UNIVERSIDAD POLITÉCNICA DE MADRID
FACULTAD DE INFORMÁTICA
Campus de Montegancedo
Boadilla del Monte. 28660 Madrid

Applied Numerical Algorithms

Learning Guide – Information for Students

1. Description

Grade	University Master "Advanced Computing for Sciences and Engineering"
Module	Advanced techniques
Area	
Subject	Applied Numerical Algorithms
Type	Compulsory
ECTS credits	4 ECTS
Responsible department	Lenguajes y Sistemas Informáticos e Ingeniería de Software
Major/Section/	

Academic year	2012/2013
Term	1st term
Language	Spanish/ English
Web site	

2. Faculty

NAME and SURNAME	OFFICE	email
Vicente Martín Ayuso (Coord.)	5209	vicente@fi.upm.es
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Juan Robles Santamarta	5201	jrobles@fi.upm.es
Roberto San José García	L5002	roberto@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	•
Other required learning outcomes	•

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
(CE2)	Capacidad para definir y diseñar nuevas herramientas en plataformas computación avanzada	A
(CE7)	Desarrollo y adecuación de algoritmos y modelos científicos basados en técnicas tales como simulación de Montecarlo, álgebra lineal, mallado,..	A
(CE11)	Capacidad para integrar herramientas de modelización y simulación en enfoques multiescala y multiresolución	C
(CE12)	Adquirir conocimientos científicos avanzados del campo de la informática que le permitan generar nuevas ideas dentro de una línea de investigación	S
(CE14)	Capacidad para valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación	A
(CE15)	Capacidad de leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico	S

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Students use advanced numerical algorithms in applied problems.	CE2,CE7, CE14, CE15	C
LR2	Students learn about the fundamental algorithms in numerical linear algebra, information retrieval, ranking, and fluid dynamics as used in atmospheric modeling	CE2,CE7, CE11, CE12, CE14, CE15	A
LR3	Students become capable of determine which models are appropriate to use in applied problems	CE2,CE7,	C
LR5	Students understand the relationship among numerical methods and high performance computing	CE2,CE12	C
LR6	The students get used to the visualization of results produced by numerical methods, as in atmospheric CFD codes, for example.	CE12	A
LR7	Students use numerical libraries to solve applied problems	CE2	A

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	**Indicator**	**Related to LR**
I1	To implement and analyze the most used numerical algorithms in the application fields of the course	LR2, LR6
I2	Develop and adapt models and numerical algorithms for solving (applied) problems in the fields of information retrieval, ranking learning and atmospheric modeling	LR1,LR2,LR 4
I3	To apply high performance HW and SW tools for the practical use of numerical algorithms	LR1, LR4
I4	Use visualization techniques and programas to show and interpret the results of numerical modeling in a meaningful way.	LR5

(Optionally, use rubric table instead)

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
First Project: Definition of the objectives, tasks and working plan.	week 2	Standard classroom (networked computer required)	10 %
First Project: Result/working outcomes presentation	Week 6	Standard classroom (networked computer required)	30 %
First Project: Memoria escrita	Week 6	Delivered by electronic means (e mail or moodle)	10 %

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Second Project: Definition of the objectives, tasks and working plan.	Week 10	Standard classroom (networked computer required)	10 %
Second Project: Results presentation.	Week 14	Standard classroom (networked computer required)	30 %
Second Project: Memoria escrita	Week 14	Delivered by electronic means (e mail or moodle)	10 %
			Total: 100%

GRADING CRITERIA

Grading will be based in classroom presentations and short/long write ups of the proposed projects.

There will be two different projects that the student should work out during the course. One in the first half and other in the second.

The first project will be related to the first half themes: Information retrieval and the calculation of vectors of weights. The student will work with scientific papers and SW from these fields.

The second project will be related to the application of numerical algorithms for atmospherical simulation.

Each project will be evaluated in three steps. The first will be the definition, scope and work plan for the specific problem. The second will be a class presentation describing the development and outcome of the project. A long write up of the work done will be the third part.

Each project will account for a 50% of the total grade. Each project's part will account for a 20%-50%-30%, respectively.

GRADING CRITERIA

6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
• **Chapter 1:** Information retrieval algorithms	1.1 Information retrieval: Modeling and Numerical algorithms	I1, I2
	1.2 Web search engines. Google´s PageRank Algorithm: Mathematical models and numerical computation	
• **Chapter 2:** Ranking learning	2.1 Preference modeling	I1, I2
	2.2 Computational methods in Decision Making	
• **Chapter 3:** Numerical Solutions to Partial Differential Equations	3.1 Ordinary and Partial Differential Equations	I1,I2,I3
	3.2 Advective-Diffusion Equations	
	3.3 Finite-Difference Approximations	
	3.4 Advection schemes in Air Quality Models	
• **Chapter 4:** Finite-Differencing the Equations of Atmospheric Dynamics	4.1 The Continuity Equation for Air	I1,I2,I3
	4.2 The Thermodynamic Energy Equation	
	4.3 The Hydrostatic Equation	
• **Chapter 5:** Methods of solving Chemical ordinary Differential Equations •	5.1 Analytical Solutions to ODEs	I1,I2,I4
	5.2 Methods to ODEs	
	5.3 Methods to ODEs	

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
x	Theory Classes	*Talk to students*
	Seminars/Workshops	*Construct knowledge through student interaction and activity*
	Practical Classes	*Show students what to do*
	Placements	*Round out student training in a professional setting*
x	Personal Tutoring	*Give students personalized attention*
	Group Work	*Get students to learn from each other*
x	Independent Work	*Develop self-learning ability*

TEACHING METHODS			
	Method	**Purpose**	
x	Explanation/Lecture	*Transfer information and activate student cognitive processes*	Known as explanation, this teaching method involves t *the aim of providing information organized according t* also known as *lecture*, mainly focuses on the verbal ex under study. The term *master class* is often used to re on special occasions
x	Case Studies	*Learning by analyzing*	Intensive and exhaustive analysis of a real fact, proble interpreting or solving the problem, generating hypothe

		real or simulated case studies	and, sometimes, training in possible alternative proble
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the su applying formulae or running algorithms, applying info results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is has to solve to develop a number of previously definec
x	**Project-Oriented Learning (POL)**	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time task by planning, designing and completing a series o and applying what they have learned and making effe
	Cooperative Learning	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom and their peers' learning as part of a co-responsibility s This is both one of a number of methods for use and a
	Learning Contract	***Develop independent learning***	An agreement between the teacher and student on the independent work proposal, supervised by the teacher essential points of a learning contract are that it is a w requiring personal involvement and having a time fram

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	Durante una clase de teoría o lección magistral, el profesor realiza una exposición verbal de los contenidos sobre la materia objeto de estudio, mediante la cual suministra a los alumnos información esencial y organizada procedente de diversas fuentes con unos objetivos específicos predefinidos. Se utilizará para ello, además de la exposición oral, otros recursos didácticos (audiovisuales, documentos, etc).
PROBLEM-SOLVING CLASSES	…
PRACTICAL WORK	Este método de enseñanza se utiliza como complemento de las clases de teoría. Consiste en ilustrar la aplicación de modelos y algoritmos específicos en la resolución de problemas.
INDIVIDUAL WORK	El alumno deberá abordar el estudio y resolución de problemas en los campos de estudio considerados. Para ello, partiendo de la información dada por los profesores, trabajando con artículos científicos y algoritmos numéricos relativos al problema planteado, deberá realizar unas tareas acordadas con los profesores. Además,el alumno deberá exponer los trabajos y presentar una memoria o informe final de cada uno de ellos.
GROUP WORK	…
PERSONAL TUTORING	Durante el tiempo en el que se desarrolla la asignatura los alumnos podrán acudir en todo momento a resolver sus dudas y solicitar ayuda al profesorado en sus horario de tutorías.

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	• R. Baeza-Yates, B. Ribeiro-Neto *(1999), Modern Information Retrieval*. Ed. Addison Wesley.
	• A.N. Langville, C.D. Meyer (2006) *Google's PageRank and Beyond. The science of search engine rankings*.. Princeton University Press.
	• J. Figueira, S. Greco, M. Ehrgott (2005) Multiple criteria decision análisis. Springer
	• Celia M.A. and Gray W.G. (1992) Numerical Methods for Differential Equations. Prentice-Hall, Englewood Cliffs, NJ.
	• Makar P.A. and Karpik S.R. (1996) Basis-spline interpolation on the sphere: Applications to semi-Lagrangian advection. Mon. Wea. Rev. 124, 182-99.
	• Krishnamurti T.N. , Bedi H.S., and Hardiker V.M. (1998) An Introduction to Global Spectral Modeling. Oxford University Press, New York.
	• Jacobson M.Z. and Turco R.P. (1994) SMVGEAR: A sparse-matrix, vectorized Gear code for atmospheric models. Atmos. Environ. 28A, 273-84.
WEB RESOURCES	Subject web site (http://)
	Subject Moodle site (http://)
	Aplications examples: http://artico.lma.fi.upm.es
EQUIPMENT	Laboratory
	Room XXXX
	Group work room

9. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
Week 1 Week 2 Week 3 Week 4 (26)	Chapter 1 (6 hours)	Chapter 1 (2 hours)	• Study Chapter 1 (8 hours)	• Preparation for the first project (9 h)	• First project: definition and scope.(1h)	•
Week 5 Week 6 Week 7 Week 8 (28)	Chapter 2 (8 hours)		• Study chapter 2 (4 horas)	• Development and implementation of the first project (15 h)	• Presentaion of the results for the 1st project (1h)	•
Week 9 Week 10 (14)	• Chapter 3 (2 hours) • Chapter 4 (2 hours)		• Study Chapter 3 (2 h)	• Preparation for the second project (8h)		•
Week 11 Week 12 (14)	• Chapter 5 (2 hours)		• Study Chapter 4 (2 h)	• Development of the second project (10h)		•
Week 13 Week 14 (12)			• Study Chapter 5 (2 horas)	• Developme and implementation of the second project		•

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
				(10h)		
Week 15 Week 16 (16)				Developme and implementation of the second project (10h) • Long write up of the second project.(4h)	• Presentation of the results for the second project (2h)	•

Note: Student workload specified for each activity in hours

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Complex Systems Simulation

Learning Guide – Information for Students

1. Description

Degree	University Master "Advanced Computing for Science and Engineering"
Module	Advanced Techniques
Area	
Subject	Complex Systems Simulation
Type	Compulsory
ECTS credits	4 ECTS
Responsible department	Departamento de Matemática Aplicada (DMA)
Major/Section/	

Academic year	2012/2013
Term	1st term / Q1
Language	English
Web site	http://caci.cesvima.upm.es/

2. Faculty

NAME and SURNAME	OFFICE	Email
Antonio Giraldo Carbajo (Coord.)	1302	agiraldo@fi.upm.es
Miguel Reyes Castro	1305	mreyes@fi.upm.es
María Asunción Sastre Rosa	1318	masastre@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	• No requirement
Other required learning outcomes	• Computer programming • Mathematics & statistics

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	Competence	Level
CE2	Ability to define and design new tools in advanced computing platforms	A
CE6	Ability to adapt, use and design scientific visualization tools.	A
CE7	Ability to develop and adapt scientific models and algorithms based on techniques such as Montecarlo simulation, lineal algebra or adaptive mesh refinement	A
CE9	Ability to use optimization algorithms to improve models and simulations or as a design support tool.	A
CE10	Ability to perform studies about the reliability of the data collected from simulations for validating and verifying algorithms and tools.	A
CE11	Ability to adapt modelling and simulation tools with multiscale and multiresolution approaches.	S
CE12	Acquisition of advanced scientific knowledge in the field of computer science, being able to generate new ideas on a selected research topic.	K
CE14	Ability to comprehensively read documentary sources and search for information to undertake any research whatsoever	A
CE15	Ability to read and understand, as well as catalog and scientifically rank, publications within their field of study/research	A

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Understanding of theoretical models used to describe complex systems	CE12, CE14, CE15	A
LR2	Ability to design a simulation model for a real problem	CE9, CE15	A
LR3	Ability to implement a prototype applied to a real problem	CE2, CE6, CE7, CE11	A
LR4	Capacity to present with precision and concision the results of an applied work	CG3	A

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	Indicator	Related to LR
I1	Be able to analyze new problems and come up with their own efficient solutions using concepts and techniques from the course.	LR1, LR2, LR3, LR4
I2	Know the basic notions of dynamical systems and chaos and their applications to simulate and analyze real processes.	LR1, LR2, LR3, LR4
I3	Understand the usefulness of fractal techniques (iterated function systems, L-systems,…) to simulate nature forms.	LR1, LR2, LR3, LR4
I4	Be able to simulate complex systems made of many similar and simple parts (cellular automata, autonomous agents,…).	LR1, LR2, LR3, LR4

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Resolution of exercises and practical works (with and without computer) related to concepts introduced in the lectures	Developed and delivered through the course.	Classroom and homework	60%
Preparation and oral presentation of a subject of the course	Developed and delivered through the course.	Classroom and homework	40%
			Total: 100%

GRADING CRITERIA
In the theoretical classes, concepts and techniques for the simulation of complex systems will be presented in the classroom. Problems and practical exercises related with the theoretical classes will be proposed in the classes to the students. These will take 60% of the evaluation of the course. On the other hand, the students will have to prepare a lecture on one of the topics of the course. The lecture could be illustrated with a software application developed by the student. The weight of this activity in the evaluation will be 40%. In order to pass the course it will be necessary to obtain half of the points in each of the evaluable activities.

6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
Unit 1: Dynamical systems and chaos	1.1. Basic notions of dynamical systems. The logistic family. Stability and unstability. Bifurcations.	I1,I2
	1.2. Characteristics of Chaos	I1,I2
	1.3. Strange attactor. Henon attractor, Lorenz attractor,…	I1,I2
	1.4. Julia and Mandelbrot sets.	I1,I2
Unit 2: Cellular automata	3.1. Cellular automata.	I1,I4
	3.2. Autonomous agents and self-organitation	I1,I4
Unit 3: Fractals and iteration function systems	2.1. Fractal geometry and self-similarity (Cantor set, Koch curve, Peano curve,…). Fractal dimensions. Random fractals and Brownian motion	I1,I3
	2.2. L-systems and Fractal growth	I1,I3
	2.3. Iterated functions systems	I1,I3

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
	Theory Classes	***Talk to students***
	Seminars/Workshops	***Construct knowledge through student interaction and activity***
	Practical Classes	***Show students what to do***
	Placements	***Round out student training in a professional setting***
	Personal Tutoring	***Give students personalized attention***
	Group Work	***Get students to learn from each other***
	Independent Work	***Develop self-learning ability***

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TEACHING METHODS			
	Method	**Purpose**	
	Explanation/Lecture	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves *the aim of providing information organized according t* also known as *lecture*, mainly focuses on the verbal e under study. The term *master class* is often used to re on special occasions
	Case Studies	***Learning by analyzing real or simulated case studies***	Intensive and exhaustive analysis of a real fact, proble interpreting or solving the problem, generating hypoth and, sometimes, training in possible alternative proble
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the su applying formulae or running algorithms, applying info results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is has to solve to develop a number of previously define
	Project-Oriented Learning (POL)	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time task by planning, designing and completing a series o and applying what they have learned and making effe
	Cooperative Learning	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom and their peers' learning as part of a co-responsibility This is both one of a number of methods for use and a
	Learning Contract	***Develop independent learning***	An agreement between the teacher and student on the independent work proposal, supervised by the teache essential points of a learning contract are that it is a w requiring personal involvement and having a time fram

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	Presentation of concepts, results and algorithms on the different subjects of the course
PROBLEM-SOLVING CLASSES	…
PRACTICAL WORK	Design and implementation of algorithms to visualize and simulate with the concepts of the course
INDIVIDUAL WORK	…
GROUP WORK	Design and implementation of algorithms to visualize and simulate with the concepts of the course
PERSONAL TUTORING	Weekly tutorships to control the development of the practical work

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	Nino Boccara, Modeling Complex Systems, Springer, 2003
	Gary W. Flake, The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems, and Adaptation, The MIT Press, 2000
	Melanie Mitchell, Complexity: A Guided Tour, Oxford University Press, 2009
	Barnsley, M.F., Fractals Everywhere. Academic Press, San Diego,1988
	Peitgen, H.O.; Jürgens, H. and Saupe, D., Chaos and Fractals. New Frontiers of Science, Springer-Verlag, New York, 1992.
WEB RESOURCES	http://caci.cesvima.upm.es/web/caci/complex-system-simulation
EQUIPMENT	Laboratory

9. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
Week 1-16 (108 hours)		Presentation of concepts and algorithms by teacher and students (2 hours/week)	Study and practical work (3,75 hours/week)		Practical exercises	Collective tutorial session (Total: 16 hours)

Note: Student workload specified for each activity in hours

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Data Analysis and Visualization

Learning Guide – Information for Students

1. Description

Degree	University Master "Advanced Computing for Sciences and Engineering"
Module	Advanced Techniques
Area	
Subject	Data Analysis and Visualization
Type	Compulsory
ECTS credits	4 ECTS
Responsible department	Departamento de Arquitectura y Tecnología de Sistemas Informáticos (DATSI)
Major/Section/	

Academic year	2012/2013
Term	1st term
Language	English
Web site	http://caci.cesvima.upm.es

2. Faculty

NAME and SURNAME	OFFICE	email
Luis Pastor	53 Building "Ampliación de Rectorado" URJC	luis.pastor@urjc.es
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Juan Morales	"CeSViMa" Building	juan.morales@upm.es
Angel Rodríguez (Coord.)	4102	arodri@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	• No requirement
Other required learning outcomes	• Computer programming, Mathematics & Statistics, Graphics

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
CE6	Ability to adapt, use and design scientific visualization tools.	S
CE8	Apply tools and techniques for analyzing massive data to simulation or experimental processes.	A
CE10	Ability to perform studies about the reliability of the data collected from simulations for validating and verifying algorithms and tools.	S
CE11	Ability to adapt modeling and simulation tools with multiscale and multiresolution approaches.	A
CE12	Acquisition of advanced scientific knowledge in the field of computer science, being able to generate new ideas on a selected research topic.	S
CE14	Ability to comprehensively read documentary sources and search for information to undertake any research whatsoever	A
CE15	Ability to read and understand, as well as catalog and scientifically rank, publications within their field of study/research	S

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Apply scientific visualization advanced techniques to complex problems, data or simulations	CE6, CE12, CE14, CE15	S
LR2	Use and compare several data analysis techniques in a real framework	CE8, CE12, CE14, CE15	A
LR3	Operate and integrate 3D and advanced visualization techniques with data analysis techniques for supporting management information in complex problems	CE6, CE8, CE10, CE12	S
LR4	Accurate and brief presentation of the results obtained in a applied work	CE12, CE14, CE15	S

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	**Indicator**	**Related to LR**
I1	To analyze, design and implement an interactive data analysis system providing a scenario equivalent to a real-world problem.	LR1, LR2, LR3, LR4

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Practical appointment 1: Preliminary report	Week 4	Delivered by electronic means (e mail or moodle)	15 %
Practical appointment 2: Intermediate report	Week 13	Delivered by electronic means (e mail or moodle)	20%
Practical appointment 3: Final report	Week 17	Delivered by electronic means (e mail or moodle)	35 %
Work presentation and defense	Week 17	Regular classroom	30 %
			Total: 100%

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
STAR appointment 1: Preliminary report	Week 4	Delivered by electronic means (e mail or moodle)	25 %
STAR appointment 2: Final report	Week 17	Delivered by electronic means (e mail or moodle)	45 %
Work presentation and defense	Week 17	Regular classroom	30 %
			Total: 100%

GRADING CRITERIA

The grading system will be based on the election of:

- One practical appointment devoted to design and implement an interactive data analysis system providing a scenario equivalent to a real-world problem.
- One STAR (STate of Art) in Data Analysis and Visualization.

For the practical work, there will be three deliveries: a preliminary one (Week 4), an intermediate one (Week 13) and a final delivery (Week 17, Evaluation period). This last one will be presented at the end of the course.

Grading of the preliminary report will be based on the quality of scientific methodology presented on the report, the applied techniques and the discussion of the results. The intermediate delivery will briefly describe the development of the working plan and the changes introduced due to any problem not envisaged in the original proposal. The final report will include an exhaustive evaluation of the applied techniques.

For the STAR, there will be two deliveries: a preliminary one (Week 4), and a final delivery (Week 17, Evaluation period). This last one will be presented at the end of the course.

Grading of the preliminary report will be based on the quality of scientific methodology presented on the report, the applied techniques and the discussion of the results. The final report will include the complete study of the collected techniques, evaluating the discussion performed in the report as well as its extent.

Finally, in both cases, the students will present the results of one of their works with special remarks on the design decisions and the evaluation procedure followed during the preparation of their solutions.

For the practical work, the preliminary delivery represents a 15% of the evaluation, the intermediate the 20% and the final one (and ranking result) a 35% of the final grade.

For the STAR, the preliminary report represents a 25% of the evaluation, and the final report (and ranking result) a 45% of the final grade.

The final 30% of the grading will be obtained for the oral presentation in both cases.

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6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
Chapter 1: Techniques and devices for Virtual Reality (VR) and 3D visualization	1.1 VR Applications.	I1
	1.2 Architectures for VR.	I1
	1.3 I/O Devices for VR systems.	I1
	1.4 3D Object representation.	I1
	1.5 Colour models, illumination and textures.	I1
	1.6 Graphic pipeline.	I1
	1.7 Realistic visualization.	I1
	1.8 User interfaces	I1
Chapter 2: Data analysis techniques	2.1 Classic statistical approaches	I1
	2.2 Data preprocessing: e.g., Data cleaning, feature selection	I1
	2.3 Data mining and machine learning: supervised and unsupervised classification	I1
	2.4 Analysis result validation	I1
	2.5 Methodologies and tools for data analysis	I1
	2.6 Real study cases of data mining	I1
	2.7 Visualization vs. Data Mining	I1

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
X	Theory Classes	*Talk to students*
	Seminars/Workshops	*Construct knowledge through student interaction and activity*
	Practical Classes	*Show students what to do*
	Placements	*Round out student training in a professional setting*
X	Personal Tutoring	*Give students personalized attention*
	Group Work	*Get students to learn from each other*
X	Independent Work	*Develop self-learning ability*

TEACHING METHODS			
	Method	**Purpose**	
X	**Explanation/Lecture**	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves the "*presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose".* This methodology, also known as *lecture*, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term *master class* is often used to refer to a special type of lecture taught by a professor on special occasions
X	**Case Studies**	***Learning by analyzing real or simulated case studies***	Intensive and exhaustive analysis of a real fact, problem or event for the purpose of understanding, interpreting or solving the problem, generating hypotheses, comparing data, thinking, learning or diagnosis and, sometimes, training in possible alternative problem-solving procedures.
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the suitable or correct solutions by exercising routines, applying formulae or running algorithms, applying information processing procedures and interpreting the results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is a problem, designed by the teacher, that the student has to solve to develop a number of previously defined competences.
X	**Project-Oriented Learning (POL)**	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.
	Cooperative Learning	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom work where students are responsible for their own and their peers' learning as part of a co-responsibility strategy for achieving group goals and incentives. This is both one of a number of methods for use and an overall teaching approach, or philosophy.
	Learning Contract	***Develop independent learning***	An agreement between the teacher and student on the achievement of learning outcomes through an independent work proposal, supervised by the teacher, and to be accomplished within a set period. The essential points of a learning contract are that it is a written agreement, stating required work and reward, requiring personal involvement and having a time frame for accomplishment.

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	During the theory classes the professor will present the foundation of the techniques presented on each chapter, some basic formal notation and concepts and will provide additional references for each of the methods. To present these contents the professor will use additional documentation (lecture slides) and audiovisual resources.
PRACTICAL WORK	For each of theory sessions there will be a complementary session putting into practice the methods presented on the previous session, as well as possible variants. These sessions are presented as assisted laboratory activities. The students will complement these assisted lab activities with some extra hours of practice with the techniques and their practical application.
INDIVIDUAL WORK	The theory classes will include some additional references to both theoretical and applied bibliography. The students must access to this bibliography to investigate with more detail on the presented concepts and techniques and to understand their characteristics. These references will be accessible in the web page of the course and will include technical reports and scientific papers.
PERSONAL TUTORING	All along the course, the student will have direct access to the professors teaching this course to solve ant theory or practical questions, according to the personal tutoring schedule presented by the department.

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	• **- Virtual Reality Technology (Second Edition)** Grigore C. Burdea, Philippe Coiffet Ed. Wiley-IEEE Press, 2003
	• - **3D Computer graphics (Third Edition)** A. Watt Addison Wesley, 2000
	• - **Designing the user interface.** B. Shneiderman, C. Plaisant. Addison Wesley. 2012
	• **- Data Mining: Practical Machine Learning Tools and Techniques** (Second Edition) Ian H. Witten, Eibe Frank, 2005. Morgan Kaufmann.
	• **- Data Mining: Concepts and Techniques**. Jiawei Han and Micheline Kamber. Morgan Kaufmann 2000
WEB RESOURCES	http://caci.cesvima.upm.es/web/caci/data-analysis-and-visualization
EQUIPMENT	Laboratory CESVIMA (UPM) and CAT (URJC)
	Resources: CAVE and haptic devices (CESVIMA and CAT), Magerit system (CESVIMA)
	Group work room

Chapter 9.- Subject schedule

Week	Classroom activities	Lab activities		Individual work	Assessment activities	Presentation
		Assisted	Unassisted			
1 (6h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	2h		
2 (7h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	3h		
3 (6h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	2h		
4 (7h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	3h	Preliminary report Practical work (2h)	
5 (6h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	2h		
6 (7h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	3h		
7 (6h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	2h		
8 (7h)	Chapter 1 (1h)	Chapter 1 (1h)	Chapter 1 (2h)	3h		
9 (6h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	2h		
10 (7h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	3h		
11 (6h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	2h		
12 (7h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	3h		
13 (6h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	2h	Intermediate report Practical work (2h)	
14 (7h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	3h		
15 (6h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	2h		
16 (7h)	Chapter 2 (1h)	Chapter 2 (1h)	Chapter 2 (2h)	3h		
17 (2h)					Final report Practical work (1h)	2h

Note: Student workload specified for each activity in hours

UNIVERSIDAD POLITÉCNICA DE MADRID
FACULTAD DE INFORMÁTICA
Campus de Montegancedo
Boadilla del Monte. 28660 Madrid

Discrete Algorithms

Learning Guide – Information for Students

1. Description

Grade	Master on Advanced Computing in Science and Engineering
Module	Advanced Techniques
Area	
Subject	Discrete Algorithms
Type	Compulsory
ECTS credits	4 ECTS
Responsible department	Departamento de Matemática Aplicada (DMA)
Major/Section/	

Academic year	2012/2013
Term	1st term / Q1
Language	English
Web site	http://caci.cesvima.upm.es/node/21

2. Faculty

NAME and SURNAME	OFFICE	email
Manuel Abellanas (Coord.)	1314	mabellanas@fi.upm.es
Antonio Giraldo	1302	agiraldo@fi.upm.es
Gregorio Hernández	1306	gregorio@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	• No requirement
Other required learning outcomes	• Computer programming • Mathematics & statistics

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
CE2	Ability to define and design new tools in advanced computing platforms	A
CE7	Ability to develop and adapt scientific models and algorithms based on techniques such as Montecarlo simulation, lineal algebra or adaptive mesh refinement	A
CE11	Ability to adapt modelling and simulation tools with multiscale and multiresolution approaches.	S
CE12	Acquisition of advanced scientific knowledge in the field of computer science, being able to generate new ideas on a selected research topic.	K
CE14	Ability to comprehensively read documentary sources and search for information to undertake any research whatsoever	A
CE15	Ability to read and understand, as well as catalog and scientifically rank, publications within their field of study/research	A

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Ability in design efficient discrete algorithms		A
LR2	Competence in analyze discrete problems		A
LR3	Advanced knowledge on Computational Geometry		K
LR4	General overview on Computational Topology and Graph drawing		C

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	**Indicator**	**Related to LR**
I1	Be able to analyze discrete algorithms	LR2
I2	Be able to analyze the complexity of a discrete problem	LR2
I3	Be able to design efficient discrete algorithms	LR1
I4	To know the fundamental geometric structures and algorithms	LR3
I5	To know the basics of Computational Topology and Graph drawing	LR4

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Workshop on basic problems	2^{nd} Week	Classroom	10%
Oral presentation of the planned project	4^{th} Week	Classroom	10%
Workshop on advanced problems	6^{th} Week	Classroom	20%
Oral presentation of theoretical and practical results	8^{th} Week	Classroom	30%
Final delivery of written work / software	8^{th} Week	Internet	30%
			Total: 100%

GRADING CRITERIA
All activities can be made in teams. The grade for the members of the same team in delivered tasks will be the same, but all members have to be able to make an oral presentation of the work. Oral presentations will have two grading components: one 50% common for all the members of the team and the other 50% different for each one. Workshops will consist on a 90 minutes session in which as much as possible problems of a list of problems have to be solved in teams. At the end a common written document has to be deliver.

6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
Chapter 1:	Geometric sorting and its applications	LR1, LR2
Chapter 2:	Convex hulls	LR1, LR2, LR3
Chapter 3:	Data structures and algorithms for space partitions	LR1, LR2, LR3
Chapter 4:	Proximity graphs and Voronoi diagrams	LR1, LR2, LR3
Chapter 5:	Introduction to Graph Drawing. Spanners and routing strategies in geometric networks	LR1, LR2, LR4
Chapter 6:	Fundamentals of topology. Computational topology algorithms. Digital topology algorithms for image processing	LR1, LR2, LR4

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
	Theory Classes	***Talk to students***
	Seminars/Workshops	***Construct knowledge through student interaction and activity***
	Practical Classes	***Show students what to do***
	Placements	***Round out student training in a professional setting***
	Personal Tutoring	***Give students personalized attention***
	Group Work	***Get students to learn from each other***
	Independent Work	***Develop self-learning ability***

TEACHING METHODS			
	Method	**Purpose**	
	Explanation/Lecture	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves the "*presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose".* This methodology, also known as *lecture*, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term *master class* is often used to refer to a special type of lecture taught by a professor on special occasions
	Case Studies	***Learning by analyzing real or simulated case studies***	Intensive and exhaustive analysis of a real fact, problem or event for the purpose of understanding, interpreting or solving the problem, generating hypotheses, comparing data, thinking, learning or diagnosis and, sometimes, training in possible alternative problem-solving procedures.
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the suitable or correct solutions by exercising routines, applying formulae or running algorithms, applying information processing procedures and interpreting the results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is a problem, designed by the teacher, that the student has to solve to develop a number of previously defined competences.
	Project-Oriented Learning (POL)	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.
	Cooperative Learning	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom work where students are responsible for their own and their peers' learning as part of a co-responsibility strategy for achieving group goals and incentives. This is both one of a number of methods for use and an overall teaching approach, or philosophy.
	Learning Contract	***Develop independent learning***	An agreement between the teacher and student on the achievement of learning outcomes through an independent work proposal, supervised by the teacher, and to be accomplished within a set period. The essential points of a learning contract are that it is a written agreement, stating required work and reward, requiring personal involvement and having a time frame for accomplishment.

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	…
PROBLEM-SOLVING CLASSES	…
PRACTICAL WORK	…
INDIVIDUAL WORK	…
GROUP WORK	…
PERSONAL TUTORING	…

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars: **Computational Geometry: Algorithms and *Applications*** (3rd edition). Springer-Verlag, Heidelberg, 2008.
	G. Narasimhan, M. Smid: **Geometric Spanner Networks**, Cambridge Univ. Press, 2007.
	G. di Battista, P. Eades, R. Tamassia, I. Tollis: **Graph Drawing: Algorithms for the Visualization of Graphs**, Prentice Hall, 1999.
	H. Edelsbrunner, J. Harer: **Computational Topology: An Introduction**, American Mathematical Society, 2010
WEB RESOURCES	Subject web site (http://caci.cesvima.upm.es/node/21)
	Subject Moodle site (http://)
EQUIPMENT	Laboratory
	Room XXXX
	Group work room

9. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
Week 1,2,3 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours/week) Reading, learning, writing, developping software	(2 hours) Team work		Collective tutorial sessions (16 hours)
Week 4 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software		(2 hours) Workshop on basic problems	
Week 5,6,7 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software	(2 hours) Team work		
Week 8 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software		(2 hours) Oral presentation of the planned project. Debate.	
Week 9,10,11 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software	(2 hours) Team work		
Week 12 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software		(2 hours) Workshop on advanced problems	
Week 13,14,15 (6,75 hours)	Presentation of concepts and algorithms (2 hours)		(1,75 hours) Reading, learning, writing, developping software	(2,75 hours) Team work		
Week 16 (6,75 hours)	Oral presentation of results and debates (4 hours)		(1,75 hours) Reading, learning, writing, developping software			

Note: Student workload specified for each activity in hours

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Hardware/Software for High Performance Computing

Learning Guide – Information for Students

1. Description

Degree	University Master "Advanced Computing for Sciences and Engineering"
Module	Advanced Techniques
Area	
Subject	Hardware/Software for High Performance Computing
Type	Compulsory
ECTS credits	4 ECTS
Responsible department	Departamento de Arquitectura y Tecnología de Sistemas Informáticos (DATSI)
Major/Section/	

Academic year	2012/2013
Term	1st term
Language	English
Web site	http://caci.cesvima.upm.es

2. Faculty

NAME and SURNAME	OFFICE	email
Antonio GARCÍA DOPICO (Coord.)	6603	dopico@fi.upm.es
Jose M PEÑA	4201	jmpena@fi.upm.es
Vicente MARTIN	5209	vicente@fi.upm.es
Maria S. PÉREZ HERNÁNDEZ	7380	mperez@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	•
Other required learning outcomes	• Basic programming skills

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
CE1	Capacity to use consistently all the computational resources	A
CE2	Ability to define and design new tools in advanced computing platforms	A
CE4	Definition and design of new tools to be used in advanced platform of computing	S
CE5	Capacity to use hybrid programming method and to implement source code in new architectures	A
CE12	Acquisition of advanced scientific knowledge in the field of computer science, being able to generate new ideas on a selected research topic.	S
CE14	Ability to comprehensively read documentary sources and search for information to undertake any research whatsoever	A
CE15	Ability to read and understand, as well as catalog and scientifically rank, publications within their field of study/research	S

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Students identify and use the different techniques of parallelization	CE1, CE2, CE4, CE5	S
LR2	Students uses efficiently the computational resources	CE1,CE4, CE15	S
LR3	Students understand different types of parallelization scenarios, being able to identify the most suitable parallelization approach for a given case.	CE1, CE2, CE4, CE5	S
LR4	The students are able to interpret and evaluate the quality of the results of the parallelization process	CE1,CE4, CE15	S
LR5	Students become able to apply parallelization techniques to a given real-world problem description.	CE1, CE4, CE5	S

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	Indicator	Related to LR
I1	To design and implement a parallel solution to a scenario equivalent to a real-world problem.	LR1, LR2, LR3, LR5
I2	To use of a high-performance computing facility to execute large-scale applications.	LR1, LR3, LR5
I3	To report the quality of the parallel solutions.	LR4, LR5

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Objective test	Week 8		30%
Practical appointment: Final report	Week 16		40%
Objective test	Week 17		30%
			Total: 100%

GRADING CRITERIA
The grading system will be based on two different objective tests and a practical appointment. The first test will focus on hardware for high performance and the second test will focus on software for high performance. The practical appointment will reproduce a real-world situation, with an application that need to be parallelized. There will be a final report to present the main results that each student get with this practical work. The final report will include an exhaustive evaluation of the applied techniques, the design decisions that have been taken and an evaluation of the results

6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
Chapter 1: Introduction	1.1 Why parallelization is needed	I1, I2, I3
Chapter 2: Software	2.1 Parallel programming with OpenMP	I1, I2, I3
	2.2 Parallel programming with MPI	
	2.3 Parallel programming with HPC	
	2.4 Debugging and profiling	
Chapter 3: Hardware	3.1 Differences between the current environments for high performance	I1, I2, I3
	3.2 Shared memory and multicore: Cache coherence and synchronization	
	3.3 Cluster Computing and high performance networks	
	3.4 Graphics processing units	
Chapter 4: Input/Output	4.1 MPI I/O	I1, I2, I3
	4.2 Parallel file systems	
Chapter 5: Cluster administration	5.1 Single system image	I1, I2, I3
	5.2 Process management	
Chapter 6: Other models	6.1 Grid computing	I1, I2, I3
	6.2 Cloud computing	

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
x	Theory Classes	*Talk to students*
	Seminars/Workshops	*Construct knowledge through student interaction and activity*
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	Placements	*Round out student training in a professional setting*
X	Personal Tutoring	*Give students personalized attention*
X	Group Work	*Get students to learn from each other*
x	Independent Work	*Develop self-learning ability*

TEACHING METHODS			
	Method	**Purpose**	
X	**Explanation/Lecture**	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves the "presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose". This methodology, also known as lecture, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term master class is often used to refer to a special type of lecture taught by a professor on special occasions
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X	**Project-Oriented Learning (POL)**	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.
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BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	During the theory classes the professor will present the foundation of the techniques presented on each chapter, some basic formal notation and concepts and will provide additional references for each of the methods. To present these contents the professor will use additional documentation (lecture slides) and audiovisual resources.
PROBLEM-SOLVING CLASSES	During the problem solving classes the professor will hand out some small problems and will help the students to solve them. These problems will focus on the concepts that would be explained in the theory classes
PRACTICAL WORK	For each of theory sessions there will be a complementary session putting into practice the methods presented on the previous session, as well as possible variants. These sessions are presented as assisted laboratory activities. The students will complement these assisted lab activities with some extra hours of practice with the techniques and their practical application.
INDIVIDUAL WORK	The theory classes will include some additional references to both theoretical and applied bibliography. The students must access to these bibliography to investigate with more detail on the presented concepts and techniques and to understand their characteristics. These references will be accessible in the web page of the course and will include technical reports and scientific papers.
GROUP WORK	The practical appointments will be assigned to two-student groups that will apply the knowledge presented in both theory and practical sessions to solve the problems proposed by the appointment. This group work includes also additional effort to prepare the preliminary and final reports, which are a result of the work performed by each group.
PERSONAL TUTORING	All along the course, the student will have direct access to the professors teaching this course to solve ant theory or practical questions, according to the personal tutoring schedule presented by the department.

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	• **Parallel Computer Architectures: a Hardware/Software Approach.** D.E. Culler, J.P. Singh, with A. Gupta. Ed Morgan Kaufmann. 1999. • **High Performance Cluster Computing**. R. Buyya. Ed. Prentice Hall. 1999 • **Cluster Computing White Paper**. M. Baker, et al. 2001. • **Using MPI, Portable Parallel Programming with the Message Passing Interface**. W. Gropp, E. Lusk, A. Skjellum. Ed. MIT Press. 1999 • **Message Passing Interface Forum** http://www.mpi-forum.org/ • **The High Performance Fortran Handbook. Scientific and Engineering Computation Series** C.H. Koelbel et al. The MIT Press, 1994. • **UPC: Distributed Shared Memory Programming**. T. El-Ghazawi et al. Wiley Series on Parallel and Distributed Computing, Wiley Interscience. 2005 • **Berkeley Unified Parallel C (UPC) Project**. http://upc.lbl.gov • **Parallel Programming in OpenMP**. R. Chandra et al. Ed. Morgan Kaufmann, 2001. • **The OpenMP API specification for parallel programming** http://openmp.org/ • **Overview of the MPI-IO Parallel I/O Interface**. P. Corbett et al. Proceedings of the Third Workshop on I/O in Parallel and Distributed Systems, IPPS '95, Santa Barbara, CA. April 1995. • **Improved Parallel I/O via a Two-phase Run-time Access Strategy.** J. M. del Rosario et al. ACM Computer Architecture News. Volume 21(5), pages 31-38. December 1993. • *ROMIO: A High-Performance, Portable MPI-IO Implementation* http://www.mcs.anl.gov/research/projects/romio/ • **The Anatomy of the Grid: Enabling Scalable Virtual Organizations**. I. Foster, C. Kesselman, S. Tuecke, International J. Supercomputer Applications, 15(3), 2001. • **The Physiology of the Grid: An Open Grid Services Architecture for Distributed Systems Integration. I. Foster**, C. Kesselman, J. Nick, S. Tuecke, Open Grid Service Infrastructure WG, Global Grid Forum, June 22, 2002 • **Cloud Computing and Grid Computing 360-Degree Compared.** I. Foster, Y. Zhao, I. Raicu, S. Lu, Grid Computing Environments Workshop, 2008. GCE '08 , vol., no., pp.1-10, 12-16 Nov. 2008 • **A history of cloud computing**. A. Mohamed, March 2009
WEB RESOURCES	http://caci.cesvima.upm.es/web/caci/hardware/software-for-high-performance-computing
EQUIPMENT	Laboratory
	Room XXXX
	Group work room

9. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
W 1: 2.5h	Chapter 1 (1h)		1.5 h			
W 2: 6.5h	Chapter 2 (3h)	1h	2.5 h			
W 3: 6.5h	Chapter 2 (2h)		2h	2.5h		
W 4: 6.5h		2h	2h	2.5h		
W 5: 6.5h	Chapter 2 (2h)		2h	2.5h		
W 6: 6.5h		2h	2h	2.5h		
W 7: 6.5h	Chapter 2 (2h)		2h	2.5h		
W 8: 6.5h	Chapter 2 (1h)	1h	2h	1.5h	1h	
W 9: 6.5h	Chapter 3 (2h)		2h	2.5h		
W 10: 6.5h	Chapter 3 (2h)	1h	2h	1.5h		
W 11: 6.5h	Chapter 3 (2h)		2h	2.5h		
W 12: 6.5h	Chapter 3 (2h)		2h	2.5h		
W 13: 6.5h	Chapter 4 (2h)		2h	2.5h		
W 14: 6.5h	Chapter 4 (2h)		2h	2.5h		
W 15: 6 5h	Chapter 5 (2h)		2h	2.5h		

W16: 6.5h	Chapter 5 (2h)		1h	2.5h	1h	
W 17: 8 h	Chapter 6 (4h)		3h		1h	

Note: Student workload specified for each activity in hours

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Scientific and Technical English
Oral Communication Techniques

Learning Guide – Information for Students

1. Description

Degree	University Master "Advanced Computing for Sciences and Engineering"
Module	Transversal
Area	
Subject	Scientific and Technical English: Oral Communication Techniques
Type	Compulsory
ECTS credits	3 ECTS
Responsible department	Departamento de Lingüística Aplicada a la Ciencia y la Tecnología (DLACT)
Major/Section/	

Academic year	2012/2013
Term	2nd term / Q2
Language	English
Web site	http://caci.cesvima.upm.es

2. Faculty

NAME and SURNAME	OFFICE	email
Marinela Garcia (Coord.)	5213	marinela.garcia@ upm.es
Guadalupe Aguado de Cea	5217	lupe@fi.upm.es

3. Prior knowledge required to take the subject

Passed subjects	• B2.2 Level in Oral Communication Skills (Common European Framework of Reference for Languages)
Other required learning outcomes	•

4. Learning goals

SUBJECT-RELATED COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
CE3	Ability to participate in an active user community that can disseminate information regarding new developments and advanced computing techniques	A
CE14	Ability to comprehensively read documentary sources and search for information to undertake any research whatsoever	K
CE15	Ability to read and understand, as well as catalog and scientifically rank, publications within their field of study/research	A

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	To understand and analyse oral technical presentations	CE14, CE15	C
LR2	To organize scientific and technical information, identifying the main and secondary ideas.	CE14, CE15	C
LR3	To express orally personal and professional opinions	CE3	A
LR4	To summarize orally written and oral texts	CE3, CE14, CE15	C
LR5	To give organized, clear presentations of scientific and technical contents in English	CE3	A

5 Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	**Indicator**	**Related to LR**
I1	Students can understand oral speech at a normal speed (Oral Comprehension)	LR1
I2	Students can produce connected speech fluently (Fluency)	LR2
I3	Students can use specific terminology with precision as well as some appropriate idiomatic expressions largely used in scientific and professional environments (Vocabulary)	LR2, LR3, LR4
14	Students can coherently present a specialized domain topic in public (Presentation)	LR1, LR2, LR3, LR4, LR5

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Web search of real topic-related events (Keywords)	3rd week	Individual task Email/Moodle	5%
Guided Presentation of a chosen Academic Institution	4th, 5th week	Face to face lesson. Language Lab.	10%
Draft description of the chosen final presentation: Title, keywords, audience, primary, secondary ideas	6th week	Individual task Email/Moodle	10%
Informal talks in professional environments (Role play)	7th week	Team group activity Meeting Room	5%
Academic/professional talks attendance, summary of contents.	To be confirmed	Conference Rooms	10%
Academic/professional formal talk. Individual final activity	9th week	Conference Room	60%
			Total: 100%

GRADING CRITERIA

The grading system will be based on the continuous evaluation along the programme with the achievement of the different assignments included:

- "Introducing yourself"
- "Introducing your institution"
- "Talking informal to learn formal"
- "Professional chats"
- Taking a position

All these assignments have a gradual difficulty and they will guide students to prepare the formal technical talk to be individually presented at the end of the term, as the final evaluation.

The different assignments along the term will represent 40% of the total grade. The final 60% of the grading will be obtained with the presentation of the technical talk in front of the audience.

The acquisition of the oral communicative competencies being taught in the theory lessons, together with the language proficiency, both proven in the student participation in the classes as well as in the technical presentation and the consequent discussion will be the key factors for the final graded ranking.

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
UNIT 1: How to give a talk?:	1.1 Introducing the topic and the speaker	LR1, LR2, LR3, LR4, LR5
	1.2 Formal presentation key words	LR1, LR2, LR3, LR4, LR5
	1.3 Improvement of English-language pronunciation and fluency through active participation in English-language lectures, seminars and tutorials (real or simulated)	LR1, LR2, LR3, LR4, LR5
	1.4 1st Assignment: Me and my Institution	LR1, LR2, LR3, LR4, LR5
	1.5 Improving technical vocabulary use in formal registers	LR1, LR2, LR3, LR4, LR5
	1.6 Revision of specific grammar structures for the formal oral discourse	LR1, LR2, LR3, LR4, LR5
Unit 2: Pre-requisites of Formal Presentations	2.1 Identifying the topic, the goal and the audience	LR1, LR2, LR3, LR4, LR5
	2.2 Explaining an experiment : process vs. product	LR1, LR2, LR3, LR4, LR5
	2.3 Organizing the process: linking words	LR1, LR2, LR3, LR4, LR5
	2.4 Verbal and non-verbal indicators: pronunciation, stress, …	LR1, LR2, LR3, LR4, LR5
	2.5 Improving English-language	LR1, LR2, LR3, LR4,

	2.5 Improving English-language pronunciation and fluency	LR1, LR2, LR3, LR4, LR5
Unit 3: Pre-requisites of Formal Presentations	2.1 Identifying the topic: Types of subjects: specialized vs colloquial topics:	LR1, LR2, LR3, LR4, LR5
	2.2 Identifying the audience: Types of audiences	LR1, LR2, LR3, LR4, LR5
	2.3 Identifying the objective: Personal, institutional	LR1, LR2, LR3, LR4, LR5
	2.5 Providing coherence and cohesion.	LR1, LR2, LR3, LR4, LR5
Unit 4: Writing to talk	4.1 Beginning your speech: verbal and non-verbal resources. Clarifying your purpose	LR1, LR2, LR3, LR4, LR5
	4.2 Extracting and Presenting the topic: terminology, grammatical aspects and visual indicators	LR1, LR2, LR3, LR4, LR5
	4.3 Concluding your speech. Summarizing and concluding.	LR1, LR2, LR3, LR4, LR5
	4.4 2nd Assignment: Preparing the Draft document	LR1, LR2, LR3, LR4, LR5
Unit 5: Communication constraints	5.1 The art of listening	LR1, LR2, LR3, LR4, LR5
	5.2 The audience's constraints	LR1, LR2, LR3, LR4, LR5
	5.3 The speaker's constraints	LR1, LR2, LR3, LR4, LR5
	5.4 Using modals and time connectors in	LR1, LR2,

Unit 6: Communication key factors	6.1 The topic: advantages and disadvantages	LR1, LR2, LR3, LR4, LR5
	6.2 The audience: speaking to persuade	LR1, LR2, LR3, LR4, LR5
	6.3 The speaker: Attitude and aptitudes	LR1, LR2, LR3, LR4, LR5
	6.4 The audio visuals: Characteristics	LR1, LR2, LR3, LR4, LR5
Unit 7: Preparing your talk	7.1 Getting your talk ready	LR1, LR2, LR3, LR4, LR5
	7.2 Handling the audio visuals	LR1, LR2, LR3, LR4, LR5
	7.3 Getting to know the scenario	LR1, LR2, LR3, LR4, LR5
	7.4 Do's and don'ts of formal presentations	LR1, LR2, LR3, LR4, LR5
Unit 8: Final Evaluation: Experts Conference	8.1 Giving your talk: strategies to signal the solution	LR1, LR2, LR3, LR4, LR5
	8.2 Listening to the speakers: accepting and rejecting speakers' opinions	LR1, LR2, LR3, LR4, LR5
	8.3 Questions and answers	LR1, LR2, LR3, LR4, LR5
Unit 9: Conclusions	9.1 Evaluating the presentations	LR1, LR2, LR3, LR4, LR5

	9.2 Final Questionnaires	LR1, LR2, LR3, LR4, LR5
	9.3 Programme Conclusion	LR1, LR2, LR3, LR4, LR5

5. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
Language Laboratory	**Theory Classes**	***Talk to students***
FI Conference Rooms	**Seminars/Workshops**	***Construct knowledge through student interaction and activity***
Language Laboratory	**Practical Classes**	***Show students what to do***
x	**Personal Tutoring**	***Give students personalized attention***
x	**Group Work**	***Get students to learn from each other***
x	**Independent Work**	***Develop self-learning ability***

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TEACHING METHODS			
	Method	**Purpose**	
+	**Explanation/Lecture**	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves the "*presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose"*. This methodology, also known as *lecture*, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term *master class* is often used to refer to a special type of lecture taught by a professor on special occasions
+	**Case Studies**	***Learning by analyzing real or simulated case studies***	Intensive and exhaustive analysis of a real fact, problem or event for the purpose of understanding, interpreting or solving the problem, generating hypotheses, comparing data, thinking, learning or diagnosis and, sometimes, training in possible alternative problem-solving procedures.
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the suitable or correct solutions by exercising routines, applying formulae or running algorithms, applying information processing procedures and interpreting the results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is a problem, designed by the teacher, that the student has to solve to develop a number of previously defined competences.
+	**Project-Oriented Learning (POL)**	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.
+	**Cooperative Learning**	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom work where students are responsible for their own and their peers' learning as part of a co-responsibility strategy for achieving group goals and incentives. This is both one of a number of methods for use and an overall teaching approach, or philosophy.
+	**Learning Contract**	***Develop independent learning***	An agreement between the teacher and student on the achievement of learning outcomes through an independent work proposal, supervised by the teacher, and to be accomplished within a set period. The essential points of a learning contract are that it is a written agreement, stating required work and reward, requiring personal involvement and having a time frame for accomplishment.

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
Theory Classes	Theory classes will be focused on presenting the foundations of the theory techniques included in each chapter, some basic concepts providing additional references for each of the methods. These contents will be presented with the use of additional documentation (photocopies, real documents, etc.) and audiovisual resources.
Seminars/Workshops	Students will be asked to enrol in seminars related to the subject topic: i.e. Writing techniques as well as attending talks (programmed as additional tasks) related to the technical subject of their Master's programme.
Practical Classes	The theory sessions will include different assignments to put into practice the methods presented on the previous session, as well as possible variants. Giving short presentations, either individually or in groups, will be the best way to implement the theory and get some training on lecturing
Placements	
Personal Tutoring	The professor will be in charge of supervising the preparation and implementation of the practical sessions both when students will be working individually or in groups. All along the course, the student will have direct access to the professors to solve theory or practical questions, according to the personal tutoring schedule presented by the department.
Group Work	Some of the assignments will be done in groups where students can apply and discuss the theoretical knowledge presented in the theory sessions
Independent Work	Students will be asked to dedicate special effort to prepare the preliminary and final presentations, which are a result of the work performed along the programme.
Individual or group practical assignments	Assignments can be prepared either individually or in groups, depending on the purpose and scope

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POLITÉCNICA

6. Teaching resources

<table>
<tr><th colspan="2">TEACHING RESOURCES</th></tr>
<tr><td>RECOMMENDED READING</td><td>

Brown, K. and S. Hood 2002. Academic Encounters Series. Life in Society. Cambridge University Press.
Mlynarczyk, R. and S. B. Haber. 2005. In Our Own Words. Cambridge University Press.
Moore, J. 2005. Common Mistakes at Advanced Level…and how to avoid them. Cambridge University Press.
Powerll, M. 2002. Presenting in English. How to give successful presentations. Thomson.
Zwier, L.J. 2005. Building Academic Vocabulary. The University of Michigan Series.

1. <u>WEBSITES & MULTIMEDIA</u>

http//moodle.upm.es/titulaciones oficiales
http/upm.es/archivo
http://www.wordreference.com/ (dictionary)
http://www.answers.com (dictionary)
http://iate.europa.eu/iatediff/SearchByQuery.do (dictionary)
http://www.english-at-home.com/real-life-english/ (grammar & vocabulary)
http://www.nonstopenglish.com/Default-001.asp (grammar & vocabulary)
http://www.esl-lab.com/ (with listening)
http://www.breakingnewsenglish.com/ (+ listening)
http://www.bbc.co.uk/
British Council - Teaching Updates
</td></tr>
<tr><td>WEB RESOURCES</td><td>http://caci.cesvima.upm.es/web/caci/techniques-for-oral-communication-in-english-in-scientific/technical-domains</td></tr>
<tr><td rowspan="4">EQUIPMENT</td><td>Language Laboratory</td></tr>
<tr><td>Computer Labs</td></tr>
<tr><td>Conference Rooms</td></tr>
<tr><td>Group work room</td></tr>
</table>

7. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
Week 1 (hours)	• (hours)	• (hours)	• (hours)	• (hours)	• (hours)	•
Week 2 (hours)	• (hours)	• (hours)	• (hours)	• (hours)	• (hours)	•
Week 3 (hours)	• (hours)	• (hours)	• (hours)	• (hours)	• (hours)	•
…	• (hours)	• (hours)	• (hours)	• (hours)	• (hours)	•

Note: Student workload specified for each activity in hours

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Funding Opportunities, Proposals Preparation, and Results Dissemination and Exploitation

Learning Guide – Information for Students

1. Description

Degree	University Master "Advanced Computing for Sciences and Engineering"
Module	Transversal
Area	
Subject	RTD Technical Management
Type	Compulsory
ECTS credits	3 ECTS
Responsible department	Departamento de Arquitectura y Tecnología de Sistemas Informáticos (DATSI)
Major/Section/	CeSViMa

Academic year	2012/2013
Term	2nd term / Q2
Language	English
Web site	www.caci.cesvima.upm.es

2. Faculty

NAME and SURNAME	OFFICE	email
Pilar Flores Romero (Coord.)		pilarfr@cesvima.upm.es

3. Prior knowledge required to take the subject

Passed subjects	• Not applicable
Other required learning outcomes	• Slight knowledge in RTD Management

4. Learning goals

SUBJECT-SPECIFIC COMPETENCES AND PROFICIENCY LEVEL		
Code	**Competence**	**Level**
CE3	Ability to participate in an active user community that can disseminate information regarding new developments and advanced computing techniques	A
CE16	Students can acquire the necessary knowledge about the mechanisms of funding research and technology transfer, as well as knowledge about the legislation on protection of results.	S

Proficiency level: knowledge (K), comprehension (C), application (A), and analysis and synthesis (S)

SUBJECT LEARNING OUTCOMES			
Code	**Learning outcome**	**Related competences**	**Profi-ciency level**
LR1	Students learn about the identification of funding opportunities to develop a RTD project.	CE16	S
LR2	Students learn how to apply to different project proposals and related coordination actions.	CE16	S
LR3	Students learn about the main phases, internal structure and running of RTD projects.	CE16	S
LR4	Students become capable of planning a strategic dissemination plan of project results in order to become visible when they are achieved.	CE3, CE16	S
LR5	Students become capable of designing strategic and exploitation plans of results for technology transfer.	CE3, CE16	S

5. Subject assessment system

ACHIEVEMENT INDICATORS		
Ref	**Indicator**	**Related to LR**
I1	Student's participation: contribution and involvement in the study cases during the classes.	LR1
I2	Correct Identification of opportunities depending on needs applying acquired skills and knowledge: exercises and problems solving.	LR1
I3	Application to research calls: exercises and problems solving during the student's individual and group work.	LR2
I4	Establishing of complete project structure and redaction of contents: exercises and problems solving during the student's individual and group work.	LR3
I5	Designing dissemination plans: exercises and problems solving during the student's individual and group work.	LR4
I6	Designing exploitation plans: exercises and problems solving during the student's individual and group work.	LR5

CONTINUOUS ASSESSMENT			
Brief description of assessable activities	**Time**	**Place**	**Weight in grade**
Student's participation in classes: understanding of knowledge, student's contribution, identification of important topics, etc.	Every session	Classroom	30%
Student's Group Work	Week 3	Classroom	30%
Student's Individual Work	Week 8	Classroom	40%
			Total: 100%

GRADING CRITERIA

Grading criteria of assessment in the present subject shall be composed of the following tasks with theirs corresponding weights:

- Task 1: Student's participation in classes: understanding of knowledge, student's contribution, identification of important topics, etc. (Weight: 30%)
- Task 2: Student's Group Work (Weight: 30%)
- Task 3: Student's Individual Work (Weight: 40%)

Grading criteria of assessment Task1: Student's participation in classes (30%)

Weak (Marks: 1-3)	**Adequate (Marks: 4- 6)**	**Good (Marks: 6,5-7,5)**	**Excellent (Marks: 8-10)**
Unable to distinguish opportunities based on needs. Reduced contribution during the classes. Poor participation.	Able to distinguish opportunities based on needs with help. Slight contribution during the classes. Sufficient participation.	Able to distinguish opportunities based on needs with a bit of help. Higher contribution than C during the classes. Higher participation than C.	Able to distinguish opportunities based on needs independently. Major contribution during the classes. Very high participation.

In task 1, assessment criteria will be applied once throughout the running of the subject.

Grading criteria of assessment Task 2: Student's Group Work (30%)

Weak (Marks: 1-3)	**Adequate (Marks: 4- 6)**	**Good (Marks: 6,5-7,5)**	**Excellent (Marks: 8-10)**
Unable to identify correct funding opportunities. Unable to apply to any type of taught topic. Reduced succeed in	Able to identify correct funding opportunities with help. Able to apply to any type of action with help. Slight succeed in	Able to identify correct funding opportunities with help. Able to apply to any type of action with help. Higher succeed in exercises	Able to identify correct funding opportunities. Able to apply to any type of action. Very high succeed in exercises and

exercises and problem solving in cooperation. Poor developed learning trough cooperation.	exercises and problem solving in cooperation. Enough developed learning trough cooperation.	and problem solving in cooperation than C. Higher learning developed trough cooperation than C.	problem solving in cooperation. Very high learning developed trough cooperation.

In task 2, assessment criteria will be applied as often as group activities are conducted. Final mark shall be the average of those obtained in the different activities.

Grading criteria of assessment Task 3: Student's Individual Work (40%)

Weak (Marks: 1-3)	**Adequate (Marks: 4- 6)**	**Good (Marks: 6,5-7,5)**	**Excellent (Marks: 8-10)**
Unable to identify correct funding opportunities independently. Unable to apply to any type of taught topic without help. Reduced succeed in exercises and problem solving separately. Poor active learning applying acquired skills trough practices autonomously.	Able to identify correct funding opportunities with any help. Able to apply to any type of taught topic with help. Slight succeed in exercises and problem solving separately. Enough active learning applying acquired skills trough practices autonomously.	Able to identify correct funding opportunities with any help. Able to apply to any type of taught topic without help. Higher succeed than C in exercises and problem solving independently. Higher active learning than C applying acquired skills trough practices autonomously.	Able to identify correct funding opportunities independently. Able to apply to any type of taught topic independently. Very high succeed in exercises and problem solving independently. Very high active learning applying acquired skills trough practices autonomously.

In task 3, assessment criteria will be applied as often as individual activities are conducted. Final mark shall be the average of those obtained in the different activities.

6. Contents and learning activities

SPECIFIC CONTENTS		
Unit / Topic / Chapter	**Section**	**Related indicators**
Chapter 1: General information: where can I find the information and advisory for my idea?	1.1: Recovering Information	I1
Chapter 2: National RTD Projects and Related Actions.	2.1: National Map of RTD Actions	I1, I2, I3
	2.2: RTD Projects	
	2.3: Human Resources Programmes	
	2.4: Infrastructures Programmes	
	2.5: Other: Coordination Actions	
Chapter 3: EU Programmes and Related Actions	3.1: 7^{th} Framework Programme (7FP): General Overview	I1, I2, I3
	3.2: 7FP Subprogrammes: Cooperation, Ideas, People, and Capacities.	
	3.3: Successful proposals (examples)	
	3.4: Other European Programmes	
Chapter 4: International Programs	4.1: Human Frontier Science Program (HFSP)	I1, I2
	4.2: Other Actions	
Chapter 5: Project Phases	5.1: Definition and planning phase	I1, I4
	5.2: Monitoring and control phase	
	5.3: Communication phase	
	5.4: Closure Phase	
Chapter 6: Strategic Dissemination Plan	6.1: Stages: defining message; targeting audience; selecting tools; planning the activities.	I1, I5
	6.2: Internal and external communication plans	

Chapter 6: Strategic Dissemination Plan	6.1: Stages: defining message; targeting audience; selecting tools; planning the activities.	I1, I5
	6.2: Internal and external communication plans	
	6.3: Designing targeted plans	
	6.4: Designing open plans	
	6.5: Promoting activities	
	7.1: Identification of the exploitable scientific-technical knowledge	
	7.2: Participant interests	

7. Brief description of organizational modalities and teaching methods

TEACHING ORGANIZATION		
Scenario	**Organizational Modality**	**Purpose**
	Theory Classes	***Talk to students***
	Seminars/Workshops	***Construct knowledge through student interaction and activity***
	Practical Classes	***Show students what to do***
	Placements	***Round out student training in a professional setting***
	Personal Tutoring	***Give students personalized attention***
	Group Work	***Get students to learn from each other***
	Independent Work	***Develop self-learning ability***

TEACHING METHODS			
	Method	**Purpose**	
	Explanation/Lecture	***Transfer information and activate student cognitive processes***	Known as explanation, this teaching method involves the "*presentation of a logically structured topic with the aim of providing information organized according to criteria suited for the purpose".* This methodology, also known as *lecture*, mainly focuses on the verbal exposition by the teacher of contents on the subject under study. The term *master class* is often used to refer to a special type of lecture taught by a professor on special occasions
	Case Studies	***Learning by analyzing real or simulated case studies***	Intensive and exhaustive analysis of a real fact, problem or event for the purpose of understanding, interpreting or solving the problem, generating hypotheses, comparing data, thinking, learning or diagnosis and, sometimes, training in possible alternative problem-solving procedures.
	Exercises and Problem Solving	***Exercise, test and practice prior knowledge***	Situations where students are asked to develop the suitable or correct solutions by exercising routines, applying formulae or running algorithms, applying information processing procedures and interpreting the results. It is often used to supplement lectures.
	Problem-Based Learning (PBL)	***Develop active learning through problem solving***	Teaching and learning method whose starting point is a problem, designed by the teacher, that the student has to solve to develop a number of previously defined competences.
	Project-Oriented Learning (POL)	***Complete a problem-solving project applying acquired skills and knowledge***	Teaching and learning method where have a set time to develop a project to solve a problem or perform a task by planning, designing and completing a series of activities. The whole thing is based on developing and applying what they have learned and making effective use of resources.
	Cooperative Learning	***Develop active and meaningful learning through cooperation***	Interactive approach to the organization of classroom work where students are responsible for their own and their peers' learning as part of a co-responsibility strategy for achieving group goals and incentives. This is both one of a number of methods for use and an overall teaching approach, or philosophy.
	Learning Contract	***Develop independent learning***	An agreement between the teacher and student on the achievement of learning outcomes through an independent work proposal, supervised by the teacher, and to be accomplished within a set period. The essential points of a learning contract are that it is a written agreement, stating required work and reward, requiring personal involvement and having a time frame for accomplishment.

BRIEF DESCRIPTION OF THE ORGANIZATIONAL MODALITIES AND TEACHING METHODS	
THEORY CLASSES	Explanation/Lectures for all the topics covered.
PROBLEM-SOLVING CLASSES	Problem-solving exercises are foreseen for all the classes
PRACTICAL WORK	Case studies, exercises, problem-solving
INDIVIDUAL WORK	Case studies, exercises, project-oriented learning
GROUP WORK	Case studies, exercises, cooperative learning
PERSONAL TUTORING	Personalized attention will be given depending on needs of the students weekly.

8. Teaching resources

TEACHING RESOURCES	
RECOMMENDED READING	RTD Project Map: Ministerio de Ciencia e Innovación(MICINN, www.micinn.es)
	Agencia Española de Cooperación Internacional para el Desarrollo AECID, www.aecid.es)
	Centro para el Desarrollo Tecnológico Industrial (CDTI, www.cdti.es)
	CORDIS (European Commission, http://cordis.europa.eu/home_es.html)
	7^{th} Framework Programme: http://cordis.europa.eu/fp7/home_en.html
	Human Frontier Science Program (HFSP, www.hfsp.org)
	European Science Foundation (ESF, www.esf.org)
WEB RESOURCES	http://caci.cesvima.upm.es/web/caci/funding-opportunities-proposals-preparaton-and-results-dissemination-and-exploitation
EQUIPMENT	Laboratory : Not applicable
	Room: to be confirmed
	Group work room: see ‘room’ item

9. Subject schedule

Week	Classroom activities	Lab activities	Individual work	Group work	Assessment activities	Others
Week 1 (9 hours)	• Theory classes (2 hours)	• Practical work (1 hour)	• Practical work (3 hours)	• Practical work (3 hours)	• ---	•
Week 2 (9 hours)	• Theory classes and practical cases* (3 hours)	• ---	• Practical work (4 hours)	• Practical work (2 hours)	• ---	•
Week 3 (9 hours)	• ---	• Practical work (1 hour)	• Practical work (4 hours)	• Practical work (2 hours)	• 2 hours: Practical cases presentations (I)	•
Week 4 (9 hours)	• Theory classes and practical cases* (3 hours)	• ---	• Practical work (2 hour)	• Practical work (4 hours)	• 0 hours	•
Week 5 (9 hours)	• Theory classes and practical cases* (1 hour)	• Practical work (1 hour)	• Practical work (2 hour)	• Practical work (4 hour)	• 1 hour: crossed evaluation	•
Week 6 (9 hours)	• Theory classes and practical cases* (3 hours)	• ---	• Practical work (3 hours)	• Practical work (3 hours)	• ---	•
Week 7 (9 hours)	• Theory classes and practical cases* (3 hours)	• ---	• Practical work (3 hours)	• Practical work (3 hours)	• ---	•
Week 8 (9 hours)	• ---	• Practical work (1,5 hours)	• Practical work (3 hours)	• Practical work (3 hours)	• 1,5 hours: Practical cases presentations (II)	•

Week 9 (9 hours)	• ---	• ---	• Practical work (3 hours)	• Practical work (3 hours)	• 3 hours: Practical cases presentations (III)	•

Note: Student workload specified for each activity in hours

Practical cases*: practical classes in classroom activities will consist of cases of successful proposals.