpropositional calculus, Forward and backward concatenation.
First-order logic: First-order logic syntax and semantics, Using first-order logic.
Inference in first-order logic: Propositional inference and first-order inference, Unification
Forward Concatenation, Backward Concatenation, Logic Programming, Prolog, Prolog Lists, Extralogical Operators:not, cut, fail

Part IV: Uncertain knowledge and reasoning

Uncertainty: Acting under uncertainty, Basic notation of probability theory, Inference based on complete jointdistributions, Independence, Bayes' rule and its use.
Probabilistic reasoning: Representation of knowledge in an uncertain domain, Semantics of Bayesian networksEfficient representation of conditional distributions.

Part V: Learning

Learning from observations: Forms of learning. Inductive learning.
Neural Networks: Definition of neural network, Training and Learning, Training mode, Learning laws.
Rosenblatt's Perceptron, The Multilevel Perceptron, Kolmogorov's Theorem, Learning Vector Quantization Network(LVQ)
Self-Organizing Maps of Kohonen (SOM).

READINGS/BIBLIOGRAPHY

Recommended textbooks:

S.J.Russell, P. Norvig,"*Intelligenza artificiale. Un approccio moderno, volumi 1 (3/ed, 2010) e 2 (2/ed, 2005)*", Pearson Education Italia.

Other teaching materials:

Material produced and provided by the Teachers

TEACHING METHODS

The course will take place with lectures (70% of the total hours) and laboratory exercises (30% of the total hours).

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	X
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	

The project will be proposed at the center of the course.

b) Evaluation pattern:

The exam will aim to ascertain the achievement of the training objectives provided for the course, is divided into a written test and an oral test focused on thetopics of the course.

COURSE DETAILS

"ELETTRONICA 1"

SSD ING-INF/01

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER:
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): II
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica II, Fisica Generale II.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course of Electronics I aims to learn some fundamental concepts related to the operation and use of semiconductor electronic devices for the processing of analog and digital signals. Students are able to analyze the behavior of simple circuits, even at various levels of abstraction, such as diodes, transistors, operational amplifiers. Theoretical tools are provided for the analysis of small signal sinusoidal circuits. The analysis of circuits operating in the presence of large signals is mainly carried out graphically. The course also includes a part of circuit synthesis with the aim of providing students with the basic elements necessary for the design ofdigital circuits based on logic gates made with MOSFETs.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

After passing the exam, the student has essential concepts on the physical principles that underlie the operation of simple solid-state electronic devices. He knows the fundamental characteristics of the most used solid-state devices in electronics (diodes, MOSFET and BJT transistors), and is able to highlight them, from the point of view of view of the characteristics at the terminals, similarities and differences. He knows the classification of amplifiersfrom the point of view of input-output characteristics, and the main circuit configurations of amplifiers based on BJT and MOSFET. He knows some fundamental applications of MOSFETs in the field of circuits for processing and storing logic signals. He knows the properties of Operational Amplifiers and some fundamental circuits based on them.

Applying knowledge and understanding

In order to pass the exam, the student must be able to illustrate the theoretical and technical motivations that underlie the properties of analog and digital fundamental circuits. In particular, it must demonstrate that it is able to analyse simple electronic circuits using MOSFET or BJT diodes and transistors, using the most appropriate models of such devices depending on the intended circuit application. It must also be able to predict the electrical behavior of simple circuit configurations, whether for digital or analog applications, known in the literature, resorting, where necessary, to the study in direct current, in the presence of small signals in sinusoidal regime, or for large signals.
The student must also be able to analyze some fundamental circuits based on Operational Amplifiers, single stage or multi-stage, or, starting from them, appropriately size the passive components to obtain specific assignments in terms of amplification or input and output resistance.

COURSE CONTENT/SYLLABUS

Analog signals and digital signals, amplification of analog signals, general models of amplifiers and characteristic parameters. The Operational Amplifier (OpAmp): simplified model and fundamental circuits to OpAmp (inverting, non-inverting, adding, integrator, shunt).

Semiconductor materials, charge transport in semiconductors, doping. The p-n junction: barrier dpotential, joint capacity. Diode polarization, rectifiers, small diode signal model.

Diode switching. Circuit simulators: SPICE.

Principles of operation of the MOSFET, wide signal model, the MOSFET as a controlled switch. Characteristic parameters of real logic circuits, noise margins, performance, power dissipation.

Circuitry logical based on MOSFETs, CMOS technology, synthesis of static CMOS logic networks. Semiconductor memories.Small signal models of the MOSFET, the MOSFET as an amplifier, MOSFET amplifier stages.Principle of operation of the BJT, wide signal model, small signal models. The BJT as an amplifier characteristics of BJT amplifiers. Introduction to signal acquisition and processing using simple programmable systems.

READINGS/BIBLIOGRAPHY

A. Sedra, K. Smith, "*Circuiti per la microelettronica*".
S. Daliento, A. Irace, "*Elettronica generale*".
A. Agarwal, J. H. Lang, "*Foundations of analog and digital electronic circuits*".

Slides used during lessons, video recordings of lessons and exercise solutions.

TEACHING METHODS

The teacher will use: a) lectures for about 70% of the total hours, b) exercises for the application and the deepening of the theoretical aspects, both numerical and based on the use of circuit simulators or simpleprogrammable systems.
There will also be short seminars held by experts in the field of analog or digital circuit design.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	
only oral	X
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Numerical exercises	

b) Evaluation pattern: N.A.

COURSE DETAILS

"FISICA GENERALE I"

SSD FIS/01

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II): I
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE “REGOLAMENTO”)
None.

PREREQUISITES (IF APPLICABLE)
None.

LEARNING GOALS
The student will acquire the fundamental concepts of Classical Mechanics and the first concepts of Thermodynamics, favoring the methodological and phenomenological aspects. In addition, he will acquire a conscious operational skill in solving simple exercises.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)
Knowledge and understanding

The student must demonstrate that:

1. *Understand the fundamental principles of physics and their applications in problematic situations.In particular:*
   a) state the principles;
   b) indicate the relationships between the principles;
   c) compare explanations of the same phenomenon or situation by means of different principles.
2. *Know the main laws that explain physical phenomena. In particular:*
   a) illustrate the law in mathematical terms;
   b) assess the limits of the law;
   c) extend the law to similar situations and unknown situations.
3. *Know the physical quantities operationally indicating the correct units of measurement. In particular:*
   a) define the fundamental quantities;
   b) know the operations between the fundamental quantities;
   c) Describe the derived quantities in terms of the fundamental quantities.
4. *Know the field of investigation of physics. In particular:*
   a) understand the physical meaning of the mathematical entities used to describe phenomena;
   b) outline the field of applicability (macroscopic / microscopic) of the laws used to describe the phenomena;
   c) describe the methods of investigation used in physics.

Applying knowledge and understanding

The student must demonstrate that he/she is able to :

1. analyze and examine the proposed physical situations by formulating explanatory hypotheses through mathematical models, analogies or physical laws;
2. formalize problematic situations and apply the concepts presented in the course, the mathematical methods and disciplinary tools learned during the course and relevant for their resolution, performing, where necessary, calculations, estimates, qualitative reasoning;
3. interpret and/or process proposed and/or obtained data, also of an experimental nature, verifying their relevance to the chosen model and representing them, where necessary, through graphic-symbolic language;
4. argue and describe resolution strategies adopted in problematic physical situations, communicating the results obtained while assessing their consistency with the proposed problematic situation .

Levels for all descriptors: L1 – naïve or inadequate; L2 – superficial or fragmentary; L3 – partial; L4 – complete or generally complete.

COURSE CONTENT/SYLLABUS

The scientific method. Physical quantities and their operational definition, units of measurement, dimensions. Kinematics of the material point in one dimension. Vector quantities and point kinematics in multiple dimensions. Parabolic motion of bodies and circular motion. Inertial reference frames, definition of force and mass. Principles of dynamics. Fundamental forces and laws of force. Contact forces, constraining forces, empirical force laws (elastic force, frictional and viscous forces). Notable problems: inclined plane, harmonic oscillator, simple pendulum. Impulseand momentum. Work and kinetic energy. Conservative forces and potential energy. Conservation of mechanical energy and momentum. Bumps in one dimension. Angular momentum and momentum of forces. Relative motions, non-inertial reference frames and the concept of apparent force. Notes on the motion of the planets in the solar system. Dynamics of material point systems: cardinal equations, center of mass, conservation laws, Koenig's theoremfor kinetic energy. Elements of rigid body dynamics, rotations around a fixed axis. Elements of fluid statics and dynamics. Temperature and heat, the first law of thermodynamics. Ideal gases.

READINGS/BIBLIOGRAPHY

Textbook (e.g. Mazzoldi-Nigro-Voci, Halliday-Resnick, Serwey-Jevett), exercises or questionnaires to be carried out athome.

SEE THE TEACHER’S WEBSITE

TEACHING METHODS

Lectures and classroom exercises.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type			
written and oral	X		
only written			
only oral			
project discussion			
other			
In case of a written exam, questions referto:		**Multiple choice answers**	X
		Open answers	X
		Numerical exercises	X

b) Evaluation pattern:

COURSE DETAILS

"FISICA GENERALE II"

SSD FIS/01

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")
Fisica Generale I.

PREREQUISITES (IF APPLICABLE)
None.

LEARNING GOALS
The student will acquire the basic concepts of electromagnetism, favoring the methodological and phenomenologicalaspects. In addition, he will acquire a conscious operational skill in solving simple exercises.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding
After attending the course, the student must demonstrate that:
- understand the fundamental principles of electromagnetism and its founding laws in mathematical terms, with the adequate integro-differential calculation tools
- know the scope of the laws governing the interaction of matter with the electromagnetic field in macroscopic and microscopic regimes and how to apply them both to the phenomena illustrated during the course and to unknown situations
- know how to describe the investigation techniques used in electromagnetism and the main application areas of its laws

Applying knowledge and understanding
At the end of the learning process the student will be able to:
- formulate explanatory hypotheses of the electrical and magnetic phenomena proposed during the course through mathematical models, analogies or physical laws;
- analyze and formalize problematic physical situations pertinent to electromagnetism with the correct use of concepts exposed to the course, applying the appropriate mathematical methods and disciplinary tools learned and relevant for their resolution, and performing, where necessary, calculations, estimates, qualitative reasoning;
- examine and process proposed and/or obtained data, also of an experimental nature, verifying their relevance to the model chosen to describe electromagnetic processes and representing them, wherenecessary, through graphic-symbolic language;
- argue and describe with an appropriate scientific approach solution strategies adopted in applications of electromagnetism, communicating the results obtained and at the same time evaluating their consistency withthe situation

COURSE CONTENT/SYLLABUS
Electrical interaction phenomena. Conductors and insulators, electrification. Electric charge, conservation law, quantization. Coulomb's law. Principle of overlap.
Electric field. Charged particle motion in the presence of an electric field. Fields generated by charge distributions. Electrostatic potential**. Potential** generated by charge distributions. Electrostatic energy. Relationship between fieldand electrostatic potential. Calculation of the electric field generated by a dipole. Strength and mechanical momenton dipole placed in the external electric field.
Gauss's law. The flow of a vector field. Statement and simple applications of Gauss's law. Divergence of theelectrostatic field.
Conductors in electric fields. Electrostatic properties of conductors. Capacitor. Energy density of the electric field.

Insulators in electric fields. Polarization of dielectrics. General equations of electrostatics in the presence of dielectrics. Electric current. Microscopic interpretation of the current. Ohm's law. Joule's law. Electric generator ,electromotive force. Kirchhoff's laws. RC circuit.
Phenomena of magnetic interaction. Lorentz strength and magnetic field. Particle motion charged in uniformmagnetic field. Force on a conductor traveled by current. Mechanical moment on a coil of current.
The magnetic field generated by stationary currents. The field of a coil at a great distance, magnetic dipole, magneticmoment of a coil. Gauss's law for magnetism. Ampere's law of circuitry.
Introduction to the magnetic properties of matter. Magnetization mechanisms and amperian currents.Classification of magnetic materials.
Electromagnetic induction. Faraday's law and its applications. Auto and mutual electromagnetic induction. RL circuit.Energy density of the magnetic field. Displacement current.
Maxwell's equations. Introduction to plane electromagnetic waves. Electromagnetic wave energy.

READINGS/BIBLIOGRAPHY

Textbook (e.g. Mazzoldi-Nigro-Voci, Mencuccini-Silvestrini, Halliday-Resnick, Serwey-Jevett), exercises or questionnaires to be carried out at home.
SEE THE TEACHER'S WEBSITE

TEACHING METHODS

Lectures for about 80% of the total hours and classroom exercises with simple applications of the laws of electromagnetism.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	X
	Open answers	X
	Numerical exercises	X

b) Evaluation pattern:
The positive outcome of the written test is generally binding for access to the oral test. In the case of multiple choice tests, the number n of answers is between 3 and 4, and each selected answer contributes to the finalscore with normalized weight: 1 for correct choice, -1/(n-1) (negative value) for incorrect choice.

COURSE DETAILS

"FONDAMENTI DI CIRCUITI"

SSD ING-IND/31

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica I.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course aims to provide students with the basics of circuit theory under conditions stationary, sinusoidal and periodic operation and linear dynamic circuits of the first and second order; to introduce systematically the general properties of the circuit model, the main theorems and the main methodologies of analysis

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The training course provides students with the basic knowledge and methodological tools necessary to analyze linear circuits, in conditions of stationary, sinusoidal and periodic operation and to analyze linear dynamic circuits of the firstand second order. The student will be able to recognize the limits of validity and the main implications of the fundamental theorems of circuits.

Applying knowledge and understanding

The student must demonstrate to be able to solve linear circuits, under steady state operating conditions, sinusoidal and periodic and linear dynamical circuits of the first and second order, identifying the most appropriate solution method, and using where necessary the main circuit theorems. The student must be able to expose the basic concepts of circuit theory and to derive the main theorems correctly using disciplinary language.

COURSE CONTENT/SYLLABUS

1. THE LAWS OF ELECTROMAGNETISM

Electric charge, electric current, current density. Electric field, magnetic field, Lorentz force. The laws of electromagnetism in vacuum in integral form. Law of conservation of the office. {The laws of electromagnetism inmatter in integral form}. Electric field work, energy stored in the electric field, energy stored in the magnetic field,Electric power, electrical energy. Unit of measurement.

2. THE CIRCUIT MODEL

Electrical circuits in slowly changing conditions. Bipole: electric current intensity, electrical voltage, electrical power, electrical energy. User and generator convention. Bipole circuits: Kirchhoff's laws. Canonical bipoles: resistor, switch,independent generators, capacitor, inductor. Real generators. Active bipoles, passive bipoles, dissipative bipoles and conservative bipoles. {Circuit model frequency limits.}

3. CIRCUIT EQUATIONS

Simple resistive circuit; nonlinear resistive circuit and graphic solution method; {Newton Raphson's algorithm}; linear dynamic circuits of the first order, steady state and sinusoidal. Graph of a circuit, subgraph, connected graph, shaft, coshaft, mesh, {cutting set}; planar graphs and rings; set of fundamental meshes {and fundamental cut set}; incidencematrix and reduced incidence matrix, {mesh matrix and reduced mesh matrix}, Kirchhoff equations in matrix form, independent Kirchhoff equations, the system of fundamental equations. Node potentials; {Mesh currents}.

Conservation of virtual powers (Tellegen's theorem); conservation of electrical powers.

4. RESISTIVE CIRCUITS

Bipole equivalent, resistors in series, resistors in parallel; voltage and current dividers, series and parallel of ideal generators and pathological cases, equivalence of real generators; linear resistive circuits, overlapping effects; Thevénin-Norton equivalent generator; non-amplification of voltages {and currents}. Star-triangle transformation.

5. MULTI-TERMINAL CIRCUIT ELEMENTS
N-poles, descriptive currents and voltages, double bipoles, door condition. electrical power consumption; linear controlled generators, ideal transformer; Gyrator, double bipoles of resistors, reciprocity theorem, resistance matrix, conductance matrix, {hybrid matrices, transmission matrix}mutually coupled circuits (transformer), characteristic relations, perfect coupling, equivalent circuits. {Connecting double bipoles in parallel and cascade series}. Synthesis ofdouble bipoles: T-configurations and π.

6. STEADY CIRCUITS
Circuits in permanent regime. Steady state circuits. Sinusoidal circuits. Fasors, symbolic method; complex numbers.Impedance, impedance circuits, impedance circuit properties. Complex power, medium power, reactive power.
Phasor diagrams of elementary bipoles. Complex power preservation, average power and reactive power. Bipoles of impedances; networks on a periodic basis. Resonant circuit, quality factor, power and energy balances, {universal resonance curves}. Frequency response of a circuit; filters. {Three-phase star center shift systems and Millmann formula, power measurement and Aron insertion.}

7. LINEAR DYNAMIC CIRCUITS
Equations of state of first-order circuits, equations of state of second-order circuits, associated resistive circuit. Continuity of state quantities; solution of circuits of the first and second order. Free evolution, forced evolution, natural modes of evolution, natural frequency, time constant, transient term, permanent term, dissipative circuit, time-variant circuit, {impulsive forcing circuit}; solution of second-order circuits, RLC series circuit, parallel RLC circuit,aperiodic natural modes, oscillating natural modes, RC circuits and second-order RL circuits. {Impulse response and convolution integral, operator impedances, network function, and analysis in the Laplace domain. Introduction to circuit simulation and the use of SPICE.}

N.B. The choice between the topics listed in {curly braces} may vary depending on the choices of teachers in eachchannel.

READINGS/BIBLIOGRAPHY

Reference texts
M. de Magistris, G. Miano, “*Circuiti*”, II edition, SPRINGER, settembre 2009.

Testi Di Consultazione:
[1] L.O. Chua, C.A. Desoer, E.S. Kuh, “*Circuiti Lineari E Non Lineari*”, Jackson, 1991.
[2] G. Miano, “*Lezioni Di Elettrotecnica*”, Ed. Cuen, 1998;
[3] L. De Menna, “*Elettrotecnica*”, Ed. Pironti, Napoli, 1998.
[4] I.D. Mayergoyz, W. Lawson, “*Elementi Di Teoria Dei Circuiti*”, Utet, 2000.
[5] H. A. Haus, J.R. Melcher, “*Electromagnetic Fields And Energy*”, Prentice Hall, 1989 (For further exercises)

Exercises
[1] S. Bobbio, L. De Menna, G. Miano, L. Verolino, “*Quaderno N ° 1: Circuiti In Regime Stazionario*”, Ed. Cuen, Napoli, 1998.
[2] “*Quaderno N ° 2: Circuiti In Regime Sinusoidale*”, Ed. Cuen, Napoli, 1998.
[3] “*Quaderno N ° 3: Circuiti In Evoluzione Dinamica: Analisi Nel Dominio Del Tempo*”, Ed. Cuen, Napoli, 1998.
[4] S. Bobbio, “*Esercizi Di Elettrotecnica*”, Ed. Cuen, Napoli, 1995.

Mooc
Open and Mass Online Course (Mooc) available on https://www.federica.eu/

TEACHING METHODS

Lectures (about 60%) and frontal exercises (about 40%).

EXAMINATION/EVALUATION CRITERIA

a) **Exam type:**

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Numerical exercises	X

a) Evaluation pattern:

COURSE DETAILS

"FONDAMENTI DI INFORMATICA"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

Provide the basics for computer science disciplines, introducing the student to the study of the theoretical foundations of computer science, computer architecture and high-level programming languages. Provide the necessary knowledge for the development of programs for solving problems of limited complexity.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge, understanding and be able to describe the basic concepts related to theoretical computer science, computer architecture and high-level programming languages. In addition, the student must demonstrate knowledge and understanding of programs for solving problems of limited complexity.

Applying knowledge and understanding

The student must demonstrate to be able to apply the knowledge learned for the solution of simple programming problems, designing and developing programs for the solution of problems of limited complexity.

COURSE CONTENT/SYLLABUS

2 CFU (8 lessons)

The concept of processing and algorithm. Models in Computer Science. Finite state automata: definition, graph andtable. Turing machine. Computability.
Boolean algebra: definitions and De Morgan's theorem. Boolean functions. The algebra of the logic of propositions. The encoding and representation of information. Representation of natural, relative, real numbers.
Fundamentals of architecture of computing systems: the Von Neumann model, processor operation. Memories,Input/Output. The operating system. The life cycle of a program. Translators and interpreters. Programming languages: grammars;the Backus-Naur Form.

7 CFU (24-28 lessons)

Programming: simple structured data types; elementary instructions and control structures. Structured programming.Array. Standard subprograms and libraries.
Dynamic allocation and pointers. Algorithms on sequences and arrays. Structures and strings. Input/Outputoperations to mass storage.
Abstract data types: lists, stacks, queues. Search and sorting algorithms.
The C language. Use of a program development environment with examples of fundamental algorithms and abstractdata type management. Object-oriented programming elements.

READINGS/BIBLIOGRAPHY

A. Chianese, V. Moscato, A. Picariello, C. Sansone, "*Le radici dell'Informatica: dai bit alla programmazione strutturata*", Maggioli Editore, 2017.
E. Burattini, A. Chianese, A. Picariello, V. Moscato, C. Sansone, "*Che C serve? Per iniziare a programmare*", Maggioli Editore, 2016.
MOOC "Fondamenti di Informatica" disponibile sulla piattaforma Federica.EU (www.federica.eu)

TEACHING METHODS

Teachers will use: a) lectures for about 60% of the total hours, b) and exercises on the development of programs inC++ language for about 40% of the total hours.
The exercises are carried out in the classroom and / or in the laboratory with the use of an integrated development environment and through platforms for virtual educational laboratories.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	X

In case of a written exam, questions referto:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	

b) Evaluation pattern: L'esito della prova di programmazione è vincolante ai fini dell'accesso alla prova orale.

COURSE DETAILS

"FONDAMENTI DI MISURE"

SSD ING-INF/07

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): III

SEMESTER (I, II): I

CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE “REGOLAMENTO”)

Fondamenti di Circuiti, Fisica Generale II.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

Provide the basic theoretical foundations of measurement. Inform and train the student on the founding concepts of measurement theory, on the main measurement methodologies and procedures and on the basic tools for the analysis of signals in the time and amplitude domain. Enable the student to understand and use the basic instrumentation for the analysis of signals in the time and amplitude domain, to adequately interpret the technical specifications and to correctly present the measurement results.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the basic problems related to the definition of a measurement procedure, starting from the definition of the measurand to the final expression of the measurementresult in accordance with current recommendations. To this end, he must demonstrate that he knows how to elaborate arguments concerning the relationships in order to identify the links between the different sources of uncertainty starting from the concepts learned that are presented during the theoretical lessons.

Applying knowledge and understanding

In the light of the acquired knowledge, the student must demonstrate the ability to implement measurement procedures that are suitable for the specific measuring and the available measurement instrumentation. Particular attention is given to the competence that the student acquires in linking the different theoretical notions in order toenucleate a possible solution to the problem that is presented to him during the lessons in the classroom or in the exam session.

COURSE CONTENT/SYLLABUS

The International System: fundamental and supplementary units. National Reference Standards. Architecture of a generic digital measuring instrument. Classification of signals. Metrological characteristics of measuring instruments. Category A and category B uncertainties. Interpretation of specifications from a measuring instrument manual.
Assessment of global uncertainty. Extended uncertainty. Expression of uncertainty in absolute and relative value. Thesignificant figures. Propagation of uncertainties in indirect measurements: Probabilistic and deterministic approach. Compatibility of measures.
Time-domain measurements using numerical counter: direct frequency measurement, direct period measurement, absolute and relative resolution, measurement uncertainty, universal graphs and reciprocal counters; Time intervalmeasurement and phase shift measurement of isofrequency signals.
Measurements in the amplitude domain: simple integration voltmeter, double ramp voltmeter, multi-ramp voltmeter; relationship between measurement time and resolution; metrological characteristics of DC voltmeters; AC voltmeters:peak detector, peak-to-peak detector, voltmeter with true effective value; Features AC voltmeters; Numerical multimeters: resistance measurement with two and four terminals; Current measurement.
Analog-to-digital converters, architecture and operating principle of the main ADCs: FLASH, SAR, Interleaved and pipelined. ADC characterization: static characterization, dynamic characterization; gain and offset error, INL, DNL andENOB.
Digital-to-analog converters, architecture and operating principle of the main DACs: Weighted resistors and R-2R. Frequency domain measurement: filter bank spectrum analyzer; variable tuning spectrum analyzer; superheterodynespectrum analyzer; numerical spectrum analyzer; Resolution and selectivity of a spectrum analyzer.

READINGS/BIBLIOGRAPHY

Ernest O. Doebelin,"*Strumenti e metodi di misura*", McGraw-Hill Education, 2008.
G. Zingales, "*Misure elettriche. Metodi e strumenti*", Utet Università, 1992.
"*JCGM 100:2008 Evaluation of measurement data - Guide to the expression of uncertainty in measurement*", BIPM, 2010
Notes and handouts of the teacher.

TEACHING METHODS

The teacher will use:

a) lectures for about 70% of the total hours,

b) exercises to deepen theoretical aspects for about 20% of the total hours

c) laboratory to deepen the applied knowledge for about 10% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) **Exam type:**

Exam type	
written and oral	
only written	X
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	
	Open answers	X
	Numerical exercises	

b) Evaluation pattern:

COURSE DETAILS

"GEOMETRIA E ALGEBRA"

SSD MAT/03

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): I

SEMESTER (I, II): II

CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")
None.

PREREQUISITES (IF APPLICABLE)
The mathematical content of secondary school curricula.

LEARNING GOALS
Students will acquire the basic tools of linear algebra and geometry. The aim of this course is, on the one hand, toaccustom the student to face formal problems, using appropriate tools and correct language, and on the other to solve specific problems of algebraic and geometric type, with the classical tools of linear algebra.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)
Knowledge and understanding
The student must demonstrate knowledge of the notions (definitions, statements, proofs if foreseen by the program) relating to the algebraic and geometric structures studied (vector spaces, spaces of elementary geometry in dimensions 2 and 3, spaces of matrices) and the computational tools developed , and knowing how to understand related topics by developing the notions acquired.

Applying knowledge and understanding
The student must demonstrate that he knows how to apply what he has learned in solving verification exercises developed by the teacher, generally related to topics such as: straight lines and planes, matrices, equations, vectors. The student must also demonstrate knowledge of the issues relating to algebraic structures.

COURSE CONTENT/SYLLABUS
References to set theory and algebraic structures: 0,5 CFU
Union, intersection, complement, Cartesian product; correspondences and relationships, applications or functions, restrictions, injective, surjective, bijective, application composition, characterization of objective applications; equivalence relations (example: equivalence between applied vectors). Internal operations: associative property, existence of the neutral element (and uniqueness), existence of symmetric elements (and uniqueness, if the operationsatisfies the associative property), commutative property, (examples: addition operations in numerical sets and on free and applied vectors). Abelian and non-abelian groups (examples). Definition of field. Examples: real numbers field, field whose support contains only two elements. External operations (example: external multiplication operationon free and applied vectors.

Vector and Euclidean spaces (over one field): 1,5 CFU
Definition, elementary properties; examples (vector spaces of numbers, polynomials, matrices, free and applied vectors of elementary geometry). Linear combinations, dependence and linear independence and their characterizations; generator systems. Vector subspaces and characterization; sets of vectors that generate the same vector subspace; bases and components of a carrier in an ordered basis; theorem of extraction of a base from a system of generators; Steinitz's lemma and consequences: dimension of a vector space, completion theorem in a basisof a linearly independent set; intersection subspace, sum subspace, direct sum, Grassmann relation. Euclidean vector spaces: scalar product in a vector space on the reals: length of a vector, angle between two vectors, existence of orthonormal bases: Gram-Schmidt procedure; Canonical (or natural) scalar product between numerical vectors. Scalarproduct between geometric vectors. Calculation of a scalar product using the components of vectors in an ordered orthonormal basis. Pythagorean theorem.

Matrices and determinants: 1 CFU
Elementary line operations; matrices reduced to steps. The rank of a matrix and the number of pivots of a stepped matrix. Triangular and diagonal matrices; product rows by columns; classical definition of determinant (with the use of

permutations) and elementary properties (without proof); characterization of the maximum rank by not cancelling thedeterminant; methods of calculating the determinant: statements of Laplace's Theorem and Laplace's second theorem; statement of the Edged Theorem (Kronecker); invertible matrices and determination of the inverse matrix; similar matrices.

Linear systems: 1 CFU
Solutions, compatibility (Rouchè-Capelli theorem); Cramer's theorem; stepwise method (Gaussian elimination method) and solving a system of linear equations; determination of a basis of the vector space of solutions of a homogeneous linear system; Every subspace of a vector number space is the solution space of a homogeneous linearsystem and vice versa: Cartesian and parametric representation of the numerical vector subspaces.

Linear applications: 0.5 CFU
Definition and first properties; conservation of linear dependence; core and image; characterization of linear injective and surjective applications; fundamental theorem of linear applications; endomorphisms, isomorphisms; isomorphismassociated with an ordered basis; Associated and basic change matrices. Statement of the Size Theorem. Similarity relationship between matrices associated with endomorphisms in different ordered bases.

Diagonalization of endomorphisms and matrices: 0,5 CFU
Eigenvalues, eigenvectors and eigenspaces of endomorphisms (and square matrices); characteristic polynomial; geometric multiplicity and algebraic multiplicity of an eigenvalue; characterization of endomorphisms and diagonalizable matrices by the existence of an eigenvector basis; determination of eigenvalues and an eigenvectorbasis of a diagonalizable endomorphism and a diagonalizable matrix.

Euclidean (affine) spaces over a field: 1 CFU
Definition, Cartesian (affine) references and coordinates of a point, Euclidean (affine) subspaces, definition of parallelism, twisted lines, parametric and Cartesian representation of Euclidean (affine) subspaces. Study of incidenceand parallelism between subspaces. Conditions of orthogonality between subspaces in dimension 2 and 3. Distance between sets of points; distance of a point from a hyperplane; study of the distance between Euclidean subspaces in dimension 2 and 3, theorem of the perpendicular common. Definition of improper bundles and proper sheaves of planes in dimension 3.

READINGS/BIBLIOGRAPHY

SEE THE TEACHER'S WEBSITE

TEACHING METHODS

The lessons will be frontal, and about a third of the lessons will be exercised.

EXAMINATION/EVALUATION CRITERIA

a. **Exam type:**

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions referto:	**Multiple choice answers**	X
	Open answers	X
	Numerical exercises	X

COURSE DETAILS

"INGEGNERIA DEL SOFTWARE"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: STEFANO RUSSO
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EMAIL: STEFANO.RUSSO@UNINA.IT

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 10

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Programmazione, Basi di Dati.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The aim of the course is to provide the methodologies and techniques fundamental for the engineering of quality software systems, concerning: modern software production processes; techniques and languages for object-orientedanalysis and specification, cost estimation, design, implementation in Java, and testing .

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate: to know the main software life cycle models; to know the techniques of analysis and specification of requirements; to know the UML modeling language; to know the principles underlying functional andstructural testing; to know the basic aspects of the Java language.

Applying knowledge and understanding

The student must demonstrate: to be able to specify the requirements and to be able to design a small-scale softwaresystem through the UML language; to be able to implement it in Java language; to be able to estimate costs with the FPA method; to be able to design test cases.

COURSE CONTENT/SYLLABUS

Introduction to Software Engineering: A Brief History of Software Engineering. Process and product. Software qualityfactors. Principles of software engineering.

The software lifecycle: Waterfall model; feedback model. Evolutionary models. Transformational model. 'V' model.Agile methodologies.

Cost estimation. General information on cost estimation. Function Point Analysis (FPA).

Analysis and specification of requirements. Types of requirements: user, system and domain, functional and non-functional. Comprehensiveness, consistency, verifiability and traceability of requirements. The requirements specification document (SRS). Use case modeling.

Object modeling: The UML language: diagrams of classes, interaction, state, activity, components, packages, deployment. Analysis and design in UML. Architectural and design patterns. **Software verification and validation**:Basic principles. Objectives and planning of testing. Black-box and white-box testing techniques. Unit, integration,system, acceptance, regression, α-test, β-test tests. Structural test, coverage criteria. Cyclomatic complexity.

Combinatorial test. Model-based testing. Robustness test.

Software quality metrics and models. Software metrics. Software quality models; the ISO 9126 standard.Management of software configurations (outline).

From design to object-oriented programming. The Java language. Access RDBMS systems from Java programs.Exception handling in Java. From UML project to Java implementation.

READINGS/BIBLIOGRAPHY

I. Sommerville, "*Ingegneria del Software*", 10° edizione, Pearson, 2017

J. Arlow, I. Neustadt, "*UML 2 e Unified Process - Analisi e progettazione Object-Oriented*", McGraw-Hill, 2007Lecture transparency and exercises (available on the teacher's website).

TEACHING METHODS

Teaching is provided: a) 60% with lectures; b) 40% with exercises.
The topics of the lectures and exercises are exposed with the help of detailed transparencies, made available to the student in the teaching material through the official website of the teacher.

EXAMINATION/EVALUATION CRITERIA

a) **Exam type:**

Exam type	
written and oral	
only written	
only oral	X
project discussion	X
other	

The exam is divided into the drafting of a paper, pre-assigned to the student well in advance and drawn up by the student independently, and in an oral exam. The discussion of the paper is the first topic of the test oral, which for the rest consists of two questions on the principles, methodologies and techniques illustrated in the course.

a) Evaluation pattern:

COURSE DETAILS

"METODI MATEMATICI PER L'INGEGNERIA"

SSD MAT/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): I
CFU: 8

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica II, Geometria e Algebra.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

To provide the fundamental concepts and results, in view of the applications, related to the theory of analyticfunctions, of distributions of Fourier series, Fourier and Laplace transforms and their applications.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student will have to demonstrate knowledge of the notions (definitions, statements, demonstrations if foreseen by the program) related to the theory of holomorphic functions and integration in a complex field, distributions, Fourier series, Fourier and Laplace transforms and the developed calculation tools, and be able to understand relatedtopics by elaborating the acquired notions.

Applying knowledge and understanding

Finally, he must demonstrate to be able to apply what he has learned in the resolution of verification exercises developed by the teacher, in principle related to topics such as: calculation of integrals in real field and in complexfield with residue theory, linear difference equations, series and Fourier transforms of periodic signals, Laplace transforms of functions and applications to linear differential problems, distributional calculation.

COURSE CONTENT/SYLLABUS

(0,5 cfu) Complex numbers. Algebraic, trigonometric, exponential form. Form and argument properties. De Moivreformulas and n-th roots. Elementary functions in the field of complex numbers: exponential, sine and cosine, hyperbolic sine and cosine, logarithm, power. Sequences and series in the field of complex numbers. Power series: radius of convergence and properties, term-to-term derivation.

(1 cfu) Analytical functions. Holomorphy and Cauchy-Riemann conditions. Line integrals of functions of complex variable. Cauchy's theorem and formulas. Taylor series development. Serial development by Laurent. Zeros of analyticfunctions and identity principles. Classification of isolated singularities. Liouville's theorem.

(0,5 cfu) Integration. Notes on the measure and the Lebesgue integral. Summable functions. Limit passage theoremsunder the integral sign. Integrals in the sense of the main value according to Cauchy. Summable function spaces.

(1 cfu) Residues. Residue theorem. Calculation of residues at the poles. Calculation of integrals by the residuemethod. Lemmas of Jordan. Decomposition into simple fractions.

(0,5 cfu) Difference equations. Z-transformed: definition and properties. Z-antitransformed. Sequences defined by recurrence.

(1 cfu) Laplace transformation. Signals. General information about signals. Periodic signals. Convolution. Definition and domain of the bilateral Laplace transform. Analyticity and behavior ad infinitum. Notable examples of a Laplace transform. Formal properties of the Laplace transform. Unilateral transformation of Laplace and property. Initial andfinal value theorems. Antitransform (s.d.). Use of the Laplace transform in linear differential models.

(0.5 cfu) Fourier series. Notes on Banach and Hilbert spaces. Energy of a periodic signal. Trigonometric polynomials.

Exponential and trigonometric Fourier series. Convergence in the punctual sense and in the sense of energy.

(0.5 cfu) Fourier transform. Definition of a Fourier transform. Formal properties of the Fourier transform. Anti-transformed. The Fourier transform and the heat equation.

(1.5 cfu) Distributions. Linear functionals. Limits in the sense of distributions. Derived in the sense of distributions. Derivation rules. Notable examples: Dirac δ, v.p. 1/t. Convolution of distributions. Space of fast-decreasing functionsand their topology. Temperate distributions and slow-growing functions. Fourier transform of temperate distributions. Laplace transform of distributions. Fourier transform of the Dirac δ, of the pulse train. Fourier transform of periodic signals.

(0.5 cfu) Boundary problems Self-added equations. Green's function, the alternative theorem. The Sturm-Liouvilleproblem, orthogonality eigenfunctions.

(0.5 cfu) Partial differential equations Generalities. Laplace and Poisson equations, harmonic functions, Dirichlet and Neumann problems. Solving the Dirichlet problem for the Laplace equation in a circle. Heat equation, Cauchy problemin the half-plane. Wave equation, Cauchy problem in the half-plane, mixed problem in the half-strip.

READINGS/BIBLIOGRAPHY

SEE THE TEACHER'S WEBSITE

TEACHING METHODS

The lessons will be frontal, and about a third of the lessons will be exercised.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	X
	Open answers	X
	Numerical exercises	X

b) Evaluation pattern:

COURSE DETAILS

"PROGRAMMAZIONE"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): II

SEMESTER (I, II): II

CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Fondamenti di Informatica.

PREREQUISITES (IF APPLICABLE)

None beyond the skills provided by the course of Fundamentals of Computer Science.

LEARNING GOALS

The course aims to provide students with the methodological, theoretical and practical skills of modular programming and object-oriented programming, necessary for the correct development of small and medium-sized software projects.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and ability to elaborate the concepts underlying programming. The training course aims to provide the knowledge and tools that will allow students to develop autonomous skills in designing and developing applications according to the object-oriented programming paradigm.

Applying knowledge and understanding

The student must demonstrate the ability to apply the skills acquired by designing and implementing simple software applications, using the reference programming language (Java) and the UML language. In particular, he must be able to recognize and implement the relationships between classes and objects in the domain and in the proposed contextand know how to implement the basic data structures (list, stack, queue, trees).

COURSE CONTENT/SYLLABUS

- ***References and fundamentals of programming in Java:*** Java language and comparison with other languages, in particular with C / C ++: development cycle of a Java program, Java Virtual Machine, bytecode. SDK, lifecycle of classes, objects and variables, type system, operators and structures for flow control in Java; Cut motions, parameter exchange.
- ***Modular programming***: abstraction on data and control, the concept of module, relationships between modules, cohesion and coupling, information hiding, abstract data type (ADT), ADT design, the role of interfaces. Techniques and tools for modularization, separate compilation, the make utility.
- ***Fundamental data structures*****:** Lists, Stacks, Queues, Trees, Fundamental algorithms (search, sorting).
- ***Object-oriented programming****:* The OO paradigm; Encapsulation, Classes and Objects, Overloading and Overriding, relationships between classes: composition, association and inheritance; derived classes and base-derived relationship, Polymorphism.
- ***Object-oriented programming in Java****:* classes and objects, inheritance and polymorphism in Java. Controlling the visibility of attributes and methods. Abstract classes and interfaces. Composition and association in Java. Modularization in Java, package, introduction to libraries.
- ***Error handling in Java*****:** the model for handling exceptions in Java. checked and unchecked exceptions. Exception handling classes. the throwing of exceptions.
- ***Java I/O Management:*** Classes for I/O. Stream and I/O from files.
- ***UML design and language***: Software design (outline); Phases of Object-Oriented Design; The UML language in O.O. design; UML to Java: UML elements for describing classes and class relationships.
- Design of graphical interfaces in Java.

READINGS/BIBLIOGRAPHY
Textbook, practice material, transparencies from the lessons.
FOR FURTHER INFORMATION SEE WEBSITE OF THE TEACHER OF THE SUBJECT (www.docenti.unina.it)

TEACHING METHODS
Lectures (50%), exercises (25%) and laboratory activities (25%).

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Programming exercises	X

b) Evaluation pattern:

The outcome of the written test is binding for access to the oral test. The final grade is the average between the vote of the written test and that of the oral exam.

COURSE DETAILS

"RETI DI CALCOLATORI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")
Calcolatori elettronici.

PREREQUISITES (IF APPLICABLE)
None.

LEARNING GOALS
The aim of the course is to provide the first theoretical notions and the necessary operational skills on computer networks and in general on packet-switched communication networks. The course is developed following a top-downapproach, thus favoring a vision primarily of application of modern telematic technologies, to then get to the presentation of software and hardware technologies at the base of the realization of telematic systems. The main training objectives are: knowledge of communication needs in modern computer and telematic applications; the characteristics of packet-switched communication technologies; the basic models for the design of a computer network; the basic characteristics of TCP/IP architecture and the Internet; the main technologies currently used in both wired and wireless local networks; the basic problems related to the secure management of networks and telematic systems; basic skills for distributed programming based on the client/server model; adequate operation in the basic configuration of simple network systems based on TCP/IP architecture; the ability to use simple tools for monitoring, managing and configuring computer networks.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)
Knowledge and understanding
The student must demonstrate knowledge of the fundamental concepts that inspire the design of the various levels of a network system. In particular, the student must demonstrate understanding and ability to describe the communication protocols described in the course and ability to understand the advantages, limitations and tradeoffs of the technologies and protocols studied..

Applying knowledge and understanding
The student must demonstrate to be able to apply the techniques and knowledge learned for the solution of simple problems of network configuration, analysis of protocols and traces of network traffic. The student must also demonstrate that he has acquired the ability to use simple software tools for network analysis and simulation of network systems.

COURSE CONTENT/SYLLABUS
Part I – General concepts.
Computer networks and network services. Layered architectures of computer networks. The ISO/OSI model. Packet-switched networks. Communication protocols. Quality of Service in packet-switched networks. Datagram networks and virtual circuit networks. The TCP/IP protocol stack and the IETF.
Part II - The application layer.
Characteristics of application protocols. The client/server paradigm. HTTP, FTP, SMTP protocols. The DNS system. The peer-to-peer paradigm. Development of distributed software and the API socket and its use in C and Python languages.
Part III - The transport layer.
Techniques for reliable end-to-end transmission. Go-back-N and Selective Repeat. End-to-end techniques for error,flow and congestion control. TCP, UDP and RTP protocols. Congestion control in TCP. Fairness. Checksum.
Part IV - The mesh layer.
The IP protocol. Management of addressing in IP networks. Subnetting. NAT. Il protocollo IPv6. Unicast and multicast routing in an intra-domain environment. Routing distance-vector and link-state. The RIP and OSPF protocols.
Hierarchical routing on the Internet. Autonomous System. Overview of inter-domain routing. Internet ExchangePoints. Relationships between Autonomous Systems.

Part V - LAN networks.
Shared access techniques in the LAN environment. Aloha. CSMA/CD. Ethernet technology and its evolution. LAN interconnection: bridging and switching. VLAN. Structured cabling systems. LAN connection to the geographical network: access technologies. Local Area Network Management: addressing, NAT and DHCP services, VLAN services. Wireless LAN and PAN networks: 802.11 and Bluetooth technologies.
Part VI - Techniques for secure communication on the network.
Cryptographic techniques. Cryptographic hash functions. Digital signature.
Part VII – Exercise activities
Configuring a TCP/IP network. Using a network simulator/emulator. Network monitoring. Software tools for network analysis. Analysis of traces of network traffic.

READINGS/BIBLIOGRAPHY

- J. Kurose, K. Ross, "Reti di calcolatori e Internet. Un approccio top-down", (7a ed.) - Pearson 2017
- Lesson slides

TEACHING METHODS

The course consists of: a) lectures for about 80% of the total hours; b) practical exercises for the remaining 20%.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	X
	Open answers	
	Numerical exercises	

b) Evaluation pattern:

The outcome of the written test is binding for access to the oral test

COURSE DETAILS

"SISTEMI MULTIMEDIALI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: ANTONIO M. RINALDI
PHONE: 0817683911
EMAIL: ANTONIOMARIA.RINALDI@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Basi di Dati.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course provides students with the basic knowledge and methodological tools necessary to understand and design multimedia systems. The course will present models, techniques and technologies for the management of multimedia data together with the architectural aspects of multimedia systems. Different methodologies and standards for multimedia representation will be presented and discussed. Software tools will be used for the implementation of multimedia descriptor extraction and their use in different applications.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course provides students with the knowledge and methodological tools necessary to analyze the problems related to multimedia to allow its management. These tools will allow students to recognize the main relationships between the representation of multimedia data, the analysis and management of the same and to understand their effects in terms of effectiveness and efficiency within the entire multimedia management process.

Applying knowledge and understanding

The course provides skills and methodological and operational tools necessary to concretely apply the knowledge related to the analysis of multimedia data for the identification of effective techniques to represent them and the useof efficient technologies to implement multimedia systems.

COURSE CONTENT/SYLLABUS

INTRODUCTION TO MULTIMEDIA - Media and multimedia, types of media, multimedia computing, components of multimedia applications, semiotics, semantic gap.

MULTIMEDIA BASICS - Metadata, document formats, markup languages, text properties, document organization, image formats, audio formats, video formats, multimedia document preprocessing.

IMAGE REPRESENTATION - Bit Plan, Dithering, 1-bit Images, 8-bit 24-bit, Graphic/Image Data Types, Color Search Tables, Popular File Formats.

COLOR IN IMAGES AND VIDEOS - Color science, color models inimages, color models in video.

BASIC CONCEPTS IN VIDEO - Analog Video, Digital Video, Display Video Interfaces, 3D Video and TV.

DIGITAL AUDIO FUNDAMENTALS - Sound digitization, signal-to-noise ratio (SNR), signal-quantization-to- noise ratio (SQNR), linear and nonlinear quantization, audio filtering, audio quantization and transmission, Pulse Code Modulation, Differential audio coding, lossless predictive coding, DPCM, DM, ADPCM.

DATA COMPRESSION – Lossless compression, basics of information theory, Run-Length Coding, Variable-Length Coding, dictionary-based coding, arithmetic coding (outline), lossy compression, distortion measures, rate-distortion theory, quantization, transform coding, Wavelet-based coding, Wavelet packets, Embedded Zerotree of Wavelet coefficients, Set Partitioning in Hierarchical Trees (outline).

IMAGE COMPRESSION STANDARDS - The JPEG standard, Main steps in JPEG image compression, JPEG mode, Bitstream JPEG, the JPEG2000 standard, main steps of JPEG2000 image compression, adaptation of EBCOT to JPEG2000, ROI, JPEG and JPEG2000 performance comparison.

INTRODUCTION TO VIDEO COMPRESSION - Video compression based on motion compensation, motion vector search (outline), H.261, H.263 (outline), MPEG-1, 2, 4, 7 and 21. MPEG AUDIO COMPRESSION - Psychoacoustics, Frequency masking, Time masking, MPEG audio, MPEG layers, MPEG audio strategy, MPEG audio compression algorithm. MULTIMEDIA DESCRIPTORS - Color histograms, Color layout, Texture characteristics, Multiresolution analysis (outline), Shape characteristics, Shape representation, SIFT, SURF, Audio characteristics, Video (outline). MULTIMEDIA SYSTEMS ARCHITECTURE - Multimedia Content Management, Multimedia Information Retrieval Systems (MIRS), Systems Evaluation, Multimedia Databases, Indexes for multimedia data.

READINGS/BIBLIOGRAPHY

Libri di testo: Ze-Nian Li , Mark S. Drew, e al., “*Fundamentals of Multimedia*”, 2ed, Springer, 2014.
Vittorio Castelli and Lawrence D. Bergman, editors, “*Image Databases. Search and Retrieval of Digital Imagery*”, Wiley, 2002
Course Slides.

TEACHING METHODS

Lectures, exercises, seminars, specialized software for the extraction of multimedia descriptors and applications (OPENCV: Open Source Computer Vision Library)

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
oral	X
project discussion	X

COURSE DETAILS

"SISTEMI OPERATIVI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER:
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Programmazione, Calcolatori Elettronici.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The course aims to provide skills on the reference architectures of operating systems; on the methodologies used for resource management in a modern operating system; on tools for system programming; the use of a Unix platform atthe user and administrator level; on the basic principles of concurrent programming. The exercises and laboratory activities are developed in the Linux environment and consist of concurrent programming applications and programming of Linux kernel modules.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate: to know the problems related to the management of computing resources in multi-user and multi-programmed systems, to understand the methodological tools and basic algorithms used for the realization of high-performance processing systems that efficiently use computing resources, to illustrate the fundamental techniques inherent in concurrent and system programming.

Applying knowledge and understanding

The student must demonstrate to be able to apply the methodological tools learned for the design of processing systems, based on the use of the fundamental abstractions provided by operating systems (eg processes, threads, filesystems, inter-process communication). In addition, the student must demonstrate to be able to apply the methodological tools in order to develop new systems, using the knowledge and techniques of concurrent and system programming, and in order to diagnose the problems of computing systems due to incorrect synchronization and inefficient use of computing resources.

COURSE CONTENT/SYLLABUS

Introductory concepts. Historical evolution of the S.O. - Mono and multiprogramming - Batch, time sharing, real-time, mobile, cloud computing - Recall of architectural elements to support an OS (I/O mode, interruption management, user and supervisor mode, memory hierarchies) - Resource virtualization in the O.S. - The kernel - Callto supervisor - Layered, monolithic, modular, microkernel architectures.

Management and Scheduling of Processes and Threads. Process concept – States of a process – Descriptor of a process – Process queues – The change of context – Process management in Linux and Windows operating systems – Short, medium and long-term CPU scheduling – Evaluation parameters of scheduling algorithms – Starvation – Preemption – First Come First Served, Round Robin, Shortest Process Next algorithms, Shortest Remaining Time, multiple queues with feedback – Comparison between single-processor scheduling algorithms – Traditional UNIX scheduling – The O(1) and CFS schedulers of the Linux operating system – Scheduling in the Windows operating system – Multiprocessor scheduling: SMP, multicore, and hyperthreading architectures, scheduling with load sharing and dynamic load balancing, gang scheduling – Thread concept – Processes and threads – States of a thread – Threads at user level and at the core level – Multithreading programming models – Primitives for thread management – Noteson thread management in Linux, Windows, Java systems.

Concurrent programming. Competition and parallelism – Speed-up in concurrent and parallel architectures – Amdahl's law – Primitive forks/joins – Resource and resource manager concepts – Competition, cooperation, and interference – Race condition and synchronization – Global and local environment models – The interaction between processes in the global environment model – The problem of mutual exclusion: requirements, hardware support and solution. The problem of communication – Traffic lights – Communication via shared memory – The solution of mutualexclusion problems through traffic lights – Problems of cooperation in the global environment model:

producer/consumer problem and solutions through traffic lights, reader/writer problem and solutions through traffic lights – Monitors – Signal and continuous control strategies, signal and wait, and Hoare's solution – The realization of a monitor through traffic lights – The solution of the problems of mutual exclusion, producer/consumer and readers/writers through monitors – The interaction between processes in the local environment model – The primitives for message exchange – Direct and indirect, symmetric and asymmetric communication – Asynchronous and synchronous communication – Asynchronous and synchronous send – Receive blocking and non-blocking – Realization of synchronous send and receive using asynchronous primitives – Servant process – The deadlock problem
– Conditions necessary for the deadlock – Methods for managing the deadlock – Deadlock prevention – Deadlock Avoidance and banker's algorithm – Detection and recovery of the deadlock – Comparison of strategies for managingthe deadlock.

The Management of the Central Memory. Aspects characterizing memory management: relocation, allocation, organization of virtual space, loading – Swapping – Multiple partition management – Pagination: address translation scheme, pagination architecture, TLB, Page table structure – Segmentation: address translation scheme, segmentationarchitecture – Segmentation with Pagination – Virtual memory – Pagination on demand – Algorithms for page replacement – Degenerate paging activity (thrashing) – The working set model – Memory management in the Linux operating system: user-space and kernel-space allocators, memory zones, buddy system, page cache, page frame reclaim algorithm – Notes on memory management in the Windows operating system.

I/O management. I/O operations – Virtualization of I/O resources – Device independent layer, device-dependent layer – Drivers – Secondary memory structure – Disks – Disk access scheduling with reference to cylinders and sectors
– I/O caching and buffering – I/O scheduling algorithms FIFO, SCAN, and variants – Disk scheduling in Linux OS – RAIDarchitectures – Solid state drives.

File Management. Logical organization of the file system: directories and files - Directory and file operations - Access methods - File descriptor - File sharing - Directory structure for file sharing - Links for sharing - File protection - Logical organization of the file system - File allocation methods: contiguous, linked and indexed list allocation - Freeblock management - Inode and file management in Unix - The Virtual File Linux system and ext2, ext3 and ext4 file systems – The Windows NTFS File System – Journaling File Systems – Log-structured File System – The Linux F2FS FileSystem for SSD.

Primitives for process management and threads in the UNIX/Linux OS. Primitives for creating and terminating processes: fork, exec, exit, wait – IPC resource management – Primitives for shared memory management – Primitives for traffic light management – use of semop for the realization of primitive wait and signal – Examples of use: solution of problems of mutual exclusion and communication (producer / consumer and readers / writers), object-based and object-oriented realization of a type Monitor – Primitives for the management of queues of messages and use examples – The POSIX Threads primitives for thread management, and use examples.

Insights on the UNIX/Linux operating system. Linux OS installation – The shell and basic commands (filesystem navigation, permission assignment, software installation, program compilation) – Program compilation: makefiles, static and dynamic libraries – Process I/O channels – Pipes – Environment variables – Shell scripting – UNIX signals –Linux kernel configuration and compilation – Development of system calls and kernel modules.

Insights into virtualization and Android mobile OS. Uses of virtualization. Virtualization architectures. CPU virtualization (CPU virtualizability, trap-and-emulate technique, full virtualization using DBT, paravirtualization, Intel VT hardware support). Memory virtualization (shadow page tables, extended page tables). I/O virtualization (full virtualization, PV I/O, I/O passthrough, IO-MMU, SR-VIO). Example of VMware technologies. Android history and design goals. Applications in Android. Process and memory management (life cycle of Activities, Intent, OOM). Application Security Model. Inter-Process Communication in Android.

READINGS/BIBLIOGRAPHY

Textbooks adopted

- Ancillotti, Boari, Ciampolini, Lipari, "*Sistemi Operativi*", McGraw Hill.
- Stallings, "*Operating Systems: Internals and Design Principles", 6th ed*., Pearson Education

Recommended textbooks

- Silberschatz, Galvin, Gagne, "*Sistemi operativi - sesta edizione*", Addison Wesley
- Tanenbaum, "*I Moderni Sistemi Operativi – terza edizione*", Pearson Education

Didactic handouts and transparencies of the lessons available on the teacher's website.

TEACHING METHODS

The teaching will be delivered through lectures (about two thirds of the total hours of the course), with classroom andlaboratory exercises (about one third of the total hours of the course). The lectures will introduce the theoretical aspects related to the abstractions realized by operating systems, to the algorithms for the efficient management of computing resources (CPU, memory, I/O), and to the problems, algorithms and the most common mechanisms for thedevelopment of competing systems (eg traffic lights, mutex, monitors, shared memory, message queues). In classroom and laboratory exercises, students will practically deepen the theoretical aspects, independently developing competing programs with the Linux operating system and the C programming language.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Concurrent programming exercises	X

c) Evaluation pattern:

The evaluation will take into account in a uniform way both the course of the written test (programmingexercises competitor), and the conduct of the oral exam.

COURSE DETAILS

"TECNOLOGIE INFORMATICHE PER L'AUTOMAZIONE INDUSTRIALE"

SSD ING-INF/04

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: GIANMARIA DE TOMMASI
PHONE: 081 768 3853
EMAIL: DETOMMAS@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): II
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Programmazione.

PREREQUISITES (IF APPLICABLE)

Basic knowledge of closed-loop control systems; basic knowledge of issues related to determinism in the design and development of real-time software systems.

LEARNING GOALS

The aim of the course is to educate the student to the problems of software design of industrial automation systems. The experimentation of the salient phases of the design and software implementation of automation systems through the use of professional tools and plant simulators is foreseen. At the end of the course the student will know the principles of operation and programming of control devices and their main requirements.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The training course aims to provide students with the methodological tools for the design of automation software based on Programmable Logic Controllers (PLCs). The main requirements for industrial control devices will be introduced, to then focus on the operating principle and programming languages for PLCs. The student must demonstrate that he has learned what are the peculiar requirements of hardware and software systems dedicated tothe control of industrial processes. The student will also demonstrate the knowledge of the main phases of design of an automation system and the role of validation of control logics using simulation tools.

Applying knowledge and understanding

The student must demonstrate to be able to formalize through formal languages (such as, for example, the SequentialFunctional Chart, SFC) the closed-loop operating specifications expressed in natural language for simple processes to be automated. Starting from the formal specifications, then, the student must demonstrate the ability to develop simple automation algorithms and implement them on a PLC using the languages provided by the IEC 61131-3 standard. The student will have to show the ability to develop simple synoptics to be used as a *user panel* for the management of an industrial plant. Finally, the student will have to show the ability to design the validation tests of the control logic also using simple plant simulators.

Communication skills

During the course there are classroom exercises in which students (in groups of 3/5 people) will have to develop and validate through the use of simulators, simple automation software. Through this activity, the student will have the opportunity to develop soft skills related to group work. In addition, these exercises will require to develop part of thesolution outside of class hours, so the student will have the opportunity to have to report briefly to the teacher about the work done.

Learning skills

For the practical part of the course, we will refer to the CODESYS tool (https://www.codesys.com/). However, since this tool is *fully compliant* **with the IEC 61131-3** standard, the student will not be limited in any way by the tool adopted and will learn the concepts related to IEC 61131-3 that are independent of the particular implementation. Therefore, the student will acquire the ability to use in a short time any commercial development environment for PLC.

COURSE CONTENT/SYLLABUS

Control devices

- Requirements for a control device
- Controllers for general applications
- Specialized controllers

Programming of control devices

- The programmable logic controller (PLC)
- The IEC 61131-3 standard
- Variables and variable types

Programming languages

- Structured Text
- Ladder Diagram
- Functional Block Diagram
- Instruction List

Program organization units (POUs)

- Functions and Function Blocks
- Programs
- Tasks
- Resources
- Configuration

Sequential Functional Chart (SFC)

- Supervision, control and data acquisition systems (SCADA)
- Development cycle of automation systems
- Validation of simple automation logics using plant simulators (digital twin)

READINGS/BIBLIOGRAPHY

Chiacchio e F. Basile, “*Tecnologie Informatiche per l'Automazione*”, seconda ed., McGraw-Hill, 2004.

TEACHING METHODS

The teacher will use: a) lectures for about 60% of the total hours, b) classroom exercises through the use of the CODESYS tool (https://www.codesys.com/) for about 40% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	
	Open answers	X
	Numerical exercises	

The written test is aimed at verifying the student's ability to design simple automation algorithms and consists in the solution of 1 or 2 simple industrial automation problems, a solution that requires.
development of control algorithms in one or more of the graphical programming languages provided by the standard IEC 61131-3 (Ladder Diagram, Function Block Diagram, Sequential Functional Chart). Typically, the student has 3 hours for the written test.
The oral interview follows the written test and is aimed at a critical discussion of the solution (s) given by the student to the problems proposed in the written test, and to ascertain the acquisition of concepts and content introduced during the lessons.

b) **Evaluation pattern:** The outcome of the written test is binding for access to the oral test. The written and oral tests each contribute to 50% of the final evaluation, therefore passing the written test is not sufficient to pass the exam.

COURSE DETAILS

"TEORIA DEI SEGNALI"

SSD ING-INF/03

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): I
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica I.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The aim of the course is to provide the basic tools for the analysis of deterministic signals and for their processing bysystems (in particular linear systems) both in the time domain and in the frequency domain. A further objective is tointroduce the basic concepts of probability theory.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate to be able to classify and describe the signals of interest for engineering, both in thetime domain and in that of frequency. Must demonstrate the ability to analyze simple signal processing schemes, particularly by means of linear systems. He must also demonstrate that he understands the random nature of manyphenomena of interest to engineering and that he knows the fundamental aspects of probability theory.

Applying knowledge and understanding

The student must demonstrate that he is able to recognize problems that involve the analysis and processing of signals, choosing models appropriate to their description and solution. Must demonstrate the ability to size simple signal processing schemes, in particular by means of linear systems. He must also demonstrate that he can model andsolve simple problems of a random nature with the tools of probability theory.

COURSE CONTENT/SYLLABUS

Deterministic signals: continuous-time and discrete-time signals, energetic characterization of signals, series and Fourier transform, band of a signal. Classification of systems: causality, stability, linearity, time-invariance. Time-invariant linear systems: filtering in the time and frequency domain, band of a system, linear and nonlinear distortion.Analog/digital and digital/analog conversion. Elements of probability theory. Random variables: complete and synthetic characterization of a variable, a pair of variables, a vector of random variables. Remarkable random variables.

READINGS/BIBLIOGRAPHY

Textbooks:

E. Conte: "*Lezioni di Teoria dei Segnali*", Liguori.
E. Conte, C. Galdi, "*Fenomeni Aleatori*", Liguori.
G. Gelli: "*Probabilità e Informazione*", www.docenti.unina.it.
G. Gelli, F. Verde: "*Segnali e sistemi*", Liguori.
M. Luise, G.M. Vitetta: "*Teoria dei segnali*", **III edition**, 2009, McGraw-Hill.

Handouts:

L. Verdoliva: "*Appunti di Teoria dei Segnali*", www.docenti.unina.it.

TEACHING METHODS

Teaching is provided for 100% with lectures, which include both theory and exercise

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	
	Open answers	
	Numerical exercises	X

b) Evaluation pattern:

COURSE DETAILS

"TEORIA DEI SISTEMI"

SSD ING-INF/04

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: ALFREDO PIRONTI
PHONE: 081 768 3172
EMAIL: PIRONTI@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): II
CFU: 9

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Fisica Generale II.

PREREQUISITES (IF APPLICABLE)

Basic knowledge of Laplace, Zeta and Fourier transforms.

LEARNING GOALS

Provide the student: the basics of mathematical modeling of natural and / or artificial systems in continuous and discrete time, the techniques of analysis of systems described by mathematical models input-state-output and input-output, with particular reference to linear and stationary systems, the main techniques of analysis of feedback systems. Introduce the student to the use of the main software for the analysis and simulation of systems.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The training course aims to provide students with the methodological tools to describe simple engineering systems using an adequate mathematical model, derive models for small signals of nonlinear systems, and characterize the response over time and the main structural properties of linear systems. To this end, the student will be introduced tothe main techniques of analysis of dynamical systems, both in the time domain and in the complex domain. In addition, the analysis of systems in the frequency domain will be treated by presenting the main parameters that, in this context, characterize linear systems.

Applying knowledge and understanding

At the end of the course, students will be able to analyze block patterns, obtaining an overall model, and to evaluate the response of this model to assigned signals. In addition, the student will be able to analyze the structural propertiesof this model with particular reference to stability. You will also be able to use Matlab/Simulink software for system analysis and simulation.

COURSE CONTENT/SYLLABUS

- References to matrix algebra: elementary operations on matrices and vectors. Eigenvalues and eigenvectors of a matrix. Vector spaces. Banach spaces and Hilbert spaces. P norms of matrices and vectors.
- Dynamical systems: input, state and output variables, state and input-output representations, classification of dynamical systems.
- Elements of modeling, examples of mathematical models.
- Nonlinear systems: equilibrium points of a nonlinear system, linearization around a trajectory and an equilibrium point.
- Analysis of linear and stationary systems in continuous and discrete time: the principle of superposition of effects, free-evolving response and forced response. Calculation of the transition matrix through diagonalization. The natural ways.
- Analysis of linear and stationary systems in continuous time with the aid of the Laplace transform: transfer function, impulsive response and step response, characteristic parameters of step response, response to polynomial and sinusoidal signals, regime and transient response.
- Analysis of linear and stationary discrete-time systems with the help of the Zeta transform: transfer function, pulse response and step response, regime and transient response.

- Stability of equilibrium points: simple and asymptotic stability, instability. Examples of analysis of the stability of equilibrium points of nonlinear systems (pendulum, etc.). Notes on Lyapunov's Theory. Stability of linear systems, Routh criterion, application of Routh's criterion to discrete time systems. Input-output stability of linear systems.
- Interconnected systems and block diagrams: series, parallel and feedback systems. Representation of interconnected systems i. Notes on the stability of interconnected systems.
- Theory of realization for monovariable systems, canonical form of observability and canonical form of reachability.
- Techniques for digitizing a continuous-time system. Sampled data systems: ZOH sampler and filter. Sampled data representation of a finite-dimensional linear system.
- Series and Fourier transform. Frequency response of a linear and stationary system.
- Plotting Bode diagrams.
- Filtering action of dynamic systems: low-pass, high-pass, band-pass, needle filters.
- Analysis of the stability of closed-loop systems: plotting Nyquist diagrams, the Nyquist criterion. Margins of stability.
- Structural properties: reachability, controllability and observability, canonical Kalman forms.

- Matlab and Simulink for simulation and analysis of dynamical systems.

READINGS/BIBLIOGRAPHY

G. Celentano, L. Celentano – *“Modellistica, Simulazione, Analisi, Controllo e Tecnologie dei Sistemi Dinamici -Fondamenti di Dinamica dei Sistemi*”, Vol. II, EdiSES, 2010.
Other texts and/or notes suggested by the teacher.

TEACHING METHODS

The teacher will use: a) lectures for 80% of the total hours, b) classroom exercises through the use of the MATLAB/SIMULINK tool (https://www.mathworks.com/) for about 20% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	X
other	

The written test is aimed at verifying thestudent's ability to calculate the response of a linear signal systemto draw Bode diagrams, and to analyze the stability properties of interconnected systems.
The oral interview, which follows the written test, consists of a discussion on the theoretical topics covered in the course and on simple papers in Matlab / Simulink, in order to ascertain the acquisition of the concepts and contents covered during the lessons.

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

b) Evaluation Pattern:

The outcome of the written test is binding for access to the oral test. Overcoming written test is not sufficient to pass the exam.

COURSE DETAILS

"LABORATORIO DI MISURE"

SSD ING-INF/07

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2024-2025

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): III
SEMESTER (I, II): I
CFU: 3

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE “REGOLAMENTO”)

None.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

The aim of the course is to provide the ability to independently design and develop measurement systems based on low-cost microcontroller hardware architectures. Particular attention is paid to the understanding of microcontrollerperipherals and their functionalities in the field of physical quantity measurements. The focus is also on the main parameters of signal acquisition, on the optimal use of the hardware resources made available, on the writing of efficient measurement algorithms in C language of low and higher level and on how to evaluate the metrological performance of the developed instrument.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student must demonstrate knowledge and understanding of the problems related to the measurement of quantities of interest typical of scientific and industrial applications of Engineering. He must demonstrate that he has achieved the ability to distinguish between the different measurement methodologies and identify the most suitablein terms of measurement uncertainty for the measurement of the quantities of interest. He must also demonstrate the ability to link the notions acquired in other courses in order to configure hardware resources and define the algorithm for processing the acquired signals, in order to measure the magnitude of interest.

Applying knowledge and understanding

Given the objectives and the technical-applicative nature of the course, the student must demonstrate the ability to apply knowledge and understanding through the implementation and gradual development of a series of microcontroller measurement systems, capable of acquiring physical quantities from both analog and digital sensors.The student must therefore be able to choose the peripherals suitable for the specific application, know how to realize the conditioning circuits, size the main acquisition parameters, know how to write the measurement firmwareof a microcontroller in C language, know how to execute and debug the developed code.

COURSE CONTENT/SYLLABUS

Architecture of a Microcontroller. Main features of a microcontroller. The STM32F3 Discovery demo board. Digital,analog, sequential circuits. Arithmetic Logic Unit. Flash memory and RAM. Encoding the instruction set. Compiler C. IAR embedded workbench IDE development environment: Creating a project.
Pointers. Operations and manipulation on bits in C language. Mapping registers in memory.
Read and Write logs.Configuration of microcontroller peripherals.

GPIO peripherals. Digital Inputs, Digital Outputs, Alternate Function, Analog Inputs/Outputs. Output Data Register.Input Data Register.
Timer devices. Timer used as time base. Minimization of uncertainty due to resolution in time measurements. Timemeasurements with microcontroller. Counter. Frequency meter.
Interrupt. Vector Table, Service Procedure. Example of interrupt generated by Timer and external button.
ADC device. Configuration. Single-ended or Differential sampling. Setting up Time Sampling. Setting the sample rate. Sampling sequence. Internal temperature sensor. Temperature measurement with ADC.
DAC device. generation of a constant voltage. Generation of a sine waveform. Generation of an arbitrary waveform.Using DMA for sample transfer.
I2C device. Data reading from MEMS digital sensors: Accelerometer, Gyroscope, magnetometer.

READINGS/BIBLIOGRAPHY

M0316 – STM32F303 ARM Reference Manual (available on the manufacturer's website https://www.st.com

TEACHING METHODS

The teacher will use:
a) lectures for about 20% of the total hours,
b) laboratory to deepen the applied knowledge for about 80% of the total hours.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	
only oral	
project discussion	
other	X

In case of a written exam, questions refer to:	**Multiple choice answers**	
	Open answers	
	Numerical exercises	