

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	Engineering		
<b>ACADEMIC UNIT</b>	Mechanical Engineering		
<b>LEVEL OF STUDIES</b>	Undergraduate (towards 5-year Diploma Degree)		
<b>COURSE CODE</b>	ΟΠ0903	<b>SEMESTER</b>	9th
<b>COURSE TITLE</b>	Computational Tools and Software in Operations Research		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>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</i>	<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>	
Lectures	3	3	
Laboratory Exercises	2	3	
	5	6	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
<b>COURSE TYPE</b> <i>general background, special background, specialized general knowledge, skills development</i>	<ul style="list-style-type: none"> <li>• Specialized general knowledge,</li> <li>• Skills development.</li> </ul>		
<b>PREREQUISITE COURSES:</b>			
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	Greek		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	No		
<b>COURSE WEBSITE (URL)</b>	<a href="https://www.mie.uth.gr/?page_id=18511&amp;lang=en">https://www.mie.uth.gr/?page_id=18511&amp;lang=en</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning Outcomes</b></p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area.</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B.</i></li> <li>• <i>Guidelines for writing Learning Outcomes.</i></li> </ul>
<p>The aim of this course is to learn computational tools and to familiarize with software and programming languages for successfully addressing operational research problems. The course will teach specialized techniques for in-depth analysis of problems arising in practical applications.</p> <p>The focus will be on the Python programming language, which is distinguished for its easy-to-use and readable code, while it has a variety of features that make it particularly effective in the fields of operations research and data science. The source code will be written in interactive development environments (IDEs) such as JupyterLab and Spyder using the Anaconda distribution.</p> <p>Indicative topics that will be studied include optimization problems related to product distribution, transportation and transshipment, supply chain network flow, warehouse allocation.</p> <p>Indicatively, packages (libraries) and software, both commercial and open-source, will be presented on optimization, network analysis (graphs), data manipulation, analysis and visualization issues such as CPLEX, GLPK, Google OR-Tools, Gurobi, igraph, Matplotlib, NumPy, pandas, PuLP, Pyomo, SciPy, Seaborn.</p>

Upon successful completion of the course, students are expected to:

- Understand the basic programming principles with Python.
- Write source code in interactive development environments (IDEs).
- Use basic data manipulation, analysis and visualization packages (libraries).
- Have an understanding of the basic usage principles and interface of Python language with packages (libraries) and optimization software to solve operations research problems.
- Be familiar with analyzing case studies and solving real-world problems with emphasis on supply chain management problems using Python language.

**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*

*Adapting to new situations*

*Decision-making*

*Working independently*

*Team work*

*Working in an international environment*

*Working in an interdisciplinary environment*

*Production of new research ideas*

*Project planning and management*

*Respect for difference and multiculturalism*

*Respect for the natural environment*

*Showing social, professional and ethical responsibility and*

*sensitivity to gender issues*

*Criticism and self-criticism*

*Production of free, creative and inductive*

*.....*

*Others...*

*.....*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.
- Adapting to new situations.
- Decision-making.
- Working independently.
- Project planning and management.
- Criticism and self-criticism.
- Production of free, creative and inductive.

**(3) SYLLABUS**

- Introduction to Python Programming Language,
- Data Types and Structures,
- Control Structures,
- File Handling (Input and Output),
- Define and Call Functions,
- Packages (libraries) for Data Manipulation and Analysis,
- Packages (libraries) for Data Visualization,
- Interface with Packages (Libraries) and Software for Modelling and Solving Operations Research Problems,
- Packages (libraries) for Network (Graph) Analysis,
- Introduction and Analysis of Basic Algorithms (Indicative of Heuristic Algorithms),
- Product Distribution Problems (TSP and VRP),
- Transportation and Transshipment Problems,
- Supply Chain Network Flow Problems,
- Warehouse Allocation Problems.

**(4) TEACHING and LEARNING METHODS - EVALUATION**

<p><b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i></p>	<p>Face-to-face teaching in a computer lab (for the theoretical and laboratory part of the course).</p>
<p><b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students.</i></p>	<p>Use of ICT in teaching (delivery of lectures with writing and analysis of source code, web-based learning process support), in laboratory training (familiarization with the Anaconda distribution, practice in interactive development environments JupyterLab and Spyder) and in communication with students (advisory guidance and the option of electronic homework submission).</p>

<p><b>TEACHING METHODS</b></p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>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.</i></p> <p><i>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</i></p>	<b>Activity</b>	<b>Semester Workload</b>
	Lectures	70
	Laboratory Exercises	30
	Independent Study	50
	<b>Course Total (25 hours of workload per credit)</b>	<b>150</b>
<p><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><i>Description of the evaluation procedure</i></p> <p><i>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</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p>I. Computer Lab-Based Final Exam (70%)</p> <p>II. Assignments (30%)</p> <p>Specifically-defined evaluation criteria are given at the beginning of the semester.</p>	

## (5) ATTACHED BIBLIOGRAPHY

### **Suggested bibliography:**

- Bynum, Michael L. et al. (2021). Pyomo — Optimization Modeling in Python. Springer International Publishing. <https://doi.org/10.1007/978-3-030-68928-5>
- Hillier, F. S., Lieberman, G. J., & Διαμαντίδης, Α. (Επιστ. Επιμέλεια) (2021). Εισαγωγή Στην Επιχειρησιακή Έρευνα (11η Έκδοση). Εκδότης: ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε. ISBN: 9789604189168.
- ΜΑΤΤΗΣ, Ε. (2020). Η ΓΛΩΣΣΑ ΠΡΟΓΡΑΜΜΑΤΙΣΜΟΥ ΡΥΘΟΝ. Εκδότης: ΕΚΔΟΣΕΙΣ ΔΙΣΙΓΜΑ ΙΚΕ. ISBN:9786182020036.
- Κολέτσος, Ι., & Στογιάννης, Δ. (2021). Εισαγωγή στην Επιχειρησιακή έρευνα (4η Έκδοση). Εκδότης: Συμείων (ΚΑΛΑΜΑΡΑ ΕΛΛΗ). ISBN: 9789609400688.
- ΜΠΟΥΡΑΣ, Α. Σ., & ΚΑΠΠΟΣ, Γ. Θ. (2020). ΡΥΘΟΝ 3: ΑΛΓΟΡΙΘΜΙΚΗ ΚΑΙ ΠΡΟΓΡΑΜΜΑΤΙΣΜΟΣ. Εκδότης: ΕΚΔΟΣΕΙΣ ΚΛΕΙΔΑΡΙΘΜΟΣ ΕΠΕ. ISBN:9789606450877.

### **Related academic journals:**

- Computers & Industrial Engineering, Elsevier
- European Journal of Operational Research, Elsevier
- Expert Systems with Applications, Elsevier
- International Journal of Production Economics, Elsevier
- International Journal of Production Research, Taylor & Francis
- Management Science, INFORMS
- Operational Research, Springer