**COMPUTER ENGINEERING MSc PROGRAMME**

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| --- | --- | --- | --- | --- | --- | --- |
| **First Year** | | | | | | |
| **I. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#C6) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 503001501 | [ALGORITHM DESIGN AND ANALYSIS](#C1) | 7.5 | 3+0 | 3 | **C** | Turkish |
|  | Elective Course-1 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-2 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of I. Semester | 30 |  | 12 |  |  |
| **II. Semester** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | Turkish |
| 503002001 | Seminar | 7.5 | 0+1 | - | **C** | Turkish |
|  | Total of II. Semester | 30 |  | 9 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 21 |  |  |

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| **Second Year** | | | | | | | | |
| **III. Semester** | | | | | | | | | |
| Code | Course Title | | ECTS | | T+P | Credit | C/E | Language |
| 503001702 | MSc THESIS STUDY | | 25 | | 0+1 | - | **C** | Turkish |
| 503001703 | SPECIALIZATION FIELD COURSE | | 5 | | 3+0 | - | **C** | Turkish |
|  | | Total of III. Semester | 30 |  | |  |  |  | |
| **IV. Semester** | | | | | | | | | |
| Code | | Course Title | ECTS | T+P | | Credit | C/E | Language | |
| 503001702 | | MSc THESIS STUDY | 25 | 0+1 | | - | **C** | Turkish | |
| 503001703 | | SPECIALIZATION FIELD COURSE | 5 | 3+0 | | - | **C** | Turkish | |
|  | | Total of IV. Semester | 30 |  | |  |  |  | |
| 503001515 | | TOTAL OF SECOND YEAR | 60 |  | |  |  |  | |

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| **Elective Courses** | | | | | | |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503001511 | [Advanced Software Testing](#C28) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001502 | [ARTIFICIAL INTELLIGENCE](#C5) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001515 | [Artificial Intelligence Applications in Communications](#C24) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002507 | [BIG DATA APPLICATIONS](#C21) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002502 | [CLOUD COMPUTING](#C8) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002501 | [COMPUTATIONAL GEOMETRY](#C7) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001504 | [COMPUTER VISION](#C2) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001512 | [Data Analysis and Statistics](#C26) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002506 | [DATA MINING](#C12) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001510 | [Deep Learning Applications](#C25) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002505 | [FUNDAMENTALS OF ROBOT PROGRAMMING](#C11) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001505 | [FUZZY LOGIC](#C3) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002509 | [GRAPH ALGORITHMS](#C34) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001513 | [Heuristic Algorithms](#C29) | 7.5 | 3+0 | 3 | E | Turkish |
| 503012605 | [Veri Mahremiyeti](#C35) | 7.5 | 3+0 | 3 | E | Turkish |
| 503012606 | [Sinir Ağları ve Derin Öğrenme](#C36) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001506 | [INFORMATION AND DATA SECURITY](#C15) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001507 | [INFORMATION RETRIEVAL SYSTEMS](#C23) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002508 | [MACHINE LEARNING FOR INFORMATION SECURITY](#C20) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001508 | [Machine Learning and Anomaly Detection](#C33) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002503 | [MOBILE PROGRAMMING](#C9) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001514 | [Mobile Communications Systems](#C30) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001509 | [Network Programming](#C32) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002511 | [New Generation Communications Technologies](#C31) | 7.5 | 3+0 | 3 | E | Turkish |
| 503001503 | [PARALLEL COMPUTER ARCHITECTURES AND PROCESSING](#C4) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002504 | [PATTERN RECOGNITION SYSTEMS](#C10) | 7.5 | 3+0 | 3 | E | Turkish |
| 503002510 | [Robotic Middleware and Simulaton Environments](#C27) | 7.5 | 3+0 | 3 | E | Turkish |

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Algorithm Design and Analysis |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | |  |  | | | 3 | 7.5 | COMPULSORY  ( x ) | | ELECTIVE  (   ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | | 1 | | 30 |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | Calculus I  Algorithms and Complexities | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Sorting and searching Algorithms, Discrete Fourier Transform, symbolic calculatiobs | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Writing various algorithmtecniques for problems | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Writing and developing programs | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1)Apply the algorithms tecniques fort the different area of the sciences (Lo 1)  2 Learning new Algorithm tecniques(LO 2, lo 5)  3 Learning analysis of algorithms(lo 4)  4 Using mathematical tecniques to write algorithms(lo 6) | | | | | | | |
| **TEXTBOOK** | | | | | Algorithmics: theory and PracticeGilles Brassard, Paul Bratley | | | | | | | |
| **OTHER REFERENCES** | | | | | Introduction to algorithms, Thomas H. Corme | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Various sorting algorithms, heapsort, sorting in lineear time |
| 2 | Bubble sort, Shell sort, bucket sort |
| 3 | Comp sort, counting sort, radix sort |
| 4 | Hash tables, , binary search trees, red-blavk trees, skip trees. |
| 5 | Minimizing time in the system |
| 6 | Midterm Examination 1 |
| 7 | Scheduling with deadlines |
| 8 | String searching problems,Knuth-Morris algorithm |
| 9 | Boyer-moor algorithm |
| 10 | Discrete fourier tarnsform |
| 11 | Midterm Examination 2 |
| 12 | Inverse ransform |
| 13 | Repeted evaluation of polynomials, |
| 14 | Symbolic operations on polynomials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE** **MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |
| **LO 10** | - |  |  |  |
| **LO 11** | - |  |  |  |
| **LO 12** | - |  |  |  |

**Prepared by:** İdiris Dağ **Date:** 20.6.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | COMPUTER VISION |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | TURKISH |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Computer vision is concerned with the theory for building artificial systems that obtain information from images | | | | | | | |
| **COURSE OBJECTIVES** | | | | | This course is designed for graduate students interested in vision, machine learning. Many of the ideas and techniques used here are also used in other areas of AI (e.g. robotics, natural language understanding, learning). The course offers a broad introduction to the field, the current problems and theories, the basic mathematics, and some interesting algorithms. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | This course include.Relation to human visual perception. The analysis and understanding of image and video data. Mathematical foundations, image formation and representation, Segmentation, feature extraction, contour and region analysis, camera geometry and calibration, stereo, motion, 3-D reconstruction, object and scene recognition, object and people tracking, human activity recognition and inference. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1)how light is reflected off surfaces, how objects move, and how all of this information gets projected onto an image by the optics of a camera. (LO 1) 2) find out that all that linear algebra and calculus you learned is actually useful for something real (LO 2) 3) implement a number of programming assignments to get hands-on experience working with images and image sequences ( LO 4) 4) design and implementation a project that fits CVapplications (LO 5) | | | | | | | |
| **TEXTBOOK** | | | | | Computer Vision:Algorithms and Applications,” Richard Szeliski, 2010 Springer | | | | | | | |
| **OTHER REFERENCES** | | | | |  | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction |
| 2 | Image Representation |
| 3 | Image Processing |
| 4 | Feature Extraction and Matching |
| 5 | Segmentation |
| 6 | Midterm Examination 1 |
| 7 | Image resigtration |
| 8 | motion |
| 9 | Detection Motion parameters |
| 10 | Image Stitching |
| 11 | Midterm Examination 2 |
| 12 | computational photography |
| 13 | Binary Image |
| 14 | 3d reconstruction |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |
| **LO 10** | - |  |  |  |
| **LO 11** | - |  |  |  |
| **LO 12** | - |  |  |  |

**Prepared by:** Asist.Prof.Dr. Kemal ÖZKAN **Date:** 17.06.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | FUZZY LOGIC |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | TURKISH |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 0 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 25 |
| Quiz | | | | |  | |  |
| Homework | | | | | 4 | | 25 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Classical sets and fuzzy sets, fuzzy logic principle. Fuzzification strategies, knowledge base, fuzzy reasoning and defuzzification techniques and strategies. Examples of fuzzy logic medical application. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course is the decision making classification with the supplied data by using fuzzy logic. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | |  | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1-Have knowledge, skills and competence to develop novel approaches in science and technology. (LO1, LO2)  2-Contributes to the science and technology literature. (LO1, LO2, LO3)  3-Designs, plans and manages novel research projects; can lead multidisciplinary projects. (LO5, LO6, LO7)  4-Follows the scientific literature, and the developments in his/her field, critically analyze, synthesize, interpret and apply them effectively in his/her research. (LO2, LO4, LO7) | | | | | | | |
| **TEXTBOOK** | | | | | Ross, Timothy J. Fuzzy Logic with Engineering Applications (2nd Edition). Hoboken, NJ, USA: John Wiley & Sons, 2005. | | | | | | | |
| **OTHER REFERENCES** | | | | | Siler, William. Fuzzy Expert Systems Fuzzy Reasoning. Hoboken, NJ, USA: John Wiley & Sons, Incorporated, 2005Elmas, Çetin. Bulanık Mantık Denetleyiciler, Seçkin Yayınevi, Ankara, 2003 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Classical sets and fuzzy sets; Classical relations and fuzzy relations |
| 2 | Properties of membership functions, fuzzification and defuzzification |
| 3 | Logic and fuzzy systems |
| 4 | Development of membership functions |
| 5 | Automated methods for fuzzy systems |
| 6 | Midterm Examination 1 |
| 7 | Fuzzy systems simulation |
| 8 | Rule-base reduction methods |
| 9 | Decision making with fuzzy information |
| 10 | Fuzzy classification and pattern recognition |
| 11 | Midterm Examination 2 |
| 12 | Fuzzy arithmetic and extension principles |
| 13 | Medical applications of fuzzy logic |
| 14 | Medical applications of fuzzy logic |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |
| **LO 10** | - |  |  |  |
| **LO 11** | - |  |  |  |
| **LO 12** | - |  |  |  |

**Prepared by:** Assoc. Prof.Dr.Eyyüp GÜLBANDILAR **Date:** 20.06.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

|  |  |  |  |
| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 0 | **TITLE** | PARALLEL COMPUTER ARCHITECTURES AND PROCESSING |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | |  |  | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | | 6 | | 20 |
| Project | | | | | 1 | | 20 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Classification of computers and introduction to parallel architectures. Pipelining and vector processing. Interconnection network types; static, dynamic. Organization of data and parallel storage. Design and analysis of parallel algorithms. Cluster Computing. Performance measures of parallel algorithms. Examples of parallel algorithms. Programming assignments for parallel solution of some problems on the MPI and the Beowulf system. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Understand paralel computer architectures and processing,Learn Beowulf cluster computer systems,Get experience on paralel programming ,Solve specified problems on Beowulf cluster computer | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | 1. Clasify advanced architectures, 2. To understand memory systems,3.to define and compare RISC and CISC architectures,4.To define and use cluster computers,5.To develop basci MPI parallel programs | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.To define the layered architecture of computers(LO1),2.To descripe parallel computer s evolution and operation(LO1),3.To define pipeline architectures(LO1),4.To compare RISC and CISC CPUs(LO1),5.To describe methods to increase performance(LO4),6.To define superscalar CPUs(LO1),7.To define IA-64 CPUs(LO1),8.To classify parallel programming techniques, to develop programs(LO4),9.To use basic MPI functions(LO5),10.Being able to realize group projects(LO6),11.Being able to make presentations(LO6) | | | | | | | |
| **TEXTBOOK** | | | | | Course Notes, Advanced Computer Architecture Parallelism Scalability Programmability, Kai Hwang, Parallel Programming with MPI, Stallings, William: Computer Organization and Architecture, 5th edition, Prentice Hall International, 2000 | | | | | | | |
| **OTHER REFERENCES** | | | | | Beowulf cluster with MPI installed | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Computer Evolution and Performance |
| 2 | Memory Systems |
| 3 | Instruction Pipelining |
| 4 | RISC Architectures |
| 5 | RISC versus CISC |
| 6 | Midterm Examination 1 |
| 7 | Superscalar Architectures |
| 8 | Superscalar Architectures: Pentium |
| 9 | VLIW Architectures |
| 10 | VLIW Architectures: The IA-64 Architecture |
| 11 | Midterm Examination 2 |
| 12 | Parallel Processing |
| 13 | MPI Programming |
| 14 | Project Presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |
| **LO 10** | - |  |  |  |
| **LO 11** | - |  |  |  |
| **LO 12** | - |  |  |  |

**Prepared by:** Asist. Prof. Dr. Nihat Adar **Date:** 17/06/2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | xx | **TITLE** | Artificial Intelligence |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction and concepts of AI, Problems and solutions, Classification of Search Algorithms, Knowledge Representation, Learning, Other AI methods and applications. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the participant is expected to understand the basic concepts of Artificial Intelligent. Additionally, it is expected to model and solve some realworld problems using the methods in the artificial intelligence. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Modeling some realworld problems to transform into the computer environment, and solve using Artificial Intelligence Algorithms. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Ability to define concepts related Artificial Intelligence (LO2).  2. Modeling some problems related to Artificial Intelligence and transfering into the computer environment(LO2, LO4)  3. Propose solution method for the problems, and realizitaion of the solutions in the computer environment(LO5).  6. Combine the results of the studies, comments on them, discuss in the team, and report the results. Present and defense the studies(LO7). | | | | | | | |
| **TEXTBOOK** | | | | | Russell and P. Norvig, "Artificial Intelligence A Modern Approach", Third Edition, Prentice Hall, 2009. | | | | | | | |
| **OTHER REFERENCES** | | | | | Vasif V. Nabiyev, Yapay Zeka, 4. Baskı, SEÇKİN YAYINLARI, 2012. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Artificial Intelligence |
| 2 | Problems and Modeling Approaches |
| 3 | Some problems and blind search methods |
| 4 | Informed Search Algorithms |
| 5 | Local Search Algorithms |
| 6 | Midterm Examination 1 |
| 7 | Project Presentations I, Logical Agents |
| 8 | Knowledge Representation |
| 9 | First Order Logic |
| 10 | Inference using First Order Logic |
| 11 | Midterm Examination 2 |
| 12 | Project Presentations II |
| 13 | Example 1: Route Planning for Autonomous Vehicles |
| 14 | Example 2: Planning Parking Maneuvers for Autonomous Vehicles |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |
| **LO 10** | - |  |  |  |
| **LO 11** | - |  |  |  |
| **LO 12** | - |  |  |  |

**Prepared by:** Assoc.Prof.Dr.Ahmet Yazıcı **Date:** 16.06.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | Joint Course for the Institute | **SEMESTER** | Fall-Spring |

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| **COURSE** | | | |
| **CODE** | 501011101 | **TITLE** | The Scientific Research Methods and Its Ethics |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| MSc-  Ph.D | 3 | | 0 | 0 | | | 3+0 | 7,5 | COMPULSORY  ( X ) | | ELECTIVE  (   ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1,5 | | 1,5 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 60 |
| **PREREQUISITE(S)** | | | | | None | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Science, the scientific thought and other fundamental concepts, the scientific research process and its techniques, Methodology: Data Collecting-Analysis-Interpretation, Reporting the scientific research (Preparation of a thesis, oral presentation, article, project), Ethics, Ethics of scientific research and publication. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The main objectives are: To examine the foundations of scientific research and the scientific research methods, to teach the principles of both the methodology and the ethics, to realize the process on a scientific research and to evaluate the results of research, to teach reporting the results of research (on a thesis, presentation, article). | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Applying the scientific research methods and the ethical rules in their professional life. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Gaining awareness on ethical principles at basic research methods, becoming skillful at analyzing and reporting the data obtained in scientific researches, being able to have researcher qualification with occupational sense of responsibility, having the scientific and vocational ethics’ understanding and being able to defend this understanding in every medium. | | | | | | | |
| **TEXTBOOK (Turkish)** | | | | | Karasar, N. (2015). Bilimsel Araştırma Yöntemi. Nobel Akademi Yayıncılık, Ankara. | | | | | | | |
| **OTHER REFERENCES** | | | | | **1-**Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., Demirel, F. (2012). Bilimsel Araştırma Yöntemleri. Pegem Akademi Yayınevi, Ankara.  **2-**Tanrıöğen, A. (Editör). (2014). Bilimsel Araştırma Yöntemleri. Anı Yayıncılık, Ankara.  **3-**Türkiye Bilimler Akademisi Bilim Etiği Komitesi. Bilimsel Araştırmada Etik ve Sorunları, Ankara: TÜBA Yayınları, (2002).  **4-**Ekiz, D. (2009). Bilimsel Araştırma Yöntemleri: Yaklaşım, Yöntem ve Teknikler. Anı Yayıncılık, Ankara.  **5-**Day, Robert A. (Çeviri: G. Aşkay Altay). (1996). Bilimsel Makale Nasıl Yazılır ve Nasıl Yayımlanır?, TÜBİTAK Yayınları, Ankara.  **6-**Özdamar, K. (2003). Modern Bilimsel Araştırma Yöntemleri. Kaan Kitabevi, Eskişehir.  **7-**Cebeci, S. (1997). Bilimsel Araştırma ve Yazma Teknikleri. Alfa Basım Yayım Dağıtım, İstanbul.  **8-**Wilson, E. B. (1990). An Introduction to Scientific Research. Dover Pub. Inc., New York.  **9-**Çömlekçi, N. (2001). Bilimsel Araştırma Yöntemi ve İstatistiksel Anlamlılık Sınamaları. Bilim Teknik Kitabevi, Eskişehir. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts) |
| 2 | Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts) |
| 3 | The scientific research and its types (Importance of the scientific research, types of science, scientific approach) |
| 4 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning) |
| 5 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning) |
| 6 | The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning) |
| 7 | The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data) |
| 8 | The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data) |
| 9 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 10 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 11 | Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project) |
| 12 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 13 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 14 | Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors) |
| 15,16 | Mid-term exam, Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE INSTITUTE’S GRADUATE PROGRAMME’S LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (M.Sc.-Ph.D.)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO 1** | Having the scientific and vocational ethics’ understanding and being able to defend this understanding in every medium. | | |  | |  |  |
| **LO 2** | Being able to have researcher qualification with occupational sense of responsibility. | | |  | |  |  |
| **LO 3** | Becoming skillful at analyzing and reporting the data obtained in scientific researches. | | |  | |  |  |
| **LO 4** | Gaining awareness on ethical principles at basic research methods. | | |  | |  |  |
| **Prepared by :** | | |  | **Date:** | | 14.06.2016 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | xx | **TITLE** | Computational Geometry |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | | 1 | | 50 |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | | Knowledge about data structures | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Concepts and techniques on computational geometry. Plane sweep algorithms, Convex hulls, Polygon triangulation, Voronoi diagrams, Delauney triangulations, Ray tracing | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Gaining the ability of analyzing complex geometric problems and developing algorithms. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | 1. Student will understand geometric problems and algorithms in computer graphics.  2. They will be able to follow research in this field.  3. Student will get experience on computer graphics and GIS systems. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Knowledge and classify ability of geometric problems (ÖÇ4)  2. Choice of suitable algorithms to solve these problems (ÖÇ4)  3. Develops new techniques to solve these problems (ÖÇ4, ÖÇ5) | | | | | | | |
| **TEXTBOOK** | | | | | Computational Geometry, Mark de Berg, Marc van Kreveld, Mark Overmars, Otfried Schwarzkopf, Springer | | | | | | | |
| **OTHER REFERENCES** | | | | | Introduction to Data Structures, Bhagat Singh, Thomas L. Naps, West | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Line Segment Intersection |
| 2 | Polygon Triangulation |
| 3 | Linear Programming |
| 4 | Orthogonal Range Searching |
| 5 | Point Location |
| 6 | Midterm Examination 1 |
| 7 | Voronoi Diagrams |
| 8 | Arrangements and Duality |
| 9 | Delaunay Triangulation |
| 10 | Windowing |
| 11 | Midterm Examination 2 |
| 12 | Convex Hulls |
| 13 | Binary Space Partitions |
| 14 | Robot Motion Planning |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asst.Prof.Dr. Selçuk Canbek **Date:** 02.11.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 0 | **TITLE** | Cloud Computing |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction and cloud computing concepts, cloud architecture, virtualization, storage, programming models, development environments, big data, security, applications. Completion of the tests of the projects, preparation and submission of project presentations. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of this course, students are expected to understand some basic concepts of cloud computing. In addition, some real-world problems are expected to be modeled and solved with approaches in the field of cloud computing. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Modeling some real world problems that students may encounter and transferring them to the computer environment and finding solution in computer environment with cloud computing approaches. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Define some concepts related to cloud computing (LO1, LO2).  2. Model some problems to be solved by cloud computing and transfer them to computer environment (LO2, LO4)  3. Suggests appropriate solution method for solution of modeled problems and transfers solution method to computer environment (LO5, LO6).  4. Combine, interpret, evaluate, discuss and ultimately organize the results of the study and present and defend them in writing and orally (LO7). | | | | | | | |
| **TEXTBOOK** | | | | | Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet by Kai Hwang, Jack Dongarra & Geoffrey C. Fox. | | | | | | | |
| **OTHER REFERENCES** | | | | | Cloud Computing Theory and Practice, D. C. Marinescu, Morgan Kaufman, 2013internet | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Cloud Computing |
| 2 | Cloud Infrastructure |
| 3 | Virtualization |
| 4 | Storage |
| 5 | Programming Models |
| 6 | Midterm Examination 1 |
| 7 | Development Platforms |
| 8 | Big Data |
| 9 | Security |
| 10 | Applications |
| 11 | Midterm Examination 2 |
| 12 | Completing Project Test |
| 13 | Prepare Project Presentation |
| 14 | Project Presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Assist.Prof.Dr.M. Akcay **Date:** 07.11.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | xx | **TITLE** | MOBILE PROGRAMMING |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction and concepts of mobile programming data transaction on mobile componets. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the participant is expected to learn basics of mobile operating systems, hardware and software architectures  Learn mobile communication protocols.  Develop software for mobile components inorder to solve real world problems by using mobile programming languages. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Awareness of new technologies via mobile programmimg techniques. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Learn basics of mobile operating systems, hardware and software architectures(LO2, LO4)  Learn mobile communication protocols(LO2)  Develop software for mobile components by using mobile programming languages(LO5). | | | | | | | |
| **TEXTBOOK** | | | | | Beginning Android Programming with Android Studio (Wrox Beginning Guides) 4th Edition 2016 | | | | | | | |
| **OTHER REFERENCES** | | | | | Profesyoneller için Android ile Uygulama Geliştirme, Pusula yayıncılık | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Preparing IDE |
| 2 | Android operating system |
| 3 | XML for Android |
| 4 | Project details for Android |
| 5 | Text fields |
| 6 | Midterm Examination 1 |
| 7 | Communication |
| 8 | Layouts |
| 9 | Image and video operations |
| 10 | Transitions |
| 11 | Midterm Examination 2 |
| 12 | Advanced componets |
| 13 | Advanced componets |
| 14 | Project Presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asistant.Prof.Dr.Uğur GÜREL **Date:** 04.11.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | xx | **TITLE** | Pattern Recognition systems |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Pattern recognition techniques are used to automatically classify physical objects (2D or 3D) or abstract multidimensional patterns (n points in d dimensions) into known or possibly unknown categories. A number of commercial pattern recognition systems exist for character recognition, handwriting recognition, document classification, fingerprint classification, speech and speaker recognition, white blood cell (leukocyte) classification, military target recognition among others. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Teaching application of modern pattern recognition to real systems | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students who take this course will be better designers for pattern recognition systems | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Ability to define concepts related Pattern Recognition systems(LO2).  2. Modeling some problems related to Pattern Recognition(LO2, LO4)  3. Propose solution method for the problems, and realizitaion of the solutions in the computer environment(LO5). | | | | | | | |
| **TEXTBOOK** | | | | | Duda R. O., Hart P. E., (1973), “Pattern Classification and Scene Analysis - (Part One)”, John Wiley and Sons | | | | | | | |
| **OTHER REFERENCES** | | | | | Matlab | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Pattern Recognition |
| 2 | Review of probability theory |
| 3 | Review of probability theory, Bayes decision theory |
| 4 | Normal density and discriminant functions |
| 5 | Maximum likelihood and Bayesian parameter estimation |
| 6 | Midterm Examination 1 |
| 7 | Fisher Linear Discriminant, expectation maximization |
| 8 | Non-parametric techniques |
| 9 | FDistance based methods |
| 10 | Nearest neighborhood classification |
| 11 | Midterm Examination 2 |
| 12 | Linear discriminant functions |
| 13 | Artificial neural networks |
| 14 | Unsupervised learning |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asisst.Prof.Dr.Kemal ÖZKAN **Date:** 16.06.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | xx | **TITLE** | Fundamentals of Robot Programming |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction, industrial robots and service robots, sensors and actuators, control architecture and robot programming, robot kinematics, motion planning, motion control. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the participant is expected to understand the basic concepts of robot systems and use the fundamental programming techniques. Additionally, it is expected to develop some application of robotic systems both in simulation and real environments. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Programming of robotic systems and similar mechatronic systems. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.Ability to define concepts related robotics (LO2).  2. Ability to use the information about mechanics, electrics and computer disciplines which are covered by robotics(LO3)  3. Ability to identify and solve the robotic problems by the perspective of computer engineering(LO4). | | | | | | | |
| **TEXTBOOK** | | | | | B. Siciliano, L. Sciavicco, G. Villani, G. Oriolo: “Robotics: Modelling, Planning and Control”, Springer, 2009 | | | | | | | |
| **OTHER REFERENCES** | | | | | -- | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction |
| 2 | Industrial robots |
| 3 | Service robots |
| 4 | Sensors and actuators |
| 5 | Sensors and actuators |
| 6 | Midterm Examination 1 |
| 7 | Control architectures and robot programming |
| 8 | Control architectures and robot programming |
| 9 | Robot kinematics |
| 10 | Motion Planning |
| 11 | Midterm Examination 2 |
| 12 | Motion Planning |
| 13 | Motion control |
| 14 | Motion control |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Assist.Prof.Dr.Metin Özkan **Date:** 07.11.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 0 | **TITLE** | Data Mining |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | This course includes general definition of Data mining, application fields, data preprocessing, fundamental classification algorithms, clustering algorithms, anomaly detection techniques over data. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | This course aims to provide basic knowledge and methods on data mining discipline and introduce the algorithms that are experienced on data analysis and applications to the real life problems. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | With the help of this course, the data belongining to real-life problems can be interpreted by data mining methods and will help for process improvements. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Interpretation of the relationships between data set-attributes with the help of data mining techniques on the dataset.  Classification of unknown samples by determining the decision rule for known samples(LO1).  2. To have knowledge on up to date techniques in the field of data mining (LO3).  3. To employ data mining techniques to the data that can be obtained from various disciplines(LO6).  4. Presenting and reporting the results of the term project in comparison to the results of the related work in the literature(LO7). | | | | | | | |
| **TEXTBOOK** | | | | | 1. Introduction to Data Mining, Tan, Steinback, Kumar, ISBN-13: 9780321321367, 2006, Pearson. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Ian H. Witten , Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition (Morgan Kaufmann Series in Data Management Systems), 2005.2. Real-World Data Mining: Applied Business Analytics and Decision Making, Dursun Delen, SBN-13: 9780133551075, 2015 (Pearson). | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Data Mining, Definiton of Data Mining |
| 2 | Aims of data mining and application fields, data types, similarity-dissimilarity |
| 3 | Stages of data mining proceses |
| 4 | Data and data preprocessing techniques |
| 5 | Anomaly Detection |
| 6 | Midterm Examination 1 |
| 7 | Rule-based Classification |
| 8 | Estimation and Classification |
| 9 | Supervised Learning: Classification Algorithms |
| 10 | Supervised Learning: Classification Algorithms |
| 11 | Midterm Examination 2 |
| 12 | Unsupervised Learning: Clustering Algorithms |
| 13 | Project Presentation |
| 14 | Project Presentation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asst.Prof.Dr.Efnan ŞORA GÜNAL **Date:** 07.11.2016

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Information and Data Security |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | | 2 | |  |
| Project | | | | | 1 | | 20 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | information security, security engineering, network security, application and software security, security protocols, encryption and cryptography, e-signature, security management.  . | | | | | | | |
| **COURSE OBJECTIVES** | | | | | to increase the awareness of privacy  to understand the purpose of information and computer security  to be able to provide pratical solutions to the problems in information security area  to understand the main management techniques for controlling Information Security  to increase the number of experts in information security area | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Training computer engineers to have experts in information and computer security to provide the studies in this area | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students will gain a basic understanding on the concept of security and privacy (LO:1)  2. Students will learn that how this concept can be applied to evaluate the security and privacy aspect of an information system or a computer system. (LO: 4,8)  3. Students will be aware of the resources available for learning the latest development in the area. (LO:2)  4. Produce solutions for cyber security problems.(LO:4)  5. The "student project" provides an opportunity for each student to become expert in an area related to the topic of the course. (LO:1,2,4,6,7,8,9) | | | | | | | |
| **TEXTBOOK** | | | | | W. Stallings. Cryptography and Network Security. Principles and Practice. Prentice Hall, 2003 (third edition)Ders Notları | | | | | | | |
| **OTHER REFERENCES** | | | | | Cole, E., Krutz, R., Conley, J.W., “Security Assessments, Testing, and Evaluation”, Network Security Bible, Wiley Publishing Inc., IndWilliam Stallings and Lawrie Brown, Computer Security: Principles and Practice, 3rd edn, Prentice-Hall, 2015.Matt Bishop, Introduction to Computer Security, Addison Wesley, 2005 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Concepts for Information, Security and Computer Security |
| 2 | Security Engineering |
| 3 | Network security and enterprise network security mechanisms |
| 4 | Software security and secure coding |
| 5 | Security protocols |
| 6 | Midterm Examination 1 |
| 7 | Cryptology and Cryptoanalysis |
| 8 | Symmetric and asymmetric algorithms |
| 9 | E-signature and public key cryptography |
| 10 | İnformation security technologies and security management |
| 11 | Midterm Examination 2 |
| 12 | Student Projects |
| 13 | Student Projects |
| 14 | Student Projects |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asst. Prof. Dr. Esra N. Yolaçan **Date:** 10/04/2017

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 5030 | **TITLE** | Machine Learning for Information Security |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  (   ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | | 2 | | 20 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | None | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | There will be an introduction to machine learning where ML techniques including association rules, clustering and classification are described. This course will explore the field of machine learning from a security perspective, such as fraud detection, anomaly detection and attack prediction. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The objective of this course is to provide an understanding of the impact of machine leraning in cybersecurity. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Training computer engineers to have experts in information and computer security to provide the studies in this area | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students will gain a basic understanding on the concept of security and privacy (LO:1)  2. Students will learn that how this concept can be applied to evaluate the security and privacy aspect of an information system or a computer system. (LO: 4,8)  3. Students will be aware of the resources available for learning the latest development in the area. (LO:2)  4. Produce solutions for cyber security problems.(LO:4)  5. The "student project" provides an opportunity for each student to become expert in an area related to the topic of the course. (LO:1,2,3,4,6,9) | | | | | | | |
| **TEXTBOOK** | | | | | Machine Learning and Data Mining for Computer Security: Methods and Applications, M. A. Maloof, 2006 | | | | | | | |
| **OTHER REFERENCES** | | | | | Machine Learning and Systems Engineering, S. Ao, B.B. Rieger, M.A. Amouzegar, 2010 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to machine learning and security applications |
| 2 | Machine learning: Overview of the concepts and methods |
| 3 | Tools and applications for machine learning algorithms |
| 4 | ML applications in cybersecurity |
| 5 | ML applications in cybersecurity |
| 6 | Midterm Examination 1 |
| 7 | Classification algorithms |
| 8 | Application of classification cybersecurity |
| 9 | Clustering algorithms |
| 10 | Application of clustering cybersecurity |
| 11 | Midterm Examination 2 |
| 12 | Presentations of research and implementation projects |
| 13 | Presentations of research and implementation projects |
| 14 | Presentations of research and implementation projects |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Asst. Prof. Dr. Esra N. Yolaçan **Date:** 14/10/2017

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING (MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Big Data Applications |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | | 2 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (………) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Big data concept, MapReduce model, NoSQL databases | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course is to teach necessary methods to store, present and analysis big data. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To learn the concept of bigdata and to make necessary analysis on this data | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Understanding the right data formats for storing and sharing large data (LO2)  Create querries on Hadoop (LO1)  Analysis and visualization concepts to make sense of large data sets.(LO4)  Analyse bigdata sets (LO3) | | | | | | | |
| **TEXTBOOK** | | | | | Data Just Right: Introduction to Large-Scale Data & Analytics”, M. Manoochehri, Addison-Wesley, 2013 | | | | | | | |
| **OTHER REFERENCES** | | | | | http://hadoop.apache.org/ | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction |
| 2 | Big data concept |
| 3 | Hosting big data |
| 4 | Non-relational database |
| 5 | Processing big data |
| 6 | Midterm Examination 1 |
| 7 | Hadoop |
| 8 | Hadoop |
| 9 | Visulation of big data sets |
| 10 | Visulation of big data sets |
| 11 | Midterm Examination 2 |
| 12 | MapReduce Model |
| 13 | MapReduce Model |
| 14 | Data Conversion Workflows |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE       MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO 1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO 2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. |  |  |  |
| **LO 3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO 4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO 5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO 6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. |  |  |  |
| **LO 7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. |  |  |  |
| **LO 8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. |  |  |  |
| **LO 9** | Advanced level of Professional and ethical responsibilty. |  |  |  |

**Prepared by:** Yrd. Doç Uğur GÜREL **Date:** 15.11.2017

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

|  |  |  |  |
| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Information Retrieval Systems |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 6 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | TURKİSH |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 0 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 25 |
| Quiz | | | | |  | |  |
| Homework | | | | | 4 | | 25 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 50 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Information Retrieval Systems, Vector Space Models, Probabilistic IR | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Introducing computational methods thatpresent fast, reliable search on unorganized data.Understanding search engines. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | |  | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1-Have knowledge, skills and competence to develop novel approaches in science and technology. (LO1, LO2)  2-Contributes to the science and technology literature. (LO1, LO2, LO3)  3-Designs, plans and manages novel research projects; can lead multidisciplinary projects. (LO5, LO6, LO7)  4-Follows the scientific literature, and the developments in his/her field, critically analyze, synthesize, interpret and apply them effectively in his/her research. (LO2, LO4, LO7) | | | | | | | |
| **TEXTBOOK** | | | | | Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. | | | | | | | |
| **OTHER REFERENCES** | | | | | 1-)Information Retrieval: Implementing and Evaluating Search Engines, Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, The MIT Press, 20102-) Bilgi Erişim Sistemleri, Arıkan, A., Babil Yayınevi, 2006 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Tolerant Retrieval |
| 2 | Index Construction |
| 3 | Compression |
| 4 | Tf-idf |
| 5 | Vector Space Model |
| 6 | Midterm Examination 1 |
| 7 | Query Expansions |
| 8 | Scoring , Naïve Bayes |
| 9 | Probabilistic IR |
| 10 | BM25 Okapi |
| 11 | Midterm Examination 2 |
| 12 | SVM |
| 13 | Clustering |
| 14 | Ranking Learning |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues oof engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assoc. Prof.Dr.Eyyüp GÜLBANDILAR | **Date:** | | 04.04.2018 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Artificial Intelligence Applications in Communications |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 0 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 40 |
| Project | | | | | 1 | | 60 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | |  |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Examining the subsystems related to mobile communications systems and artificial intelligence applications, developing the basic knowledge level that may be necessary to understand the research studies in this field, gaining a vision for the related fields in order to be able to make new research activities. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Students who pass the course successfully are expected to gain the ability to interpret on which subsystems are used in the background of mobile communications systems and the relationship of these subsystems with each other. It is aimed to make the students enrolled in the program knowledgeable and equipped about today's communications systems and the related artificial intelligence applications. Within the scope of subsystems related to mobile communications systems, it is aimed to provide students with the basic knowledge expected to be acquired before developing algorithms. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | The course will contribute to the understanding, detection, interpretation and solution of the problems that may be encountered in the use of mobile communications systems and its artificial intelligence applications in today's technology industry. It will contribute to the acquisition of basic information about mobile communications systems, which are necessary for the development of novel ideas for academic research activities. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Developing the ability to comprehend general issues in the field of mobile communications systems and artificial intelligence, and to be aware of related applications (LO1, LO2)  2. Developing the ability to analyze the problems that may be encountered in the industry related to mobile communications systems and artificial intelligence, and to use the learned information (LO1, LO2)  3. Developing solutions by using different disciplines for mobile communications systems and artificial intelligence; gain the ability to produce innovative novel ideas (LO3, LO5)  4. Preparing a written report by reading example research publications in the literature and interpreting the related studies (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | R. He, Z. Ding (ed.), "Applications of Machine Learning in Wireless Communications", The Institution of Engineering and Technology, 2019, ISBN:9781785616570. | | | | | | | |
| **OTHER REFERENCES** | | | | | F-L. Luo, "Machine Learning for Future Wireless Communications", 2019, Wiley, ISBN:9781119562306.K. Suganthi, R. Karthik, G. Rajesh, P. H. C. Ching, "Machine Learning and Deep Learning Techniques in Wireless and Mobile Networking Systems", CRC Press, 2021, ISBN:9780367620066.H. Arslan, E. Başar (ed.), "Flexible and Cognitive Radio Access Technologies for 5G and Beyond", The Institution of Engineering and Technology, 2020, ISBN: 978-1-83953-079-1.N. Tripathi, J. H. Reed, "Cellular Communications: A Comprehensive and Practical Guide", Wiley, 2014, ISBN: 978-0470472071.Y. Akaiwa, "Introduction to Digital Mobile Communication", Wiley, 2015, ISBN: 978-1119041108.E. Dahlman, S. Parkvall, J. Skold, "5G NR: The Next Generation Wireless Access Technology", Academic Press, 2020, ISBN: 978-0128223208.A. Zaidi, F. Athley, J. Medbo, U. Gustavsson, G. Durisi, X. Chen, "5G Physical Layer: Principles, Models and Technology Components", Academic Press, 2018, ISBN: 978-0128145784.G. L. Stüber, "Principles of Mobile Communication", Springer, 2017, ISBN: 978-3319556147. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Course Introduction |
| 2 | Mobile Communications Topics – 1 |
| 3 | Mobile Communications Topics – 2 |
| 4 | Mobile Communications Topics – 3 |
| 5 | Mobile Communications Topics – 4 |
| 6 | Mobile Communications Topics – 5 |
| 7 | Fundamental Machine Learning Topics |
| 8 | Machine Learning Applications in Mobile Communications – 1 |
| 9 | Evaluation of All Homeworks |
| 10 | Students Presentations and Discussions (for the 1st Report) |
| 11 | Machine Learning Applications in Mobile Communications – 2 |
| 12 | Students Presentations and Discussions (for the 2nd Report) |
| 13 | Machine Learning Applications in Mobile Communications – 3 |
| 14 | Students Presentations and Discussions (for the 3rd Report) |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Dr. Öğretim Üyesi Ahmet Yazar | **Date:** | | 16/04/2022 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| --- | --- | --- | --- |
| **COURSE** | | | |
| **CODE** |  | **TITLE** | Network Programming |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | |  | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 20 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 4 | | 60 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 20 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | This course concentrates upon the use TCP/IP sockets to implement network-centric applications. The focus is on implementing client-server applications that talk over the TCP/IP protocol stack such as DNS/DHCP Clients Servers, Web Client/Servers, FTP Clients/Servers etc. Socket Interface exported by different programming languages such as C, Java and C# will be covered. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of this course, the students are expected to learn how to use the socket interface of different programming languages to implement client-server applications that work over the TCP/IP protocol. The focus will be on implementing these applications on the Linux OS, which would increase the students’ ability to use the Linux OS and implement code on it. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Implementing client-server programming enables the students to understand how the TCP/IP protocols really work and comes very handy in many applications. This course is ideal for students who want to extend their knowledge of computer networks and gain hands-on experience with the implementation application-layer protocols. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | At the end of this course, the student:  1.has a detailed knowledge of the TCP/IP Sockets  2. creates applications using techniques such as multiplexing, forking, multithreading  3. makes use of different types of I/O Models such as non-blocking I/O and event-driven programming  4.understands the key protocols that support the Internet  5. becomes familiar with several common programming interfaces for network communication  6. applies the knowledge of Unix/Linux operating systems to build robust client and server software for this environment  7. learns advanced programming techniques such as Broadcasting, Multicasting | | | | | | | |
| **TEXTBOOK** | | | | | Internetworking with TCP/IP: Client-Server Programming and Applications | | | | | | | |
| **OTHER REFERENCES** | | | | | Computer Networks: A Top-Down Approach Featuring the Internet, Jim Kurose, Keith Ross | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Review of the TCP/IP Protocol Stack |
| 2 | Socket Layer and Socket Data Structures |
| 3 | UDP Socket Programming |
| 4 | UDP Socket Programming |
| 5 | UDP Socket Programming |
| 6 | I/O Models |
| 7 | I/O Models |
| 8 | Midterm |
| 9 | TCP Socket Programming |
| 10 | TCP Socket Programming |
| 11 | TCP Socket Programming |
| 12 | Multicasting |
| 13 | Broadcasting |
| 14 | Daemons |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assoc. Prof. Dr. Cüneyt Akınlar | **Date:** | | 11/06/2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | New Generation Communications Technologies |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 0 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Examining the new generation technologies related to communications systems, developing the basic knowledge level that may be necessary to understand the research studies in this field, gaining a vision for the related fields in order to be able to make new research activities. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Students who pass the course successfully are expected to gain the ability to interpret on which technologies are used in the background of communications systems and the relationship of these technologies with each other. It is aimed to make the students enrolled in the program knowledgeable and equipped about today's new generation communications tecnologies. Within the scope of tecnologies related to communications systems, it is aimed to provide students with the basic knowledge expected to be acquired before developing algorithms. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | The course will contribute to the understanding, detection, interpretation and solution of the problems that may be encountered in the use of communications technologies in today's technology industry. It will contribute to the acquisition of basic information about new generation communications technologies, which are necessary for the development of novel ideas for academic research activities. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Developing the ability to comprehend general issues in communications technologies field and to be aware of related applications (LO1, LO2)  2. Developing the ability to analyze the problems that may be encountered in the industry related to new generation communications technologies and to use the learned information (LO1, LO2)  3. Developing solutions by using different disciplines for new generation communications technologies; gain the ability to produce innovative novel ideas (LO3, LO5)  4. Preparing a written report by reading example research publications in the literature and interpreting the related studies (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | H. Arslan, E. Başar (ed.), "Flexible and Cognitive Radio Access Technologies for 5G and Beyond", The Institution of Engineering and Technology, 2020, ISBN: 978-1-83953-079-1. | | | | | | | |
| **OTHER REFERENCES** | | | | | T. S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2001, ISBN: 978-0130422323.N. Tripathi, J. H. Reed, "Cellular Communications: A Comprehensive and Practical Guide", Wiley, 2014, ISBN: 978-0470472071.Y. Akaiwa, "Introduction to Digital Mobile Communication", Wiley, 2015, ISBN: 978-1119041108.E. Dahlman, S. Parkvall, J. Skold, "5G NR: The Next Generation Wireless Access Technology", Academic Press, 2020, ISBN: 978-0128223208.A. Zaidi, F. Athley, J. Medbo, U. Gustavsson, G. Durisi, X. Chen, "5G Physical Layer: Principles, Models and Technology Components", Academic Press, 2018, ISBN: 978-0128145784.G. L. Stüber, "Principles of Mobile Communication", Springer, 2017, ISBN: 978-3319556147. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | General overview to historical development of communications technologies |
| 2 | General overview to innovations in new generation communications technologies |
| 3 | General overview to standardization processes for communications technologies |
| 4 | New generation technologies for the flexible usage of radio spectrum - 1 |
| 5 | New generation technologies for the flexible usage of radio spectrum - 2 |
| 6 | New generation technologies for physical and MAC layers - 1 |
| 7 | New generation technologies for physical and MAC layers - 2 |
| 8 | Midterm |
| 9 | New generation technologies for heterogeneous networks - 1 |
| 10 | New generation technologies for heterogeneous networks - 2 |
| 11 | New generation technologies for integrated sensing and communications |
| 12 | New generation technologies for intelligent communications |
| 13 | New generation technologies for green communications |
| 14 | New generation technologies for secure communications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Dr. Öğretim Üyesi Ahmet Yazar | **Date:** | | 10/06/2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Mobile Communications Systems |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 0 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Examining the subsystems related to mobile communications systems, developing the basic knowledge level that may be necessary to understand the research studies in this field, gaining a vision for the related fields in order to be able to make new research activities. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Students who pass the course successfully are expected to gain the ability to interpret on which subsystems are used in the background of mobile communications systems and the relationship of these subsystems with each other. It is aimed to make the students enrolled in the program knowledgeable and equipped about today's communications systems. Within the scope of subsystems related to mobile communications systems, it is aimed to provide students with the basic knowledge expected to be acquired before developing algorithms. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | The course will contribute to the understanding, detection, interpretation and solution of the problems that may be encountered in the use of mobile communications systems in today's technology industry. It will contribute to the acquisition of basic information about mobile communications systems, which are necessary for the development of novel ideas for academic research activities. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Developing the ability to comprehend general issues in the field of mobile communications systems and to be aware of related applications (LO1, LO2)  2. Developing the ability to analyze the problems that may be encountered in the industry related to mobile communications systems and to use the learned information (LO1, LO2)  3. Developing solutions by using different disciplines for mobile communications systems; gain the ability to produce innovative novel ideas (LO3, LO5)  4. Preparing a written report by reading example research publications in the literature and interpreting the related studies (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | T. S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2001, ISBN: 978-0130422323. | | | | | | | |
| **OTHER REFERENCES** | | | | | H. Arslan, E. Başar (ed.), "Flexible and Cognitive Radio Access Technologies for 5G and Beyond", The Institution of Engineering and Technology, 2020, ISBN: 978-1-83953-079-1.N. Tripathi, J. H. Reed, "Cellular Communications: A Comprehensive and Practical Guide", Wiley, 2014, ISBN: 978-0470472071.Y. Akaiwa, "Introduction to Digital Mobile Communication", Wiley, 2015, ISBN: 978-1119041108.E. Dahlman, S. Parkvall, J. Skold, "5G NR: The Next Generation Wireless Access Technology", Academic Press, 2020, ISBN: 978-0128223208.A. Zaidi, F. Athley, J. Medbo, U. Gustavsson, G. Durisi, X. Chen, "5G Physical Layer: Principles, Models and Technology Components", Academic Press, 2018, ISBN: 978-0128145784.G. L. Stüber, "Principles of Mobile Communication", Springer, 2017, ISBN: 978-3319556147. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | General overview to historical development of mobile communications systems |
| 2 | General overview to biological and sociological effects of mobile communications systems |
| 3 | General overview to applications that need mobile communications systems |
| 4 | General overview to different standardizations for mobile communications systems |
| 5 | General overview to effects of 5G networks for mobile communications systems |
| 6 | General overview to the current situation in Turkey for mobile communications systems |
| 7 | General overview to possible 6G developments for mobile communications systems |
| 8 | Midterm |
| 9 | General overview to design development processes for mobile communications systems |
| 10 | General overview to cellular concept for mobile communications systems |
| 11 | General overview to wireless channel and interference issues for mobile communications systems |
| 12 | General overview to the usage of non-terrestrial platforms for mobile communications systems |
| 13 | General overview to the current basic technologies and concepts for mobile communications systems |
| 14 | General overview to the future innovational technologies and concepts for mobile communications systems |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Dr. Öğretim Üyesi Ahmet Yazar | **Date:** | | 07/06/2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Heuristic Algorithms |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Türkçe |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
|  | | 3 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 30 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Use of heuristics in optimization problems, classification of heuristics methods and common concepts, software and programs for heuristics, nature-inspired/physics-inspired heuristic algorithms | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aim of this course is to examine in detail the heuristic algorithms that are frequently used in optimization problems and to teach them in a way that can be applied to real life problems. Students are expected to learn the working principles of heuristic algorithms and choose the right algorithms when they encounter different problems. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | This course will contribute to students in recognizing the problem, determining the appropriate solution methods, and determining the most accurate method by comparing the results of the algorithms they have chosen. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1-) Students can explain the concepts of what optimization is, in which situations it is needed, what is achieved as a result of optimization.  2-) Students explain the classification of heuristic algorithms, similarities and differences between them.  3-) Students can compare heuristic algorithms, identify and explain their weaknesses and strengths.  4-) Students know which heuristic algorithm will give better results in a real life problem and can choose the appropriate heuristic algorithm and apply it to the related problem. | | | | | | | |
| **TEXTBOOK** | | | | | Mykel J. Kochenderfer, Tim A. Wheeler, "Algorithms for Optimization", MIT Press, 2019 | | | | | | | |
| **OTHER REFERENCES** | | | | | 1) Ke-Lin Du, M. N. S. Swamy, "Search and Optimization by Metaheuristics:Techniques and Algorithms Inspired by Nature", Birkhäuser Basel, 20162) A.Vasuki, "Nature Inspired Optimization Algorithms", CRC Press, 20203) Zbigniew Michalewicz, David B. Fogel, "How to Solve It: Modern Heuristics", Springer, 2004 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Definition of optimization, application areas, basic methods, heuristic approach |
| 2 | Grey Wolf Optimization |
| 3 | The Firefly Algorithm |
| 4 | Big Bang-Big Crunch Optimization |
| 5 | Flower Pollination Algorithm |
| 6 | The Bat Algorithm |
| 7 | Cuckoo Search Algorithm |
| 8 | Midterm |
| 9 | Butterfly Optimization Algorithm |
| 10 | Harris Hawks Optimization |
| 11 | Crow Search Algorithm |
| 12 | Genetic Programming |
| 13 | Genetic Programming |
| 14 | Project Presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Asst. Prof. Dr. Emrah ATILGAN | **Date:** | | June 09, 2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 0 | **TITLE** | Advanced Software Testing |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | |  |  | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 10 |
| Project | | | | | 1 | | 35 |
| Report | | | | | 1 | | 15 |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction to Software Testing, software quality assurance concepts and commonly used methods and tools. Test-driven software development, simulation and model-based software testing, verification and validation stages, workflow planning and design, evaluation scenario and criteria definition, potential applications of software testing in this field. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the student is expected to understand methods, tools, techniques, solutions in software testing and be familiar with new application areas in the industry. In addition, they are expected to be able to analyze, model and solve problems shown in the light of some taught methods and tools. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Gaining ability to offer solutions to the problems that may be encountered in today's industry are software testing, software quality assurance, etc. be able to transfer, model and find solutions in computer environment by using trend approaches | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Becoming aware of the concepts and domain applications in the field of software testing, gaining ability to be able to use it effectively in the field (LO2)  2. By combining the fundamental concepts and theory taught in the class, developing novel ideas and methods to the problems faced in today's industry and gaining practical ability to implement (LO1, LO2)  3. By assigned in-class projects, gaining ability to study in a multi-disciplinary/single discipline team and practice teamwork or carrying individual work and taking responsibility and ownership of the assigned work. At the same time, aweraness in project and timeline management (LO4, LO5, LO86)  4. Articulating study results, interpreting, evaluating and critisizing them eventually reporting and defending both in written and verbal forms (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship 1st Edition, ASIN : 0132350882, , Publisher : Pearson; 1st edition (August 1, 2008), ISBN-10 : 9780132350884, ISBN-13 : 978-0132350884 | | | | | | | |
| **OTHER REFERENCES** | | | | | Foundations of Software Testing ISTQB Certification, 4th edition 4th edition, Publisher : Cengage Learning EMEA; 4th edition (August 9, 2019), ISBN-10 : 1473764793, ISBN-13 : 978-1473764798Liliana Iancu, QA Quality Assurance & Software Testing Fundamentals, Publisher : Independently published (March 29, 2019), ISBN-10 : 1091993920, ISBN-13 : 978-1091993921https://www.turkishtestingboard.org/en/about-istqb-exams/ | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Software Testing Overview |
| 2 | Software Testing Concepts |
| 3 | Software Verification and Validation Lifecycle |
| 4 | Software Verification and Validation Framework |
| 5 | Software Verification and Validation Workflow Planning and Design |
| 6 | Software Testing Techniques (White / Black Box and Experience Driven) |
| 7 | Software Testing Management, Organization, Monitoring, Control and Fault Management |
| 8 | Midterm |
| 9 | Software Testing Methods and Tools Overview |
| 10 | Software Testing Methods |
| 11 | Software Testing Tools |
| 12 | Simulation Based Testing |
| 13 | Mutation Based Testing |
| 14 | In-class research and application project presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assistant Prof. Uğur YAYAN | **Date:** | | 08.06.2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 0 | **TITLE** | Robotic Middleware and Simulaton Environments |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | |  |  | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | | 1 | | 10 |
| Project | | | | | 1 | | 35 |
| Report | | | | | 1 | | 15 |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Robotic, middleware, publisher/subscriber architecture, client/service architecture, robot operating system, ros commands, robotic software verification and validation, autonomous robots, mobile robots, robotic manipulators, basic linux, basic python and applications in industry | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the student is expected to understand methods, tools, techniques, middleware, environments and solutions in robotics and be familiar with new application areas in the industry. In addition, they are expected to be able to analyze, model and solve problems shown in the light of some taught methods and tools. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Gaining ability to offer solutions to the problems that may be encountered in today's industry are robotic middleware and simulation environments etc. be able to transfer, model and find solutions in computer environment by using trend approaches | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Becoming aware of the concepts and domain applications in the field of robotic middleware and simulation environments, gaining ability to be able to use it effectively in the field (LO2)  2. By combining the fundamental concepts and theory taught in the class, developing novel ideas and methods to the problems faced in today's industry and gaining practical ability to implement (LO1, LO2)  3. By assigned in-class projects, gaining ability to study in a multi-disciplinary/single discipline team and practice teamwork or carrying individual work and taking responsibility and ownership of the assigned work. At the same time, aweraness in project and timeline management (LO4, LO5, LO86)  4. Articulating study results, interpreting, evaluating and critisizing them eventually reporting and defending both in written and verbal forms (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | Uğur Yayan, Hikmet Yücel, Abdullah Taha Arslan, Hakan Gençtürk, Adım Adım Uygulamalı ROS ile Robot Programlama (Robot İşletim Sistemi), Seçkin Yayıncılık, Eylül 2020, ISBN 978-975-02-6146-6 | | | | | | | |
| **OTHER REFERENCES** | | | | | Lentin Joseph and Jonathan Cacace, Mastering ROS for Robotics Programming - Second Edition: Design, build, and simulate complex robots using the Robot Operating System 2nd Revised edition, ‎ Packt Publishing, ISBN-10 ‏ : ‎ 1788478959, ISBN-13 ‏ : ‎ 978-1788478953by Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, Lentin Joseph, ROS Programming: Building Powerful Robots: Design, build and simulate complex robots using the Robot Operating System, Packt Publishing; 1st edition, ASIN ‏ : ‎ B07BGBR7LXhttp://wiki.ros.org/ROS/Tutorials | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Robotic Middlewares Overview |
| 2 | Simulation Environment Overview |
| 3 | Robot Operating System (ROS) |
| 4 | Preparation of Ubuntu and ROS Environment |
| 5 | Publisher / Subscriber Architecture |
| 6 | Service / Client Architecture |
| 7 | ROS and Linux Commands |
| 8 | Midterm |
| 9 | ROS Tools |
| 10 | GAZEBO Simulation Environment |
| 11 | World Modelling in GAZEBO |
| 12 | Robot Modelling in GAZEBO |
| 13 | Mobile Robot Application via ROS and GAZEBO |
| 14 | In-class research and application project presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assistant Prof. Uğur YAYAN | **Date:** | | 14.06.2021 | | | |

**Signature**:

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ESKISEHIR OSMANGAZI UNIVERSITY GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** | Fall |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Data Analysis and Statistics |

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| **LEVEL** | **HOUR/WEEK** | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | |
| **MSc** | 3 | | 0 | 0 | | 3 | 7,5 | COMPULSORY  ( ) | | ELECTIVE  ( x ) | TR |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with ()]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | **Number** | | **Contribution ( % )** |
| Midterm | | | | 1 | | 20 |
| Quiz | | | |  | |  |
| Homework | | | | 2 | | 10 |
| Project | | | | 1 | | 30 |
| Report | | | |  | |  |
| Seminar | | | |  | |  |
| Other ( ) | | | |  | |  |
| **Final Examination** | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Data Analysis and Statistics focuses on data and algorithms that form the basis of data science. In this course, statistical and mathematical foundations of algorithms are explained. Within the scope of data analysis and visualization, programming languages such as Python, R and Matlab are taught in practice. On the algorithm side, data preparation and reduction techniques, data representation, basic data science methods and data mining algorithms are explained. Within the scope of the course, a better understanding of algorithms will be provided by working on real data. | | | | | | |
| **COURSE OBJECTIVES** | | | | | One of the aim of the course is to train Data Scientists who have the latest information, concepts, data processing and analysis techniques in the field of data analysis, who can contribute to the sector applications with their acquired competencies, who are open to entrepreneurship and adopt teamwork. The infrastructure of the algorithms described in the field of Data Science and Statistics will be comprehended. | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Developing experts in data analysis and statistics and conducting studies in this field. | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Concept the basic principles of data analysis (LO: 1) 2. Comprehending how the knowledge learned within the scope of data analysis can be applied in information and computer systems (LO: 4, 8) 3. Following the latest developments in the field of data analysis (LO: 2) 4. Access to the expertise of each student about the subjects covered in the course with the given student projects (LO: 1, 2, 4, 6, 7, 8, 9) | | | | | | |
| **TEXTBOOK** | | | | | * Nisbet, R., Elder, J., & Miner, G. (2009). Handbook of statistical analysis and data mining applications. Academic Press. | | | | | | |

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| **OTHER REFERENCES** | * Arnholt, A. T. (2007). Statistics: The art and science of learning from data. * Everitt, B. S., & Hothorn, T. (2006). A handbook ofstatistical analyses using R. Chapman & Hall, Boca Raton, FL. * Maimon, O., & Rokach, L. (Eds.). (2005). Data mining and knowledge discovery handbook. * Glen, C. (1998). Statistical Data Analysis, Clarendon Press Oxford. |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Fundamentals of Data Analysis |
| 2 | Data Visualization |
| 3 | Introduction to Probability and Probability Distributions |
| 4 | Statistics for Data Analysis |
| 5 | Introduction to Statistics |
| 6 | ANOVA and Chi-square Analysis |
| 7 | Data Preprocessing |
| 8 | Midterm |
| 9 | Regression Methods |
| 10 | Supervised Learning Methods |
| 11 | Unsupervised Learning Methods |
| 12 | Data Science Project Lifecycle |
| 13 | Student Projects |
| 14 | Student Projects |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | **3**  High | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. |  |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyses and learn new applications. |  |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. |  |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. |  |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. |  |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently |  |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. |  |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. |  |  |  |
| **LO9** | Advanced level of Professional and ethical responsibility. |  |  |  |

**Prepared by :** Asst. Prof. Dr. Sinem BOZKURT KESER **Date:** 08/06/2021

**Signature**:

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**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | Deep Learning Applications |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | | 2 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | | 10 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | | 40 |
| Project | | | | |  | | 20 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Understanding the fundamentals of deep learning: learning basics of neural networks, convolutional networks, recurrent networks, deep learning architectures on health, military and agriculture, deep learning implementing libraries (Keras, Tensorflow, Pytorch). | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To cover the essentials of Deep Learning for image, signal and text processing, implementing the creative deep learning models. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Learning the difference between deep learning and traditional methods , analyzing performance and contrubutions to deep learning architectures | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Analyzing the weakness of traditional machine learning algorithms,  2. Understand new Convolutional Neural Network (CNN) Model Creation,  3. Understand hyperparameters of CNN  4. Understand CNN models for text classification,  5. Understand CNN models for image classification,  6. Examine components of convolutional neural networks,  7. Introduce Recurrent Neural Networks,  8. Understand transformer models. | | | | | | | |
| **TEXTBOOK** | | | | | https://d2l.ai/ | | | | | | | |
| **OTHER REFERENCES** | | | | | github | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Hand Crafted Features and Problems |
| 2 | Linear Classification:Percepton |
| 3 | Back-Propagation: Stochastic Gradient Descent |
| 4 | Multi-Layer Neural Network |
| 5 | Convolutional Neural Network (CNN) |
| 6 | CNN Settings |
| 7 | Recurrent Neural Networks |
| 8 | Midterm Examination |
| 9 | CNN Types: Classification |
| 10 | CNN Types: Text Classification |
| 11 | CNN Types: Segmentation |
| 12 | CNN Types: Object Detection |
| 13 | Performans Analysis and Problems |
| 14 | Proje Sunumlar |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Dr. Öğr. Üyesi Şahin Işık | **Date:** | | 03-06-2021 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503001508 | **TITLE** | Machine Learning and Anomaly Detection |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | |  |  | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | |  | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 25 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 35 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Introduction to machine learning, data analytics and commonly used algorithms in the field. With data-oriented approaches intelligent anomaly and fault detection methods, their applications in manufacturing and industry | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, it is expected students having an understanding and similarity to algorithms, techniques and software solutions in the field of machine learning, anomaly detection and diagnosis applications. In addition, in the light of methods and context taught in the class, it is expected that students gain ability to model and solve real world problems in the field. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Gaining ability to offer solutions to the problems faced in today's industry by utilizing trend approaches via tranfering and modelling in computer environment with state-of-the-art tools | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Becoming aware of the concepts and domain applications in the field of machine learning and anomaly detection, gaining ability to be able to use it effectively in the field (LO2)  2. By combining the fundamental concepts and theory taught in the class, developing novel ideas and methods to the problems faced in today's industry and gaining practical ability to implement (LO1, LO2)  3. By assigned in-class projects, gaining ability to study in a multi-disciplinary/single discipline team and practice teamwork or carrying individual work and taking responsibility and ownership of the assigned work. At the same time, aweraness in project and timeline management (LO4, LO5, LO86)  4. Articulating study results, interpreting, evaluating and critisizing them eventually reporting and defending both in written and verbal forms (LO7) | | | | | | | |
| **TEXTBOOK** | | | | | K. Mehrotra, C. Mohan, H. Huang, Anomaly Detection Principles and Algorithms, Springer, 2017, ISBN: 21978786 | | | | | | | |
| **OTHER REFERENCES** | | | | | Charu Aggarwal, Outlier Analysis: The Textbook, Springer-Verlag, 2015, ISBN: 9783319475783.M. G. Pecht, M. Kang , Prognostics and Health Management of Electronics : Fundamentals, Machine Learning, and the Internet of Things, Wiley, 2018 ISBN: 9781119515302T. Dunning, E. Friedman, Practical Machine Learning: A New Look at Anomaly Detection, O'Reilly, 2014, ISBN: 9781491911600 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction to machine learning and anomaly detection applications |
| 2 | Machine learning: a general outlook to concepts and methods |
| 3 | Introduction to feature extraction, data cleaning and fundamental signal pre-processing methods |
| 4 | Distance based machine learning methods |
| 5 | Clustering based machine learning methods |
| 6 | Midterm |
| 7 | Classification based machine learning methods |
| 8 | Algorithms for time series data |
| 9 | Machine learning: Diagnosis and Prognostics |
| 10 | Introduction to data driven prognistics modelling and predictive maintenance methods |
| 11 | Remaining useful life and health prediction modelling and its applications |
| 12 | In-class research and application project presentations |
| 13 | In-class research and application project presentations |
| 14 | In-class research and application project presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assistant Prof. Eyup Cinar | **Date:** | |  | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING(MSc)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503002509 | **TITLE** | GRAPH ALGORITHMS |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **MSc** | 3 | | 0 | 0 | | |  |  | COMPULSORY  (   ) | | ELECTIVE  ( x ) | TURKISH |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 40 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 60 |
| **PREREQUISITE(S)** | | | | | Students must have taken the compulsory Algorithm Design and Analysis course | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | This course covers graph algorithms. Representation of graphs, graph traversal algorithms, topological sort, minimum-spanning trees, shortest-path algorithms, NP-complete graph algorithms and their approximation algorithms will be covered. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of this course, the students are expected to learn basic graph algorithms and apply them in solving new problems. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Graph algorithms are used in modelling and solving many practical problems. With the experience gained in this course, students will learn how to model a new problem as a graph problem and solve it using standard graph algorithms. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Please write minimum four learning outcomes for the course. | | | | | | | |
| **TEXTBOOK** | | | | | At the end of this course, the student: 1.knows graph representation and applications 2.computes the complexity of graph algoritms 3.learns basic graph algorithms 4.explains how to model a new problem as a graph problem | | | | | | | |
| **OTHER REFERENCES** | | | | | 1. Introduction to Algorithms, Cormen, Lieserson, Rivest, Stein 2. Data Structures and Algorithm Analysis, Mark Allen Weiss | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Graph: Representation, Applications |
| 2 | Graph traversal algorithms: BFS, DFS |
| 3 | Topological Sort, Articulation Points (or Cut vertices) |
| 4 | Strongly Connected Components |
| 5 | Euler Path and Circuit |
| 6 | Minimum Spanning Trees: Kruskal’s Algorithm and Union-Find Data Structure |
| 7 | MIDTERM |
| 8 | Minimum Spanning Trees: Prim’s Algorithm |
| 9 | Shortest Path Algorithms: Single Source Shortest Path and Dijkstra’s Algorithm |
| 10 | All-Pairs Shortest Path Algorithm: Floyd-Warshall Algorithm |
| 11 | Network Flow Problems: Max-Flow, Min-Cut |
| 12 | NP-Complete Graph Problems: Clique, Vertex-Cover, |
| 13 | NP-Complete Graph Problems: Hamiltonian Path, Travelling Salesman Problem |
| 14 | NP-Complete Graph Problems: Graph Coloring and Partitioning |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING MSc PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (MSc)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to reach, evaluate, interpret, and apply knowledge in depth in the field of Computer Engineering through scientific research. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to analyse and learn new applications. | | |  | |  |  |
| **LO3** | Ability to complete vague, limited or missing data using scientific methods and ability to use information from different disciplines. | | |  | |  |  |
| **LO4** | Ability to identify and solve Computer Engineering problems. | | |  | |  |  |
| **LO5** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO6** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO7** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO8** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project Management. | | |  | |  |  |
| **LO9** | Advanced level of Professional and ethical responsibilty. | | |  | |  |  |
| **Prepared by :** | | | Assoc. Prof. Dr. Cüneyt Akınlar | **Date:** | | 12/11/2019 | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503012606 | **TITLE** | Neural Networks and Deep Learning |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | |  | |  |
| Quiz | | | | |  | |  |
| Homework | | | | | 6 | | 30 |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | Calculus I, Linear Algebra, Probability and Statistiscs, Python Programming | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Learning fundamental concepts of Neural Networks and Deep Learning. Starting from the basic Neural Networks components, applying various techniques during training and testing process. Furthermore, learning modern deep learning architectures including contemprary research work in the literature and gaining ability to implement them. Investigation and Discussion of Advanced Neural Network and Deep Learning architectures such as Graph Graph Convolutional Networks, Deep Generative Models and Deep Reinforcement Learning | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Increasing knowledge level of the student in widely used Neural Networks and Deep Learning models and gaining ability to read and comprehend the recent research work from the literature. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Especially for a Ph.D. level engineer's R&D oriented job responsibilities, this course contributes to the student's knowledge level by proving exposure to a very active research field. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Expresses fundamental concepts in Neural Networks and Deep Learning (LO2)  2. The student develops new or original methods by critically analyzing a recently published research paper in the field (LO3) | | | | | | | |
| **TEXTBOOK** | | | | | I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.Michael Nielsen, Neural Network and Deep Learning, 2019 | | | | | | | |
| **OTHER REFERENCES** | | | | | C. Aggarwal, Neural Networks and Deep Learning, Springer, 2018 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Introduction, Linear Models |
| 2 | Perceptron, Multi Layer Perceptron and Feedforward Neural Networks |
| 3 | Backpropagation and SGD algorithm |
| 4 | Machine Learning Basics |
| 5 | Neural Networks Train, Test and Regularization Tecniques |
| 6 | Midterm Week |
| 7 | Convolutional Neural Networks (CNNs) |
| 8 | Sequence Models (RNN, GRU, LSTM) |
| 9 | Graph Convolutional Networks I |
| 10 | Graph Convolutional Networks II |
| 11 | Deep Generative Models I |
| 12 | Deep Generative Models II |
| 13 | Deep Reinforcement Learning I |
| 14 | Deep Reinforcement Learning II |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Computer Engineering and other related areas. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to learn and apply new methods. | | |  | |  |  |
| **LO3** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO4** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO5** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO6** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and, ability to make critical analysis and evaluation of new ideas and developments. | | |  | |  |  |
| **LO7** | Advanced level of Professional and ethical responsibility. | | |  | |  |  |
| **Prepared by :** | | | Asst. Prof. Dr. Eyup Cinar | **Date:** | |  | | | |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **COMPUTER ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503012605 | **TITLE** | Data Privacy |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **Credit** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **Practice** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7.5 | COMPULSORY  (   ) | | ELECTIVE  ( X ) | Turkish |
| **CREDIT DISTRIBUTION** | | | | | | | | | | | | |
| **Basic Science** | | **Basic Engineering** | | | | **Knowledge in the discipline**  **[if it contains considerable design content, mark with (√)]** | | | | | | |
| 1 | | 2 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **Evaluation Type** | | | | | **Number** | | **Contribution**  **( % )** |
| Midterm | | | | | 1 | | 20 |
| Quiz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | | 1 | | 10 |
| Seminar | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **Final Examination** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | - | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Privacy is a broad topic that encompasses many disciplines, stakeholders and concerns. This course addresses the intersection of data privacy and information technology. In this context, it includes many topics such as the history and need of privacy, privacy risks and damages, laws, policies and practices for privacy, privacy in the Internet of Things, networks and privacy, information security and corporate privacy management, privacy in big data, privacy in current technologies. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | • To increase knowledge on personal data privacy;  • To identify situations where data is sensitive, assess risks and describe how various stakeholders can respond to these risks;  • To explain how to minimize privacy breaches throughout the data lifecycle (from collection to distribution);  • To introduce concepts and methods for creating privacy-protected technologies and policies;  • To teach to produce both theoretical and practical solutions to the problems that may be encountered in these subjects; | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Developing experts on data security and privacy, and carrying out studies to protect data and ensure its privacy in the digital environment for information security. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | P1. To be able to comprehend the basic principles and requirements for data privacy (LO:1)  2. To be able to analyze a system in terms of data privacy (LO:2)  3. To be able to compare different environments and technologies in terms of data privacy and evaluate the results (LO:1, 2)  4. To be able to review scientific articles in the field of data privacy and to be aware of the resources where they can follow the latest developments in the field (LO:2)  5. Ability to define, develop and implement privacy requirements for a system (LO:3,4)  6. With the project, each student can access expertise on a subject related to the subject of the course (LO:1,2,3,4,6) | | | | | | | |
| **TEXTBOOK** | | | | | Course HandoutsReading material and papers will be provided | | | | | | | |
| **OTHER REFERENCES** | | | | | Sharma, Sudhir Kumar, et al., eds. Blockchain Technology for Data Privacy Management. CRC Press, 2021.Gkoulalas-Divanis, Aris, and Claudio Bettini, eds. Handbook of Mobile Data Privacy. Springer International Publishing, 2018.Palmatier, Robert W., and Kelly D. Martin. The intelligent marketer's guide to data privacy: The impact of big data on customer trust. Cham, Switzerland: Springer International Publishing, 2019.Choo, Kim-Kwang Raymond, and Ali Dehghantanha, eds. Handbook of Big Data Privacy. Springer, 2020. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Personal data and privacy |
| 2 | Privacy risks and harms |
| 3 | International data privacy laws |
| 4 | Data privacy in Turkey |
| 5 | Privacy and Big Data |
| 6 | Privacy in the Internet of Things |
| 7 | Privacy in web and mobile applications |
| 8 | Midterm Exam |
| 9 | Privacy preserving machine learning |
| 10 | Privacy in data collection/data mining |
| 11 | Privacy in e-payment and e-voting |
| 12 | Data privacy in social networks |
| 13 | Project Presentations |
| 14 | Project Presentations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE COMPUTER ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | | | **CONTRIBUTION LEVEL** | | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | | | **3**  High | | **2**  Mid | **1**  Low |
| **LO1** | Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Computer Engineering and other related areas. | | |  | |  |  |
| **LO2** | Having extensive knowledge about contemporary techniques and methods applied in engineering, and ability to learn and apply new methods. | | |  | |  |  |
| **LO3** | Developing new and original ideas and methods; ability to develop innovative/alternative solutions in systems, component or process design. | | |  | |  |  |
| **LO4** | Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently an taking responsibility. | | |  | |  |  |
| **LO5** | Use a foreign language at an advanced level, and ability to communicate in oral and written forms. | | |  | |  |  |
| **LO6** | Awareness of social, environmental, health, safety, and legal issues of engineering applications and, ability to make critical analysis and evaluation of new ideas and developments. | | |  | |  |  |
| **LO7** | Advanced level of Professional and ethical responsibility. | | |  | |  |  |
| **Prepared by :** | | | Esra N. YOLAÇAN | **Date:** | | 09/11/2022 | | | |

**Signature**: