COURSE OUTLINE

(1) GENERAL

SCHOOLS	NATURAL SCIENCES		
ACADEMIC UNIT/UNITS	MATHEMATICS		
TITLE OF MASTER'S DEGREE	COMPUTATIONAL AND STATISTICAL DATA ANALYTICS (MCDA)		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	MCDA202	**SEMESTER**	A
COURSE TITLE	ALGORITHM ANALYSIS AND DATA STRUCTURES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures	3	7.5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.math.upatras.gr/courses/MSC-MCDA115/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning*

and Appendix B

- *Guidelines for writing Learning Outcomes*

Upon completing the course, students are expected to understand the different approaches between standard algorithms and algorithms for large data sets, like the difficulties of storing data in central memory and the need of creating and maintaining data structures in secondary storage. They are expected to have understood some algorithms for big data and the methods that are used to analyze them. Emphasis will be upon specific important applications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*

- Seeking, analyzing and composing data and information with the use of necessary technology.
- Adapting to new situations.
- Decision making.
- Working independently.
- Team work.
- Working in an interdisciplinary environment.
- Production of free, creative and inductive thinking.

(3) SYLLABUS

(**i**) Short introduction to data bases and data base management systems. Relational DB and SQL. (**ii**) Storing methods, insertion, deletion and querying Data Bases. Ordered files, arrays, pointers, hashing, B trees and B^+ trees (review). (**iii**) Problems and tradeoffs in big data sets in creating, updating and searching a DB. Input/output models, memory hierarchy, the Disk Access Model (DAM). Examples. (**iv**) Disk sorting algorithms. Merge Sort. Analysis. Divide and conquer. The DAM model, applications. Cache oblivious and non-oblivious algorithms. (**v**) Examples, models, analysis. Insertion/searching tradeoffs. Appropriate data structures. (**vi**) Application matters. Performance. (**vii**) Introduction/overview in data mining. Introduction to machine learning. (**viii**) Programming techniques for big data. MapReduce, Hadoop. Physical organization. Some algorithms on the model. (**ix**) Representation, LSH for texts. Distance measures. (**x**) The model. Sampling in runs. Data filtering. Estimation. (**xi**) Link analysis.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures (face to face)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Support of the course via the online platform eClass of University of Patras.
• Use of Information Technology in Education methods (electronic transparencies, specialized software etc.).</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Study (no driven)</td><td>100</td></tr>
<tr><td>Solving suggested exercises</td><td>45</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Final examination</td><td>3.5</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total number of hours for the Course (25 hours of work-load per ECTS credit)</td><td>187.5</td></tr>
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</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Assessment Language: Greek
Assessment Language for Erasmus students: English

Assessment methods: Final exam (100%).

Minimum passing grade: 5
Maximum passing grade: 10</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Bender, M.A. and Kuszmaul, B.C. *Data Structures and Algorithms for Big Datasets*.
- Blum, A. Hopcroft, J.E. and Kannan, R. (2017). *Foundations of Data Science*. Cornell University.
- Leskovec, J., Rajaraman, A. and Ullman J.D. (2014). *Mining of Massive Datasets*. 2nd ed. Cambridge University Press.
- Zafarani, R., Abbasi, M.A. and Liu, H. (2014). *Social Media Mining. An Introduction*. Cambridge University Press.

Class notes.