OPERATING TOOLS FOR HYDRAULIC AND ENVIRONMENTAL STUDIES
A.A. 2020/2021

Denominazione insegnamento	OPERATING TOOLS FOR HYDRAULIC AND ENVIRONMENTAL STUDIES	
Codice insegnamento	27006857	
Corso di Studio (CdS)	ENVIRONMENTAL AND TERRITORIAL SAFETY ENGINEERING	
Livello CdS	SECOND	
Codice CdS	0773	
Settore Scientifico Disciplinare (SSD)	ICAR/02	
Crediti Formativi Universitari (CFU)	9	
Tipologia Attività Formativa (TAF)	Caratterizzante	
Tipo attività formativa	COMPULSORY	
Anno di corso	1	
Periodo didattico	SECOND SEMESTER	
Docente responsabile	SIRANGELO BENIAMINO	
Altri docenti coinvolti		
Organizzazione didattica*	***Ore Lezioni***	*54*
	Ore Esercitazioni	18
	Ore Laboratorio	---
	Ore Studio individuale	153
Lingua di insegnamento	ITALIAN & ENGLISH	
Propedeuticità	NONE	
Prerequisiti	NONE	
Contenuti	The course falls within the disciplines of computational engineering with particular reference to the topics of hydraulic engineering and environmental engineering. The course content consists of the numerical calculation techniques necessary for modeling and solving hydraulic and environmental engineering problems and include univariate and multivariate modeling of problems formulated in both deterministic and stochastic terms.	
Obiettivi formativi (in termini di risultati di apprendimento attesi)	The course aims to provide the student with the fundamental notions for the development of the numerical calculations necessary for the solution of advanced hydraulic and environmental problems. The student will have to know and be able to understand the links between the engineering nature of the problems, their mathematical formulation and their numerical solution assisted by automatic calculation tools. The student must be able to apply the knowledge acquired, also jointly and also for problems of different nature. Students are required to acquire critical skills in relation to the chosen approaches and the results obtained. The ability to expose what has been learned is also ascertained and further study of the topics covered is also requested through subsequent studies developed independently.	
Programma	1. Multivariate linear models Systems of linear equation, matrix formulation, bands	

	matrices. Direct and iterative algorithms. Routines. Exercise 1: Numerical resolution of a network problem 2. Multivariate nonlinear models Univariate and multivariate nonlinear problems, numerical resolution of nonlinear system of equations, maximum and minimum of a multivariate function. Linear searching and minimization. Routines Exercise 2: Numerical resolution of a slope stability problem. 3. Univariate differential models Ordinary differential equations and systems of equations. Initial conditions and particular solutions. Numerical schemes, stability and convergence. Routines. Exercise 3: Numerical solution of reservoir routing equations. 4. Multivariate differential models Partial differential equations and systems of equations. Elliptic, parabolic and hyperbolic equations. Boundary and initial conditions, particular solutions. Finite difference method, algorithms, stability and convergence. Routines. Exercise 4: Numerical calculus of stresses for a two dimensional structural element of a water tank. 5. Univariate probabilistic models Univariate stochastic models, pseudo-random numbers, Monte Carlo methods. Routines. Exercise 5: Hydrological process simulation by means of Monte Carlo method. 6. Multivariate probabilistic models Multivariate stocastic processes and random fields. Correlation structure. Geostatistics, Kriging. Routines. Exercise 6: Rainfall field analysis by means of Kriging.
Modalità di erogazione	Front
Metodologie didattiche	Teaching is provided both through lessons and through exercises. The lessons are carried out via video projection and the teaching material used is fully available to students, with the addition of further examples and problems proposed and carried out. The exercises are carried out with the direct involvement of the students who are called to develop, under the control of the teacher, a calculation code that applies the notions presented in the lessons to real engineering problems. In carrying out the exercises, the integration between the engineering skills possessed by the students and the calculation techniques they have learned during the course is required.
Metodi e criteri di valutazione dell'apprendimento	Students' learning of the topics covered during the course is assessed by means of a three-part exam test. The first part consists of a practical test in which the student is asked to solve a specific problem numerically by writing a calculation code that uses the numerical algorithms developed during the course. These tests are carried out individually by each student during the

	exam and are followed individually in their development by the teacher. The student's ability to reach the numerical values constituting the solution of the proposed problem is expected. The second part consists of a discussion having computational aspects in engineering problems by topic with particular reference to the problems faced during the course exercises. The student's ability to integrate his engineering skills with the computational skills acquired through the course is expected. The third and final part consists of exposing the basic principles, application areas and the potentials and limits of one of the numerical algorithms covered by the course indicated by the teacher. It is here expected that the student will have knowledge and show understanding of the topics covered. The overall assessment consists of a final mark, weighted average of the results of the three parts of the exam.
Testi di riferimento ed eventuali letture consigliate	• Notes of lessons. • W.H. Press, S.A. Teukolsky, W.T. Vetterling, B.P. Flannery - Numerical Recipes in C, Cambridge Univ. Press, 1997. • M.K. Jain, S.R.K. Iyengar, R.K. Jain - Numerical Methods for Scientific and Engineering Computation, New Age Int. , 2003. • M. Shaefer - Computational Engineering: Introduction to Numerical Methods, Springer, 2006. • G. Hornberger, P. Viberg - Numerical Methods in the Hydrological Sciences. AGU Special Publication Series, 2013.
Peer review	Topics and organization of the course were agreed with other professors of the hydraulic and environmental sector
Orario delle lezioni	*http://diam.unical.it*
Calendario degli esami	*http://diam.unical.it*
Commissione d'esame	*http://diam.unical.it*

STIMA DEL CARICO DI LAVORO PER LO STUDENTE				
	Lezioni [Ore]	Esercitazioni [Ore]	Laboratorio [Ore]	Studio individuale [Ore]
blocco argomenti 1 e 2 MULTIVARIATE LINEAR AND NON LINEAR MODELS - Notes of lessons - W.H. Press, S.A. Teukolsky, W.T. Vetterling, B.P. Flannery - Numerical Recipes in C, Cambridge Univ. Press, 1997. - M.K. Jain, S.R.K. Iyengar, R.K. Jain - Numerical Methods for Scientific and Engineering Computation, New Age Int. , 2003.	18	6		36
blocco argomenti 3 e 4 UNIVARIATE AND MULTIVARIATE DIFFERENTIAL MODELS - Notes of lessons - M.K. Jain, S.R.K. Iyengar, R.K. Jain - Numerical Methods for Scientific and Engineering Computation, New Age Int. , 2003. - M. Shaefer - Computational Engineering: Introduction to Numerical Methods, Springer, 2006.	24	7		47
blocco argomenti 5 e 6 UNIVARIATE AND MULTIVARIATE PROBABILISTIC MODELS - Notes of lessons - G. Hornberger, P. Viberg - Numerical Methods in the Hydrological Sciences. AGU Special Publication Series, 2013.	12	5		25
Ore riservate allo sviluppo delle competenze trasversali				9
Tesine/altri homework				
Ulteriori ore da dedicare alla preparazione dell'esame				36
TOTALE	**54**	**18**		**153**
ORE COMPLESSIVE	✓ **225**			