UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING
SUBJECT	SCIENTIFIC COMPUTING
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20923-Attività formative affini o integrative
CODE	22269
SCIENTIFIC SECTOR(S)	MAT/08
HEAD PROFESSOR(S)	FRANCOMANO ELISA Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**FRANCOMANO ELISA** Tuesday 09:00 11:00 Ed.6- Stanza 2

DOCENTE: Prof.ssa ELISA FRANCOMANO

PREREQUISITES	Fundamental of numerical methods and programming in MATLAB.
LEARNING OUTCOMES	KNOWLEDGE AND UNDERSTANDING At the end of the course, the student will have acquired advanced knowledge and numerical methodologies of scientific computing for the solution of problems in engineering. In particular, he will learn numerical methodologies suitable for the automatic resolution of problems deriving from applications governed by non-linear equations and systems, by linear systems of large dimensions, by ordinary differential equations. He will be able to proceed in the research and formulation of advanced and efficient numerical algorithms, and in the conscious use of programming techniques typical of scientific computing. This objective will be assessed during the end term exam ABILITY TO APPLY KNOWLEDGE AND UNDERSTANDING The student will be able to apply advanced numerical methodologies for the solution of a given problem through critical reasoning and the interpretation of the results obtained from the execution of the algorithms presented automatically. He will be able to identify the theoretical advantages and limitations of the proposed methodologies and to generate efficient codes from a numerical point of view, in terms of computational complexity, stability, accuracy and memory demanding in the MATLAB environment. To achieve these objectives, the course will be divided into lectures and single and group exercises with discussions of case studies and applications, pseudo-codes and codes in MATLAB. This objective will be assessed during the end term exam. AUTONOMY OF JUDGMENT Lo studente sarà in grado di identificare le metodologie numeriche avanzate alla base di molti problemi delle scienze applicate e di valutarne la robustezza numerica progettando codici computazionali in linguaggio Matlab. Sarà inoltre in grado di interpretare i dati dei problemi oggetto di studio, i risultati del calcolo e l'efficacia del solutore numerico adottato COMMUNICATION SKILLS The student will be able to discuss with competence, properties of language and clarity on the issues of scientific computing. He will be able to argue in support of the algorithms designed and critically evaluate the response obtained from the software used. LEARNING ABILITY At the end of the course, the student will have acquired the skills of numerical and computational mathematics for studies in electrical engineering.
ASSESSMENT METHODS	The assessment of learning is carried out through an interview during which the degree of knowledge actually acquired, the ability to apply the proposed methodologies and the algorithm in an effective way will be ascertained. The grade will be attributed on the basis of the level that the student demonstrates to have reached during the exam based on the grid at the bottom: 30-30 cum laude: Excellent / excellent rating. Excellent knowledge of the topics, excellent analytical skills even in new contexts; excellent language and learning properties. 27-29: Very good rating. Good command of the topics, full ownership of language, the student is able to apply the knowledge to solve the proposed problems. 24-26: Good rating. Basic knowledge of the main topics, good language properties, with limited ability to autonomously apply the knowledge to the solution of the proposed problems. 21-23: Satisfactory. Partially autonomously the acquired knowledge. 18-20: Sufficient. Minimum knowledge of the course topics and of the technical language, very little or no ability to autonomously apply the acquired knowledge. Less than 18: insufficient knowledge of the topics, insufficient ability to analyze and solve the problems posed, lack of autonomy or to perform disciplinary and interdisciplinary connections, lack of expository and argumentation skills, lack of clarity and inadequate language properties.
EDUCATIONAL OBJECTIVES	The educational objectives of the course consist in the acquisition of notions, methodologies and techniques of the scientific computation in order to provide the fundamental numerical solvers for electrical engineering problems.
TEACHING METHODS	The course will be divided into lectures in class and computer class work, single and group exercises with discussions of case studies and applications algorithms, pseudo-codes and calculation codes.
SUGGESTED BIBLIOGRAPHY	A.Quarteroni, F. Saleri, P. Gervasio, Scientific Computing, Springer, 2015, ISBN 10: 8847039525 CJ..Zarowski, An introduction to numerical analysis for electrical and computer engineers, Wiley, 2004.ISBN: 978-0-471-65040-9 S.C.Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, ISBN 10: 0073397962

SYLLABUS

Hrs	Frontal teaching
1	Introduction to the course and educational objectives

SYLLABUS

Hrs	Frontal teaching
8	Approximation of functions and data: Hermite interpolation - Spline functions - Least squares method - Discrete Fourier Transform - Antitransform - Fast Fourier Transform (FFT). Implementation analysis of the computational processes approached.
5	Numerical integration: automatic interpolation formulas, formulas with a high degree of precision. Notes on the Monte Carlo Method.Implementation analysis of the computational processes approached.
5	Methods for solving linear systems: relaxation methods, gradient method, conjugate gradient method.
5	Numerical methods for solving nonlinear equations and systems. Numerical optimization methods: golden section method. Non linear least squares method. Gauss-Newton method.
5	Ordinary differential equations. One-step methods. Multi-step methods.

Hrs	Practice
25	Esercitazioni, applicazioni e implementazione dei metodi affrontati in MATLAB