

## COURSE OUTLINE

### (1) GENERAL

|                                                                                                                                                                                                                                                                       |                                                                                                                             |                              |                |
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| <b>SCHOOL</b>                                                                                                                                                                                                                                                         | School of ECE, Technical University of Crete (TUC)                                                                          |                              |                |
| <b>ACADEMIC UNIT</b>                                                                                                                                                                                                                                                  | Master's Program in Biomedical Engineering                                                                                  |                              |                |
| <b>LEVEL OF STUDIES</b>                                                                                                                                                                                                                                               | Postgraduate (MSc)                                                                                                          |                              |                |
| <b>COURSE CODE</b>                                                                                                                                                                                                                                                    | <b>BME 16</b>                                                                                                               | <b>SEMESTER</b>              | <b>4th</b>     |
| <b>COURSE TITLE</b>                                                                                                                                                                                                                                                   | Artificial Intelligence and Medical Decision Support Systems                                                                |                              |                |
| <b>INDEPENDENT TEACHING ACTIVITIES</b><br><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> |
|                                                                                                                                                                                                                                                                       |                                                                                                                             | 3                            | 3              |
|                                                                                                                                                                                                                                                                       |                                                                                                                             |                              |                |
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| Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).                                                                                                                                                     |                                                                                                                             |                              |                |
| <b>COURSE TYPE</b><br><i>general background, special background, specialised general knowledge, skills development</i>                                                                                                                                                | specialised general knowledge                                                                                               |                              |                |
| <b>PREREQUISITE COURSES:</b>                                                                                                                                                                                                                                          | None, but knowledge of basic principles in mathematics, computer science, and information technologies will help.           |                              |                |
| <b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>                                                                                                                                                                                                                      | English                                                                                                                     |                              |                |
| <b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>                                                                                                                                                                                                                      | yes                                                                                                                         |                              |                |
| <b>COURSE WEBSITE (URL)</b>                                                                                                                                                                                                                                           | <a href="https://mscs.uoc.gr/bme-crete/curriculum-and-syllabus/">https://mscs.uoc.gr/bme-crete/curriculum-and-syllabus/</a> |                              |                |

### (2) LEARNING OUTCOMES

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| <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>Consult Appendix A</p> <ul style="list-style-type: none"> <li>• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</li> <li>• Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</li> <li>• Guidelines for writing Learning Outcomes</li> </ul>                                     |
| <p>After completing this course the student will be able to:</p> <ul style="list-style-type: none"> <li>• recognize the benefits and limits of intelligent agents</li> <li>• synthesize elements from the fields of Artificial Intelligence, Machine Learning</li> <li>• develop parts of software for intelligent agents in biomedical engineering</li> <li>• use modern AI/ML algorithms, tools, suites, platforms, and libraries</li> <li>• manage large collections of data in order to extract useful knowledge</li> <li>• compare (evaluate) state estimation, decision making and learning techniques</li> <li>• experiment with different settings and techniques to optimize the result</li> </ul> |
| <p><b>General Competences</b></p> <p><i>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?</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| <i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i><br><i>Adapting to new situations</i><br><i>Decision-making</i><br><i>Working independently</i><br><i>Team work</i><br><i>Working in an international environment</i><br><i>Working in an interdisciplinary environment</i><br><i>Production of new research ideas</i> | <i>Project planning and management</i><br><i>Respect for difference and multiculturalism</i><br><i>Respect for the natural environment</i><br><i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i><br><i>Criticism and self-criticism</i><br><i>Production of free, creative and inductive thinking</i><br><i>.....</i><br><i>Others...</i><br><i>.....</i> |
| <ul style="list-style-type: none"> <li>• Search for, analysis and synthesis of data and information, with the use of the necessary technology</li> <li>• Decision-making</li> <li>• Working independently</li> <li>• Alternative/Innovative thinking</li> <li>• Use of computers</li> <li>• Problem solving</li> <li>• Data management</li> </ul>                                 |                                                                                                                                                                                                                                                                                                                                                                                                        |

### (3) SYLLABUS

The course introduces the students to the basic concepts of Artificial Intelligence (AI) and Machine Learning (ML). It also presents to the students state-of-the-art applications of AI and ML in medicine and healthcare, focusing on decision-support systems for disease diagnosis and treatment. Finally, it develops the students' interest for such systems, and for AI and ML in general.

1. What is AI; History of AI; Symbolic AI and Expert Systems; Statistical AI. Data-driven AI; The Intelligent Agent paradigm; AI for medicine: an overview;
2. Intelligent Search methods. Informed Search and Uninformed Search;
3. Constraint Satisfaction Problems; Applications in the Medical Domain;
4. Logic: propositional logic and first-order logic; Logical Inference;
5. Decision-making under uncertainty: Bayesian reasoning, Markov Decision Processes;
6. Expert Systems for Medical Decision Support and Assistive Technologies (symbolic AI-based expert systems, Bayesian systems, hybrid approaches);
7. Machine Learning: Neural Networks, Deep Learning, and their applications in medicine and healthcare.

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

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                      |                          |
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| <b>DELIVERY</b><br><i>Face-to-face, Distance learning, etc.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Distance Learning                                                                                                                                                                                    |                          |
| <b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b><br><i>Use of ICT in teaching, laboratory education, communication with students</i>                                                                                                                                                                                                                                                                                                                                                                                                     | Teaching, Communication with Students                                                                                                                                                                |                          |
| <b>TEACHING METHODS</b><br><i>The manner and methods of teaching are described in detail.<br/> 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><br><br><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>                                  | <b>Activity</b>                                                                                                                                                                                      | <b>Semester workload</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Lectures                                                                                                                                                                                             | 21 hours                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Study                                                                                                                                                                                                | 25 hours                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Project                                                                                                                                                                                              | 25 hours                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Literature Review                                                                                                                                                                                    | 4 hours                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Final Exam                                                                                                                                                                                           | 3 hours                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                      |                          |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Course total</b>                                                                                                                                                                                  | <b>78 hours</b>          |
| <b>STUDENT PERFORMANCE EVALUATION</b><br><i>Description of the evaluation procedure</i><br><br><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><br><br><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i> | Language of evaluation: ENGLISH<br><br>Evaluation: <ul style="list-style-type: none"> <li>written final exam (35%)</li> <li>course project (65%)</li> </ul> Grade: on a 0-10 scale<br>Pass: grade >5 |                          |

## **(5) ATTACHED BIBLIOGRAPHY**

### **- Suggested bibliography:**

Chapters in textbooks, course notes and current literature (selected reviews and research articles) for Artificial Intelligence, Machine Learning, and their application in medicine and healthcare.

- Artificial Intelligence: A Modern Approach. Stuart Russell and Peter Norvig, 4th edition, Prentice Hall, 2020.
- Artificial Intelligence: Structures and Strategies for Complex Problem Solving. George Luger. 5th edition, Addison-Wesley, 2005.
- Artificial Intelligence: A New Synthesis. Nils Nilsson. Morgan Kaufmann, 1998.
- Artificial Intelligence: Theory and Practice. Dean, Allen, Aloimonos. Benjamin/Cummings Pub. Co., 1998.
- Artificial Intelligence. Patrick Winston, 3rd edition, Addison-Wesley, 1992.
- Artificial Intelligence. Rich and Knight. 2nd edition, McGraw Hill, 1991.
- An Introduction to Multiagent Systems. Michael Wooldridge. Wiley, 2nd edition, 2009.
- Guide to Health Informatics. Enrico Coiera, CRC Press, 3rd edition, 2015.

### **- Related academic journals:**

- Artificial Intelligence in Medicine  
<https://www.sciencedirect.com/journal/artificial-intelligence-in-medicine>
- Journal of Medical Artificial Intelligence  
<https://jmai.amegroups.org>