Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Integrated course "Mathematical modelling and optimization"

This course is composed of 3 Modules: 1) Advanced Analysis 1, 2) Modelling and control of networked distributed systems, 3) Process and Operations Scheduling

- Code: DT0114
- Type of course unit: Compulsory (Master Degree in Mathematics curriculum Generale), Compulsory (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Mathematics) 6 (workload 150 hours), (Master Degree in Mathematical Engineering) 6 (workload 150 hours)

Teachers: Corrado Lattanzio

1	**Course objectives**	Knowledge of mathematical methods that are widely used by researchers in the area of Applied Mathematics, as Sobolev Spaces, distributions. Application of this knowledge to a variety of topics, including the basic equations of mathematical physics and some current research topics about linear and nonlinear partial differential equations.
3	**Course prerequisites**	Basic notions of functional analysis, functions of complex values, standard properties of classical solutions of semilinear first order equations, heat equation, wave equation, Laplace and Poisson's equations.
4	**Teaching methodsand language**	Lectures **Language**: English **Reference textbooks** • G. Gilardi, ***Analisi 3***. McGraw–Hill. • V.S. Vladimirov, ***Equations of Mathematical Physics***. Marcel Dekker, Inc.. • C.M. Dafermos, ***Hyperbolic Conservation Laws in Continuum Physics***. Springer. • L.C. Evans, ***Partial Differential Equations***. AMS. • M.E. Taylor, ***Partial Differential Equations, Nonlinear equations***. Springer. • H. Brezis, ***Sobolev Spaces and Partial Differential Equations***. Springer.
5	**Assessment methods**	Oral exam

Programme of Module "Modelling and control of networked distributed systems"

- Code: DT0011
- Type of course unit: Compulsory (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Mathematical Engineering) 6 (workload 150 hours)

Teachers: Giordano Pola

1	**Course objectives**	The aim of this course is to provide basic knowledge of the analysis and design of dynamic multiagent networks.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Introduction to graph theory: graphs; matrices representation; algebraic and spectral graph theory; graph symmetries. • The agreement protocol - the static case: undirected and directed networks; agreement and markov chains; the Factorization Lemma. • The agreement protocol - Lyapunov and LaSalle: agreement via Lyapunov functions, agreement over switching digraphs, edge agreement, generalizations to nonlinear systems. • Formation Control: formation specification-shapes and relative states; shape based control; relative state based control, dynamic formation selection, assigning roles. • Mobile Robots: Cooperative robotics; weighted graph based feedback; dynamic graphs; formation control revisited; the coverage problem.

3	**Course prerequisites**	Linear Algebra. Linear control systems. Stability theory for linear control systems.
4	**Teaching methodsand language**	Lectures and exercises. **Language**: English **Reference textbooks** • M. Mesbahi and M. Egerstedt, ***Graph Theoretic Methods in Multiagent Networks***. Princeton University Press. 2010. *http://press.princeton.edu/titles/9230.html*
5	**Assessment methods**	Written and oral exam

Programme of Module "Process and Operations Scheduling"

- Code: DT0219
- Type of course unit: Compulsory (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Mathematical Engineering) 6 (workload 150 hours)

Teachers: Stefano Smriglio (Stefano.Smriglio@univaq.it)

1	**Course objectives**	Train the students in recognizing machine scheduling problems, classify them in terms of computational complexity and solve them by heuristic, approximation or exact algorithms.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Elements of a (deterministic) scheduling problem, examples of practical applications • Classification of scheduling problems • Integer Linear Programming formulations • Single machine scheduling: computational complexity, heuristic and exact algoritms • Parallel machine scheduling: exact, heuristic and approximation algorithms • Relationships with basic Combinatorial Optimization problems • Optimization problems in Project Scheduling • Job Shop scheduling: formulations, heuristic and exact algorithms On successful completion of this module, the student should : • Acquire knowledge of Machine Scheduling problems, their classification in terms of computational complexity and algorithmic techniques developed for their solution. Acquire the fundamentals of optimization methods for project management. • Acquire the ability to recognize Machine Scheduling problems in different application contexts, such as computer science, industrial engineering and management, and to identify effective solution paradigms. • Acquire autonomy in modeling and algorithmic choices for complex problems related to scheduling and project management. • Being able to hold a conversation and to read texts on topics related to the modeling of scheduling problems and the evaluation of algorithms for their solution • Acquire skills upgrading flexible knowledge and skills in the field of scheduling problems that arise in various areas, such as computer science, industrial engineering and management
3	**Course prerequisites**	basic elements of computational complexity, linear programming and network flows
4	**Teaching methodsand language**	standard lessons and exercise sessions **Language**: English **Reference textbooks** • Michael Pinedo, ***Scheduling Theory, Algorithms, and Systems***. Prentice Hall.
5	**Assessment methods**	a paper test concerning with theoretical or computational exercises; an oral test, accessible only with a sufficient grade at the paper test, about general machine scheduling theoretical issues