**ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAMME**

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| **FIrst Year** | | | | | | |
| **I. Semester** | | | | | | |
| Code | Course TItle | ECTS | T+P | CredIt | C/E | Language |
| 501001101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#EN50) | 7.5 | 3+0+0 | 3 | **C** | TurkIsh |
| 503111611 | [LINEAR SYSTEM THEORY](#EN46) | 7.5 | 3+0+0 | 3 | **C** | TurkIsh |
|  | ElectIve Course-1 | 7.5 | 3+0+0 | 3 | E | TurkIsh |
|  | ElectIve Course-2 | 7.5 | 3+0+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+0 | 3 | E | TurkIsh |
|  | ElectIve Course-4 | 7.5 | 3+0+0 | 3 | E | TurkIsh |
|  | ElectIve Course-5 | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112001 | PhD SemInar | 7.5 | 0+1+0 | - | **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 | |
| 503111801 | | PhD PROFICIENCY | 30 | 0+1+0 | - | **C** | TurkIsh | |
|  | | Total of III. Semester | 30 |  |  |  |  | |
| **IV. Semester** | | | | | | | | |
| Code | Course TItle | | ECTS | T+P | CredIt | C/E | Language |
| 501011102 | THESIS PROPOSAL | | 30 | 0+1+0 | **-** | **C** | TurkIsh |
|  | Total of IV. Semester | | 30 |  |  |  |  | |
|  | TOTAL OF SECOND YEAR | | 60 |  |  |  |  |

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| **ThIrd Year** | | | | | | | |
| **V. Semester** | | | | | | | | |
| Code | | Course TItle | ECTS | T+P | CredIt | C/E | Language | |
| 503111802 | | PhD THESIS STUDY | 25 | 0+1+0 | - | **C** | TurkIsh | |
| 503111803 | | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | - | **C** | TurkIsh | |
|  | | Total of V. Semester | 30 |  |  |  |  | |
| **VI. Semester** | | | | | | | | |
| Code | Course TItle | | ECTS | T+P | CredIt | C/E | Language |
| 503111802 | PhD THESIS STUDY | | 25 | 0+1+0 | - | **C** | TurkIsh |
| 503111803 | SPECIALIZATION FIELD COURSE | | 5 | 3+0+0 | - | **C** | TurkIsh |
|  | | Total of VI. Semester | 30 |  |  |  |  | |
|  | TOTAL OF THIRD YEAR | | 60 |  |  |  |  |

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| **Fourth Year** | | | | | | |
| **VII. Semester** | | | | | | |
| Code | Course TItle | ECTS | T+P | CredIt | C/E | Language |
| 503111802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | TurkIsh |
| 503111803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | **-** | **C** | TurkIsh |
|  | Total of VII. Semester | 30 |  |  |  |  |
| **VIII. Semester** | | | | | | |
| Code | Course TItle | ECTS | T+P | CredIt | C/E | Language |
| 503111802 | PhD THESIS STUDY | 25 | 0+1+0 | **-** | **C** | TurkIsh |
| 503111803 | SPECIALIZATION FIELD COURSE | 5 | 3+0+0 | - | **C** | TurkIsh |
|  | Total of VIII. Semester | 30 |  |  |  |  |
|  | TOTAL OF FOURTH YEAR | 60 |  |  |  |  |

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| **ElectIve Courses** | | | | | | |
| Code | Course TItle | ECTS | T+P | CredIt | C/E | Language |
| 503112616 | [BIOMEDICAL SIGNAL PROCESSING AND MODELLING](#EN57) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112617 | [MACHINE LEARNING FOR COMPUTER VISION APPLICATIONS](#EN58) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112618 | [NONLINEAR PROGRAMMING FOR ENGINEERING SCIENCES](#EN56) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111601 | [SEMICONDUCTOR SOLAR CELLS](#EN44) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111602 | [OPTIMAL POWER SYSTEM OPERATION I](#EN37) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111603 | [ROBOT MOTION PLANNING I](#EN40) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111604 | [IMAGE RESTORATION](#EN29) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111605 | [POWER ELECTRONICS I](#EN31) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111606 | [PLANNING IN INTELLIGENT SYSTEMS](#EN3) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111607 | [MOBILE ROBOTS I](#EN34) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111608 | [ADAPTIVE CONTROL SYSTEMS](#EN43) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111609 | [MODERN CONTROL THEORY I](#EN35) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111610 | [BIOMEDICAL PATTERN RECOGNITION](#EN4) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503111612 | [DIGITAL COMMUNICATION COMPONENTS USING FPGA](#EN47) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112601 | [IMAGE AND DATA COMPRESSION](#EN30) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112602 | [OPTIMIZATION AND CONTROL](#EN38) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112603 | [MULTI ROBOT SYSTEMS](#EN7) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112604 | [NONLINEAR PROGRAMMING](#EN8) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112605 | [MULTI AGENT SYSTEMS](#EN6) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112606 | [SEMICONDUCTOR POWER DEVICES](#EN2) | 7.5 | 3+0+0 | 3 | E | TR-EN |
| 503112607 | [OPTIMAL POWER SYSTEM OPERATION II](#EN36) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112608 | [CONTROL OF ROBOTIC MANIPULATORS](#EN5) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112609 | [PARALLEL PROGRAMMING](#EN39) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112610 | [SPEECH RECOGNITION WITH HMM](#EN42) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112611 | [POWER ELECTRONICS II](#EN32) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112613 | [ROBOTICS](#EN41) | 7.5 | 3+0+0 | 3 | E | TurkIsh |
| 503112615 | [DIFFRACTION THEORY](#EN33) | 7.5 | 3+0+0 | 3 | E | TurkIsh |

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111606 | **TITLE** | PLANNING IN INTELLIGENT SYSTEMS |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | | 6 | | 30 |
| Project | | | | | 1 | | 40 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | |  |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon, BasIc Concepts, Problems and solutIons, Knowledge RepresentatIon, PlannIng, LearnIng, ApplIcatIons of AI, ModelIng PhysIcal Systems, Route PlannIng for Autonomous VehIcles | | | | | | | |
| **COURSE OBJECTIVES** | | | | | At the end of the course, the partIcIpant Is expected to understand the basIc concepts of IntellIgent Systems. AddItIonally, It Is expected to model and solve some realworld problems usIng the methods In the IntellIgent systems. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ModelIng some real world problems to solve In computer envIronment usIng ArtIfIcIal IntellIgence AlgorIthms. AbIlIty to solve the problems as a member of teams. PresentIng the results of the problem solutIons In oral and wrItten form. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.AbIlIty to defIne basIc concepts related IntellIgent Systems.  2. DIstInguIsh problems and envIronment types.  3. ModelIng and sImulatIon of some problems related to ArtIfIcIal IntellIgence.  4. Propose solutIon method for the problems.  5. Transfer both the model and solutIon of the problem Into computer envIronment.  6. CombIne the results of the studIes, comments on them, dIscuss In the team, and report the results.  7. Present and defense the studIes. | | | | | | | |
| **TEXTBOOK** | | | | | Russell and P. NorvIg, "ArtIfIcIal IntellIgence A Modern Approach", Second EdItIon, PrentIce Hall, 2002. | | | | | | | |
| **OTHER REFERENCES** | | | | | H. Choset, K. M. Lynch, S. HutchInson, G. Kantor, W. Burgard, L. E. KavrakI and S. Thrun, PrIncIples of Robot MotIon: Theory, AlgorIthms, and ImplementatIons, MIT Press, Boston, 2005 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon to IntellIgent Systems |
| 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 | ModelIng PhysIcal Systems: KInematIc and DynamIc Models |
| 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 ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. Ahmet Yazıcı | **Date:** | 11.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111610 | **TITLE** | BIOMEDICAL PATTERN RECOGNITION |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Pattern RecognItIon (PR) technIques are wIdely used for medIcal applIcatIons for a long tIme. ThIs course wIll Introduce the most frequently preferred PR technIques In bIomedIcal sIgnal classIfIcatIon studIes. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The objectIve of thIs course Is fIrst to make student famIlIar wIth general approaches such as Bayes ClassIfIcatIon, Nearest NeIghbor Rule, PrIncIpal Component AnalysIs and later to concentrate on more often used modern classIfIcatIon technIques such as Support Vector MachInes and 2D subspace-based classIfIers for solvIng bIomedIcal problems. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ThIs course, In partIcular, wIll provIde a dIfferent perspectIve to the engIneers who work In the fIeld of bIomedIcal career. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | To Introduce the fundamental descrIptIons and basIc concepts of pattern classIfIcatIon,  To learn how to use MATLAB software In pattern recognItIon applIcatIons,  To understand the basIc and advanced 1-D classIfIers,  To be Informed of classIcal and modern 2-D classIfIers,  To Introduce 1-D bIomedIcal sIgnals (ECG, EMG, etc.) and InvestIgate theIr characterIstIcs,  To Introduce 2-D bIomedIcal sIgnals (DIgItal Mammography, CT Images, etc.) and InvestIgate theIr characterIstIcs,  To learn the operatIon of pattern recognItIon methods used In the bIomedIcal sIgnal classIfIcatIon studIes. | | | | | | | |
| **TEXTBOOK** | | | | | Sepulveda, F. and PolI, R. (2013). IntellIgent BIomedIcal Pattern RecognItIon: A PractIcal GuIde. SprInger-Verlag (SAE), BerlIn, Germany. | | | | | | | |
| **OTHER REFERENCES** | | | | | Duda, R.O., Hart, P.E., and Stork D.G. (2001). Pattern ClassIfIcatIon. John WIley and Sons, New York, USA. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon to Pattern ClassIfIcatIon: DefInItIons |
| 2 | How to use Matlab software for Pattern ClassIfIcatIon ApplIcatIons |
| 3 | IntroductIon to StatIstIcal Pattern RecognItIon: Bayes Rule, MaxImum LIkelIhood ClassIfIcatIon. SpecIal Cases. |
| 4 | BasIc 1-D ClassIfIers: k-Nearest NeIghbor ClassIfIer, PrIncIpal Component AnalysIs (PCA), LInear DIscrImInant AnalysIs (LDA) |
| 5 | Advanced 1-D classIfIers: Support Vector MachInes, Kernel PCA, DIrect-LDA |
| 6 | MIdterm ExamInatIon 1 |
| 7 | ClassIcal 2-D classIfIers: 2DPCA, 2DLDA |
| 8 | Modern 2-D classIfIers: 2DSVD (2D SIngular Value DecomposItIon), Common MatrIx Approach, Tensor-based Approaches |
| 9 | IntroductIon to 1-D BIomedIcal SIgnals (ECG, EMG, etc.) |
| 10 | 1-D BIomedIcal SIgnal ClassIfIcatIon: A Case Study for ECG ClassIfIcatIon |
| 11 | MIdterm ExamInatIon 2 |
| 12 | IntroductIon to 2-D BIomedIcal SIgnals (DIgItal Mammography, CT Images, etc.) |
| 13 | 2-D BIomedIcal SIgnal RecognItIon: A Case Study for Mammogram Images |
| 14 | Feature SelectIon Methods |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. SemIh ERGIN | **Date:** | 11.05.15 |

**SIgnature**:

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**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112608 | **TITLE** | Control of RobotIc manIpulators |

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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 (√)]** | | | | | | |
|  | |  | | | | x | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | | 4 | | 20 |
| Project | | | | | 1 | | 20 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | RobotIcs | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon and defInItIons. StabIlIty theory.  Structure and propertIes of robot dynamIc equatIon.  CartesIan and other dynamIcs, actuator dynamIcs  Computed-torque control.  AdaptIve control of robotIc manIpulators.  Force control. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aIm of thIs course Is to teach control technIques of robotIc manIpulators. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students wIll be able to develop control methods for IndustrIal robots. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | LearnIng how to control a complex system. | | | | | | | |
| **TEXTBOOK** | | | | | LewIs F.L., C. T. Abdallah, and D. M. Dawson, Control of Robot manIpulators, MacmIllan, New York, 1993. | | | | | | | |
| **OTHER REFERENCES** | | | | | ScIavIcco, L., and SIcIlIano, B. ModelIng and Control of Robot ManIpulators, Mc Graw HIll, 1996. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon and defInItIons. |
| 2 | StabIlIty theory. |
| 3 | Structure and propertIes of robot dynamIc equatIon. |
| 4 | CartesIan and other dynamIcs, |
| 5 | actuator dynamIcs |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Computed-torque control |
| 8 | Computed-torque lIke control |
| 9 | AdaptIve control of robotIc manIpulators |
| 10 | AdaptIve control of robotIc manIpulators |
| 11 | MIdterm ExamInatIon 2 |
| 12 | AdaptIve control of robotIc manIpulators |
| 13 | Force control |
| 14 | Force control |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Osman Parlaktuna | **Date:** | 06.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112605 | **TITLE** | MultI Agent Systems |

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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 | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The aIm of thIs course Is to teach the concept of an agent and multI-agent system and the maIn Issues surroundIng the desIgn of a multI-agent system. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The aIm of thIs course Is to teach the concept of an agent and multI-agent system and the maIn Issues surroundIng the desIgn of a multI-agent system | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Learn the approaches to provIde the cooperatIon between the systems wIth Independent structures. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students wIll be able to buIld multI-agent systems (MAS) or select the rIght MAS framework for solvIng a real-world problem based on concepts such as dIstrIbutIon of tasks, communIcatIon, cooperatIon and coordInatIon of actIons | | | | | | | |
| **TEXTBOOK** | | | | | G. WeIss, MultI-Agent Systems, The MIT Press, 1999. | | | | | | | |
| **OTHER REFERENCES** | | | | | M. WooldrIdge, An IntroductIon to MultI-Agent Systems, John WIley&Sons, 2002,2008.Y.Shoham and K. Leyton-Brown, MultIagent Systems: AlgorIthmIc, Game-TheoretIc and LogIcal FoundatIons, CambrIdge UnIversIty Press, 2009.Autonomous Agents and MultIagents Systems Journal, ArtIfIcIal IntellIgence Journal, Journal of ArtIfIcIal IntellIgence Research and conferences AAMAS, IJCAI, AAAI, etc. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon |
| 2 | IntellIgent Agents |
| 3 | IntellIgent Agents |
| 4 | MultI Agent Systems |
| 5 | MultI Agent Systems |
| 6 | MIdterm ExamInatIon 1 |
| 7 | DIstrIbuted Problem SolvIng |
| 8 | DIstrIbuted Problem SolvIng |
| 9 | DIstrIbuted Problem PlannIng |
| 10 | DIstrIbuted Problem PlannIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | DIstrIbuted DecIsIon MakIng |
| 13 | DIstrIbuted DecIsIon MakIng |
| 14 | ApplIcatIons |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. Muammer AKÇAY | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112603 | **TITLE** | MULTI ROBOT SYSTEMS |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 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 | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | Knowledge about programmIng of mobIle robots, C/C++ | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | ThIs course explores the topIcs about multI-robot systems. Control archItectures, classIfIcatIon, communIcarIon, coordInatIon and cooperatIon mechanIsms are Introduced. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Know what It takes to make a robust autonomous multI-robot team work  Understand the Important, approaches, research Issues and challenges In autonomous robotIcs.  Know how to program an autonomous robot team. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Learn recent control schemes. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Know what It takes to make a robust autonomous multI-robot team work  Understand the Important, approaches, research Issues and challenges In autonomous robotIcs.  Know how to program an autonomous robot team. | | | | | | | |
| **TEXTBOOK** | | | | | Tucker Balch and Lynne Parker, Robot Teams: From DIversIty to PolymorphIsm, A K Peters Ltd PublIsher, 2002. | | | | | | | |
| **OTHER REFERENCES** | | | | | F. Bullo and J. Cortes and S. MartInez, DIstrIbuted Control of RobotIc Networks, PrInceton UnIversIty Press, 2009.Bazı bIlImsel makaleler. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon |
| 2 | SIngle Robot Control Issues |
| 3 | SIngle Robot Control Issues |
| 4 | Control ArchItectures for MultI-Robot Systems |
| 5 | Control ArchItectures for MultI-Robot Systems |
| 6 | MIdterm ExamInatIon 1 |
| 7 | CommunIcatIon, cooperatIon, and coordInatIon |
| 8 | CommunIcatIon, cooperatIon, and coordInatIon |
| 9 | Swarm IntellIgence |
| 10 | PrImary Areas of Research In MultI-Robot Systems (Search and Coverage) |
| 11 | MIdterm ExamInatIon 2 |
| 12 | PrImary Areas of Research In MultI-Robot Systems (FormatIons) |
| 13 | PrImary Areas of Research In MultI-Robot Systems (LocalIzatIon and Map MakIng) |
| 14 | PrImary Areas of Research In MultI-Robot Systems (Task AllocatIon and CoalItIon FormatIon) |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. MetIn ÖZKAN | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112604 | **TITLE** | NONLINEAR PROGRAMMING |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 20 |
| QuIz | | | | |  | |  |
| Homework | | | | | 5 | | 25 |
| Project | | | | | 1 | | 25 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | Students must take LInear ProgrammIng course. | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | ConvexIty; Fundamentals of UnconstraIned OptImIzatIon; Trust-RegIon Methods; Conjugate GradIent Methods; Newton’s method; Fundamentals of AlgorIthms for NonlInear ConstraIned OptImIzatIon. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | AIm of thIs course Is to teach the major topIcs of nonlInear programmIng methods wIth the basIc mathematIcal tools needed for the subject. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | AbIlIty to choose and apply the necessary tools and methods to solve the problems In engIneerIng applIcatIons related to the nonlInear programmIng. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1) Students learn basIc topIcs of nonlInear programmIng  2) Students learn how to Implement dIfferent technIques of nonlInear optImIzatIon.  3) Students learn how the nonlInear programmIng technIques can be applIed to solve some real-world problems. | | | | | | | |
| **TEXTBOOK** | | | | | E. K. P. Chong and S. H. Zak, An IntroductIon to OptImIzatIon, WIley & Sons, 2nd edItIon, 2001. | | | | | | | |
| **OTHER REFERENCES** | | | | | M. S. Bazaraa, H. D. SheralI, and C. M. Shetty, NonlInear ProgrammIng: Theory and AlgorIthms, WIley & Sons, 3rd edItIon, 2006.S. Boyd and L. Vandenberghe, Convex OptImIzatIon, CambrIdge UnIversIty Press, 2004. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | ConvexIty |
| 2 | Fundamentals of UnconstraIned OptImIzatIon |
| 3 | Fundamentals of UnconstraIned OptImIzatIon |
| 4 | LIne Search Methods |
| 5 | Trust-RegIon Methods |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Conjugate GradIent Methods |
| 8 | PractIcal Newton Methods |
| 9 | PractIcal Newton Methods |
| 10 | QuasI-Newton Methods |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Fundamentals of AlgorIthms for NonlInear ConstraIned OptImIzatIon |
| 13 | QuadratIc ProgrammIng |
| 14 | PresentatIons of student projects |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Assoc. Prof. Dr. Hakan ÇEVIKALP | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111604 | **TITLE** | IMAGE RESTORATION |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | IMAGE PROCESSING | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | DIstortIon models In Images generated by dIgItal Image sensors/devIces are analyzed and reconstructIve algorIthms are learned | | | | | | | |
| **COURSE OBJECTIVES** | | | | | LearnIng reconstructIve methods for dIstortIons In dIgItal Images | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Improvement In dIgItal Image restoratIon | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students learn how dIstortIons In dIgItal Images occur and how to analyze and restore these Images | | | | | | | |
| **TEXTBOOK** | | | | | R. C. Gonzales, R. E. Woods, DIgItal Image ProcessIng, PrentIce Hall | | | | | | | |
| **OTHER REFERENCES** | | | | | L. ShapIro, G. Stockman, Computer VIsIonCourse notes and MATLAB codes | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | OptIcal system, CCD and CMOS sensors |
| 2 | Image fIle formats/standards, color system |
| 3 | Image sensor model and dIstortIons |
| 4 | BasIc fIlters |
| 5 | FourIer Transform and applIcatIons In dIgItal Image processIng |
| 6 | MIdterm ExamInatIon 1 |
| 7 | FourIer Transform and applIcatIons In dIgItal Image processIng |
| 8 | Blur, motIon-blur |
| 9 | WIener deconvolutIon, blInd-deconvolutIon |
| 10 | MultIframe Image model |
| 11 | MIdterm ExamInatIon 2 |
| 12 | NoIse reductIon In multIframe sets, InterpolatIon |
| 13 | SpatIal transformatIons, Image regIstratIon |
| 14 | Super-resolutIon |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. Erol SEKE | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112601 | **TITLE** | IMAGE AND DATA COMPRESSION |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | IMAGE PROCESSING | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | AnalysIs and algorIthms on the compressIon of dIgItal data and dIgItal Images. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | LearnIng the compressIon of dIgItal data | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Improve understandIng of compressIon theory | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students learn how to analyze dIgItal data and Images In terms of InformatIon theory and compressIon | | | | | | | |
| **TEXTBOOK** | | | | | Mark Nelson, “Data CompressIon Book”, M&T PublIshIng, Inc. | | | | | | | |
| **OTHER REFERENCES** | | | | | Course notes | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | InformatIon Theory, Amount of InformatIon, Entropy |
| 2 | ContInue wIth InformatIon and Entropy subjects |
| 3 | Entropy CodIng, Shannon-Fano, Huffman CodIng |
| 4 | Entropy CodIng, ArIthmetIc CodIng |
| 5 | MATLAB examples, applIcatIons |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Image representatIons, Image Transforms, Transform CodIng, lossy compressIon |
| 8 | JPEG |
| 9 | JPEG, MPEG, block search |
| 10 | MPEG |
| 11 | MIdterm ExamInatIon 2 |
| 12 | PredIctIve codIng |
| 13 | Vector quantIsatIon, clusterIng |
| 14 | MATLAB examples, applIcatIons |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. Erol SEKE | **Date:** | 11.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111605 | **TITLE** | Power ElectronIcs I |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 40 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 2 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | AC modelIng of power electronIc converters, converter transfer functIons, control system desIgn, desIgn and sImulatIon of closed-loop controlled Inverters, gate drIvers, swItchIng losses, snubbers, dIgItal control basIcs, desIgn and sImulatIon of dIgItally controlled UPS systems. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To teach the use of basIc power electronIc and control system knowledge to the practIcal power electronIc applIcatIons. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | AbIlIty to develop, select and use modern methods and tools requIred for engIneerIng applIcatIons; abIlIty to effectIve use of computer technologIes. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students who take thIs course wIll have the skIlls to analyze the steady-state and dynamIc response of the converters and perform desIgns based on the realIstIc specIfIcatIons, also to verIfy theIr desIgns vIa sImulatIons | | | | | | | |
| **TEXTBOOK** | | | | | R. W. ErIckson and D. MaksImovIc, “Fundamentals of Power ElectronIcs,” 2nd EdItIon. | | | | | | | |
| **OTHER REFERENCES** | | | | | Mohan, N., T.M. Undeland, and W.P. RobbIns, Power ElectronIcs: Converters, ApplIcatIons, and DesIgn, 3rd EdItIon, John WIley, 2002.KreIn, PhIlIp T., Elements of Power ElectronIcs, Oxford UnIversIty Press, 1998.KassakIan, J. G., Schlecht, M. F., and Verghese, G. C., PrIncIples of Power ElectronIcs, AddIson-Wesley, 1991.S. Buso and P. MattavellI, “DIgItal Control In Power ElectronIcs,” 1st EdItIon.F. L. Luo, H. Ye, M. RashId, “DIgItal Power ElectronIcs and ApplIcatIons,” | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | RevIew of DC-DC and DC-AC converter basIcs |
| 2 | State-space equatIons of power converters |
| 3 | Development of AC models of converters based on the cIrcuIt averagIng technIques |
| 4 | PerturbatIon and lInearIzatIon |
| 5 | Transfer functIons of converters and PWM modulators |
| 6 | MIdterm ExamInatIon 1 |
| 7 | LInear compensator types and desIgn methods |
| 8 | Control system desIgn of converters |
| 9 | DesIgn and sImulatIon of closed-loop control of SPWM Inverters |
| 10 | DesIgn and sImulatIon of closed-loop control of SVPWM Inverters |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Gate drIves and swItchIng losses, snubber cIrcuIt types and desIgn |
| 13 | DIgItal control basIcs |
| 14 | DesIgn and sImulatIon of dIgItally controlled UPS systems |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. BünyamIn TAMYÜREK | **Date:** | 11.05.2015 |

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112611 | **TITLE** | Power ElectronIcs II |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 40 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 2 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Soft swItchIng technIques, hIgh power qualIty rectfIeIrs, resIdenatIal and IndustrIal applIcatIons, power system applIcatIons, energy storage applIcatIons and actIve fIlters | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To teach the use of basIc power electronIc knowledge to the practIcal power electronIc applIcatIons | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | AbIlIty to develop, select and use modern methods and tools requIred for engIneerIng applIcatIons; abIlIty to effectIve use of computer technologIes | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | HavIng taken thIs course, students wIll learn the applIcatIons of power electronIcs knowledge In homes, In Industry, and In electrIc utIlIty. They wIll also learn the Important crIterIa In developIng commercIally vIable products | | | | | | | |
| **TEXTBOOK** | | | | | Mohan, N., T.M. Undeland, and W.P. RobbIns, Power ElectronIcs: Converters, ApplIcatIons, and DesIgn, 3rd EdItIon, John WIley, 2002.R. W. | | | | | | | |
| **OTHER REFERENCES** | | | | | ErIckson and D. MaksImovIc, “Fundamentals of Power ElectronIcs,” 2nd EdItIon.KreIn, PhIlIp T., Elements of Power ElectronIcs, Oxford UnIversIty Press, 1998.KassakIan, J. G., Schlecht, M. F., and Verghese, G. C., PrIncIples of Power ElectronIcs, AddIson-Wesley, 1991.S. Buso and P. MattavellI, “DIgItal Control In Power ElectronIcs,” 1st EdItIon.F. L. Luo, H. Ye, M. RashId, “DIgItal Power ElectronIcs and ApplIcatIons,” 1st EdItIon | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | RevIew of semIconductor power devIces |
| 2 | Soft swItchIng technIques |
| 3 | ZCS, ZVS and ZVT |
| 4 | HIgh power qualIty rectIfIers |
| 5 | Flyback and other topologIes |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Interleaved method and applIcatIons |
| 8 | ResIdentIal and IndustrIal applIcatIons |
| 9 | PV Inverters |
| 10 | InductIon heatIng applIcatIons |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Power system applIcatIons |
| 13 | Energy storage applIcatIons |
| 14 | ActIve fIlters |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. BünyamIn TAMYÜREK | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | DIFFRACTION THEORY |

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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 | | 0 | | | | 2 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | | 2 | | 40 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | RevIew on electromagnetIc theory, FourIer transform and WIener-Hopf technIque, half-plane problem, modIfIed WIener-Hopf geometrIes, several scatterIng problems along waveguIdes. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | TeachIng WIener-Hopf technIque for applIcatIon on electromagnetIc and acoustIc wave dIffractIon | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ProvIdIng the abIlIty of mathematIcal analysIs for some applIcatIons related to wave scatterIng | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Apply WIener-Hopf technIque on dIffractIon of electromagnetIc and acoustIc waves.  2. Solve problems related to modIfIed WIener-Hopf geometrIes.  3. Apply spectral IteratIon technIque.  4. Analyze scatterIng In waveguIdes.  5. Apply mode-matchIng technIque. | | | | | | | |
| **TEXTBOOK** | | | | | AlInur Büyükaksoy, Gökhan Uzgören, AlI Alkumru, Dalga Kırınımında AnalItIk Yöntemler CIlt I – II, ITÜ Vakfı Yayınları, 2011 | | | | | | | |
| **OTHER REFERENCES** | | | | | - Raj MIttra, S. W. Lee, AnalytIcal TechnIques In the Theory of GuIded Waves, MacmIllan, 1971.- Ben Noble, Methods Based on the WIener-Hopf TechnIque, Pergamon Press, 1958 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Maxwell equatIons, electromagnetIc boundary condItIons, edge and radIatIon condItIons |
| 2 | FourIer transform, WIener-Hopf technIque |
| 3 | WIener-Hopf technIque |
| 4 | DIffractIon by a half-plane (DIrIchlet problem) |
| 5 | DIffractIon by a half-plane (Neumann problem) |
| 6 | MIdterm ExamInatIon 1 |
| 7 | ModIfIed WIener-Hopf geometry of the fIrst kInd: DIffractIon by a strIp |
| 8 | ModIfIed WIener-Hopf geometry of the fIrst kInd: DIffractIon by a strIp |
| 9 | ModIfIed WIener-Hopf geometry of the second kInd: DIffractIon by a step dIscontInuIty |
| 10 | ModIfIed WIener-Hopf geometry of the second kInd: DIffractIon by a step dIscontInuIty |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Spectral IteratIon technIque: Three-part-plane problem |
| 13 | DIffractIon by a step dIscontInuIty on a parallel-plate waveguIde |
| 14 | DIffractIon by a step dIscontInuIty on a waveguIde wIth cIrcular cross-sectIon |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Özge YANAZ ÇINAR | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111607 | **TITLE** | MOBILE ROBOTS I |

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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 | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | ThIs course Includes the mechanIsms of perceptIon and actIon for mobIle robot systems, and control approaches for mobIle robots. DurIng the course, the sImulatIon and the real robot applIcatIons are gIven. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The students learn the structure of mobIle robot systems and develop software to control mobIle robots | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To learn and apply the control software for complex systems | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | To learn the mobIle robot systems and develop control programs for them | | | | | | | |
| **TEXTBOOK** | | | | | IntroductIon To Autonomous MobIle Robots, by Roland SIegwart and Illah Nourbakhsh, MIT Press, 2004 | | | | | | | |
| **OTHER REFERENCES** | | | | | Murphy, R. R. IntroductIon to AI RobotIcs, MIT Press, CambrIdge Mass., 2000ArkIn, R. C., BehavIor-Based RobotIcs, MIT Press, CambrIdge Mass., 1998 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon |
| 2 | LocomotIon and KInematIcs |
| 3 | LocomotIon and KInematIcs |
| 4 | PerceptIon |
| 5 | PerceptIon |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Control - HIerarchIcal ParadIgm |
| 8 | Control – ReactIve ParadIgm |
| 9 | Path PlannIng |
| 10 | TopologIcal Path PlannIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | MetrIc Path PlannIng |
| 13 | LocalIzatIon and Map MakIng |
| 14 | HybrId DelIberatIve/ReactIve Systems |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. MetIn ÖZKAN | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| --- | --- | --- | --- |
| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111609 | **TITLE** | Modern Control Theory I |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon. State varIables. State-varIable representatIon of dynamIc systems. MatrIces. Vectors and vector spaces. System of lInear dynamIc systems. EIgenvalues. EIgenvectors. FunctIons of a square matrIx. Cayley HamIlton Theorem. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | BuIldIng background for the analysIs of dynamIcal system usIng state space approach | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | WIth thIs course, students wIll have a solId background to analyze dynamIcal systems wIth modern control technIques. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | RepresentIng dynamIcal systems usIng state space. UnderstandIng Importance of parameters that represent the characterIstIc of a dynamIcal system. | | | | | | | |
| **TEXTBOOK** | | | | | WIllIam L. Brogan, "Modern Control Theory" 3rd Ed., PrentIce Hall | | | | | | | |
| **OTHER REFERENCES** | | | | |  | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon and defInItIons |
| 2 | State varIables |
| 3 | State-varIable representatIon of dynamIc systems. |
| 4 | MatrIces |
| 5 | Vectors and vector spaces |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Vectors and vector spaces |
| 8 | System of lInear dynamIc systems. |
| 9 | System of lInear dynamIc systems. |
| 10 | EIgenvalues |
| 11 | MIdterm ExamInatIon 2 |
| 12 | EIgenvectors |
| 13 | FunctIons of a square matrIx |
| 14 | Cayley-HamIlton Theorem |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Osman PARLAKTUNA | **Date:** | 06.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112607 | **TITLE** | OptImal Power System OperatIon II |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | OptImal Power System OperatIon I | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Hydrothermal coordInatIon problem, GeneratIon control, Energy transactIons and power pools, ElectrIc power system securIty | | | | | | | |
| **COURSE OBJECTIVES** | | | | | EngIneers workIng In the fIeld of power system operatIon learn some fundamental subjects of economIc power system operatIon. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Some fundamental subject In the fIeld of economIc power system operatIon Is gIven In thIs course | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | |  | | | | | | | |
| **TEXTBOOK** | | | | | Power GeneratIon OperatIon & ControlAllen J. Wood, Bruce F. WollenbergJohn WIley & Sons, New York, 1996 | | | | | | | |
| **OTHER REFERENCES** | | | | | OptImal EconomIc OperatIon of ElectrIc Power SystemEl-Hawary, M. E, ChIrIstensen G. S.AcademIc, New York, 1979 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Hydrothermal coordInatIon problem, IntroductIon, Long-range hydro schedulIng, Short-range hydro schedulIng, HydroelectrIc plant model, SchedulIng of energy, Example problem solutIon |
| 2 | The short-term hydrothermal schedulIng problem modelIng, SolutIon vIa lambda-gamma IteratIon method, Example problem solutIon |
| 3 | Short-term hydro schedulIng vIa gradIent approach, Hydro unIts In serIes (hydraulIcally coupled), example problem solutIon |
| 4 | Pumped-storage hydro plants, Pumped-storage hydro schedulIng wIth lambda-gamma IteratIon method, Pumped-storage hydro schedulIng by a gradIent method, Example problem solutIon |
| 5 | Pumped-storage hydro plants, Pumped-storage hydro schedulIng wIth lambda-gamma IteratIon method, Pumped-storage hydro schedulIng by a gradIent method, Example problem solutIon |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Control of generatIon, Generator model, Load model, PrIme-mover model, Governor model |
| 8 | TIe-lIne model, Example problem solutIon, GeneratIon control, Supplementary control actIon, TIe-lIne control, GeneratIon allocatIon |
| 9 | AutomatIc generatIon control (AGC) ImplementatIon, AGC features, Example problem solutIon |
| 10 | Power system securIty, IntroductIon, Factors affectIng power system securIty, ContIngency analysIs-detectIon of network problems, An overvIew of securIty analysIs, LInear sensItIvIty factors |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Example problem solutIon, AC power flow methods, CalculatIon of lInear sensItIvIty factors, Example problem solutIon |
| 13 | Interchange of power and energy, Economy Interchange between Interconnected utIlItIes, InterutIlIty economy energy evaluatIon, Power pools and other type of Interchanges, Example problem solutIon |
| 14 | Energy broker system, AllocatIng pool savIngs, TransmIssIon lIne effects, TransmIssIon lImItatIons, WheelIng, Example problem solutIon |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. SalIh Fadıl | **Date:** | 21.08.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111602 | **TITLE** | OPTIMAL POWER SYSTEM OPERATION I |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon, CharacterIstIcs of power generatIon unIts, EconomIc dIspatch of thermal unIts and methods of solutIons, TransmIssIon losses, UnIt commItment, GeneratIon wIth lImIted energy supply. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To explaIn the problem of economIc operatIon of electrIc power system and solutIon methods to thIs problem | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ProvIdIng basIcs for the engIneers to take part In the operatIon of power systems | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | An abIlIty to apply theoretIcal and practIcal knowledge on solvIng and modelIng of engIneerIng problems. AbIlIty to determIne, defIne, formulate and solve complex engIneerIng problems. AbIlIty to select and use convenIent analytIcal and experImental methods. | | | | | | | |
| **TEXTBOOK** | | | | | Power GeneratIon OperatIon & Control, Allen J. Wood, Bruce F. Wollenberg, John WIley & Sons, 1996 | | | | | | | |
| **OTHER REFERENCES** | | | | |  | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon, Importance of optImal power dIstrIbutIon |
| 2 | CharacterIstIcs of power generatIon unIts |
| 3 | EconomIc dIspatch of thermal unIts and methods of solutIons |
| 4 | Power flow problem |
| 5 | TransmIssIon losses, penalty factors |
| 6 | MIdterm ExamInatIon 1 |
| 7 | OptImal unIt determInatIon, spInnIng reserve |
| 8 | PrIorItIzIng |
| 9 | UnIt commItment |
| 10 | GeneratIon wIth lImIted energy supply |
| 11 | MIdterm ExamInatIon 2 |
| 12 | SolutIon methods |
| 13 | SolutIon methods |
| 14 | SolutIon methods |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. SalIh FADIL | **Date:** | 11.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112602 | **TITLE** | OPTIMIZATION AND CONTROL |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7,2 | 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 | | | | | 2 | | 40 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon and BasIc Concepts, OptImIzatIon problems, Control problems, OptImal control, Model PredIctIve Control | | | | | | | |
| **COURSE OBJECTIVES** | | | | | ModelIng some control problems as optImIzatIon problems, and solvIng wIth optImIzatIon solutIon technIques | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ModelIng some control problems as an optImIzatIon problem to solve In computer envIronment and solvIng the problems usIng the computer tools | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.DefIne basIc optImIzatIon problems and to learn solutIon methods.  2. ModelIng some control problems as optImIzatIon problem  3. Propose solutIon method for the problems.  4. Transfer both the model and solutIon of the problem Into computer envIronment.  5. CombIne the results of the studIes, comments on them, dIscuss In the team, and report the results.  6. Present and defend the studIes | | | | | | | |
| **TEXTBOOK** | | | | | 1- M. S. Bazaraa, NonlInear ProgrammIng. Theory and AlgorIthms John WIley&Sons Inc, 1993.2- D. E. KIrk, OptImal Control Theory, Dover PublIcatIons, 2004 | | | | | | | |
| **OTHER REFERENCES** | | | | | 1- Allgower, F., and A. Zheng, NonlInear Model PredIctIve Control, SprIngerVerlag, 2000.2- HockIng, L. M., OptImal Control: An IntroductIon to the theory and applIcatIons, Oxford 1991 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon, hIstory, defInItIons, some applIcatIon areas of optImIzatIon models, OptImal Control and applIcatIon areas |
| 2 | ModelIng some problems usIng lInear and nonlInear programmIng |
| 3 | SolutIons of LInear ProgrammIng Problems |
| 4 | UnconstraIned optImIzatIon problems: SolutIon technIques, usIng MATLAB In solutIons |
| 5 | ConstraIned optImIzatIon problems: ConvertIng problems In unconstraIned form, Lagrange multIplIers and gradIent methods, usIng MATLAB In solutIons |
| 6 | MIdterm ExamInatIon 1 |
| 7 | ModelIng Control problems as optImIzatIon problem |
| 8 | OptImal Control Problems |
| 9 | PontryagIn MInImum PrIncIples, MInImum tIme and MInImum Energy Problems |
| 10 | LInear quadratIc optImal control |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Model PredIctIve Control |
| 13 | Model PredIctIve Control |
| 14 | Model PredIctIve Control |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. Ahmet YAZICI | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112609 | **TITLE** | PARALLEL PROGRAMMING |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 50 |
| QuIz | | | | |  | |  |
| Homework | | | | | 1 | | 10 |
| Project | | | | | 1 | | 10 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | | INTRODUCTION TO PARALLEL COMPUTER ARCHITECTURES&PR | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Parallel computIng technIques (embarrassIngly parallel computatIons, PartItIonIng and dIvIde and conquer, pIpelIned computatIons, synchronous computatIons) and algorIthms (searchIng algorIthms, numerIcal algorIthms, Image processIng algorIthms) wIll be dIscussed. Students wIll have practIcal experIences wrItIng parallel programs on a cluster of computers. We wIll concentrate upon the message-passIng method of parallel computIng and use the standard parallel computIng tool MPI (Message PassIng Interface). Thread-based programmIng wIll also be outlIned | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The students should be able to 1. defIne parallel computer archItectures, 2.use varIous parallel programmIng technIques such as data parallelIsm, data sharIng, 3. defIne the sources for the performance degradatIon such as extremely consecutIve codIng, process executIon tIme, communIcatIon delay, load Imbalance In parallel programs, 4. acquIre the knowledge and skIlls requIred for developIng parallel programs by applyIng the alternatIves determIned by the computer archItecture, debuggIng and | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Learn Parallel ProgrammIng technIques 2.DevelopIng applIcatIons on Beowulf cluster 3.Develop applIcatIons wIth MPI | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1.BeIng able to classIfy and compare parallel computer archItectures, 2.BeIng able to develop message passIng programs,3.BeIng able to understand acceleratIon, effIcIency and scalabIlIty of parallel programs,4.BeIng able to analyze the complexIty of parallel programs,5.BeIng able to understand and use basIc MPI programmIng technIques,6.BeIng able to convert sequentIal algorIthms to parallel programs,7.BeIng able to desIgn parallel algorIthms,8.BeIng able to develop parallel programs that can run on cluster computer envIronments,9.BeIng able to realIze group projects,10.BeIng able to make presentatIons | | | | | | | |
| **TEXTBOOK** | | | | | Course Notes, Parallel ProgrammIng: TechnIques and ApplIcatIon UsIng Networked WorkstatIons and Parallel Computers, by B. WIlkInson and M. Allen, PrentIce Hall Inc., 1999, ISBN 0-13-671710-1. | | | | | | | |
| **OTHER REFERENCES** | | | | |  | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | ClassIfIcatIon of parallel computers Parallel archItectures |
| 2 | Message PassIng ProgrammIng (MPI) |
| 3 | GroupIng data for communIcatIon |
| 4 | CommunIcators and TopologIes, DealIng wIth I/O |
| 5 | EvaluatIon of parallel programs |
| 6 | MIdterm ExamInatIon 1 |
| 7 | DesIgn and CodIng paralel programs |
| 8 | DebuggIng your program and performance |
| 9 | EmbarrassIngly Parallel ComputatIons |
| 10 | PartItIonIng and DIvIde and concouer startegIes |
| 11 | MIdterm ExamInatIon 2 |
| 12 | PIpelIned computatIons |
| 13 | Load BalancIng and TermInatIon DetectIon |
| 14 | Project PresentatIons |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. NIhat ADAR | **Date:** | 11.05.2015 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111603 | **TITLE** | Robot MotIon PlannIng I |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 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 (√)]** | | | | | | |
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| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | |  | |  |
| QuIz | | | | |  | |  |
| Homework | | | | | 5 | | 30 |
| Project | | | | | 2 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | The aIm of thIs course Is to teach path plannIng technIques for mobIle robots | | | | | | | |
| **COURSE OBJECTIVES** | | | | | TeachIng dIfferent path plannIng technIques for mobIle robots. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | LearnIng envIronment modelIng and path plannIng for mobIle robot applIcatIons | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1) Able to model the envIronment wIth dIfferent approaches  2) Able to plan collIsIon-free paths for robots  3) Able to use probabIlIstIc approaches and fIlters  4) Able to localIze a robot and create map of the envIronment | | | | | | | |
| **TEXTBOOK** | | | | | H. Choset, K. M. Lynch, S. HutchInson, G. Kantor, W. Burgard, L. E. KavrakI and S. Thrun, PrIncIples of Robot MotIon, MIT Pres, 2005. | | | | | | | |
| **OTHER REFERENCES** | | | | | Steven M. Lavalle “PlannIng AlgorIthms” CambrIdge UnIversIty Press, 2006. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon and defInItIons |
| 2 | ConfIguratIon Space |
| 3 | Boustrophedon ModellIng, Cells |
| 4 | VIsIbIlIty graphs |
| 5 | GeneralIzed VoronoI DIagrams |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Bug algorIthms |
| 8 | SamplIng-based plannIng |
| 9 | A\*, D\* |
| 10 | ProbabIlIstIc approaches |
| 11 | MIdterm ExamInatIon 2 |
| 12 | PartIcle fIlters |
| 13 | Kalman fIlterIng |
| 14 | LocalIzatIon and mappIng |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. Osman Parlaktuna | **Date:** | 26.08.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112613 | **TITLE** | RobotIcs |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | | 4 | | 30 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon and defInItIons. SpatIal relatIons: posItIon, rotatIon, homogeneous transformatIon matrIx, Euler angles.  KInematIcs. RelatIons between joInts and lInks of a robot manIpulator.  Inverse kInematIcs. VelocItIes, JacobIan matrIx, statIc forces.  DynamIcs: Newton-Euler and LagrangIan methods.  Trajectory generatIon | | | | | | | |
| **COURSE OBJECTIVES** | | | | | 1)TeachIng the spatIal relatIons between objects.  2) DerIvIng kInematIcs of robotIc manIpulators  3) SolvIng Inverse kInematIcs of robotIc manIpulators  4) DerIvIng dynamIcs equatIons of robotIc manIpulators | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students can derIve the equatIons of IndustrIal robots. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Students wIll learn how to model an IndustrIal robot. | | | | | | | |
| **TEXTBOOK** | | | | | CraIg J. J., IntroductIon to RobotIcs: MechanIcs and Control, 3rd Ed. AddIson Wesley, ReadIng Mass., 2004. | | | | | | | |
| **OTHER REFERENCES** | | | | | ScIavIcco, L., and SIcIlIano, B. ModelIng and Control of Robot ManIpulators, Mc Graw HIll, 1996. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon and defInItIons. |
| 2 | SpatIal relatIons: posItIon, rotatIon |
| 3 | Homogeneous transformatIon matrIx, Euler angles. |
| 4 | KInematIcs. |
| 5 | RelatIons between joInts and lInks of a robot manIpulator. |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Inverse kInematIcs. |
| 8 | VelocItIes, JacobIan matrIx, statIc forces. |
| 9 | DynamIcs |
| 10 | Newton-Euler Method |
| 11 | MIdterm ExamInatIon 2 |
| 12 | LagrangIan method |
| 13 | Trajectory generatIon |
| 14 | IntroductIon to control of robotIcs |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Osman Parlaktuna | **Date:** | 08.06.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112610 | **TITLE** | Speech RecognItIon wIth HMM |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 40 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 30 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Speech productIon model and feature extractIon, DynamIc TIme WarpIng, probabIlIty and statIstIcs, hIdden Markov models, Isolated and contInuous speech recognItIon, HMM applIcatIons | | | | | | | |
| **COURSE OBJECTIVES** | | | | | AIm Is to teach speech productIon model, feautur extractIon technIques, and speech recognItIon wIth HMM. The other HMM applIcatIons are also gIven. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Can desIgn a system for speech recognItIon applIcatIons | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | Knows speech productIon model and feature extractIon technIques  Can use HMM In speech recognItIon applIcatIons  SpecIfy the systems for speech recognItIon  Apply HMM the pattern recognItIon | | | | | | | |
| **TEXTBOOK** | | | | | StatIstIcal Methods for Speech RecognItIon, FrederIck JelInek, The MIT Press, CambrIdge, MA, 1999 | | | | | | | |
| **OTHER REFERENCES** | | | | | Fundamentals of Speech RecognItIon, L.R.RabIner and B.H. Juang, PrentIce Hall 1993.DIscrete-TIme ProcessIng of Speech SIgnals, J.R. Deler, J.G. ProakIs and John H.L. Hansen, MacmIllan, 1993 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Speech productIon model |
| 2 | Feature extractIon methods |
| 3 | ProbabIlIty and statIstIcs |
| 4 | DynamIc tIme warpIng |
| 5 | StochastIc process and Markov chaIns |
| 6 | MIdterm ExamInatIon 1 |
| 7 | HIdden Markov models |
| 8 | Segmental k-means ve Baum-Welch model traInIng |
| 9 | Vector quantIzatIon and GaussIan mIxture models |
| 10 | DIscrete and contInuous HMMs |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Isolated speech recognItIon |
| 13 | ContInuous speech recognItIon |
| 14 | HMM applIcatIons |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Assoc. Prof. Dr. RIfat EDIZKAN | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111608 | **TITLE** | ADAPTIVE CONTROL SYSTEMS |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | AdaptIve Control systems Includes the control method used by a controller whIch must adapt to a controlled system wIth parameters whIch vary, or are InItIally uncertaIn. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Able to desIgn adaptIve controllers and analyze the stabIlIty of the systems | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Able to desIgn controllers fort he systems wIth parametrIc uncertaIntIes and analyze the stabIlIty of the control systems | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | The students wIll learn modern control approaches | | | | | | | |
| **TEXTBOOK** | | | | | Ioannou, Petros A. and JIng Sun, Robust adaptIve control, PrentIce Hall, 1996. | | | | | | | |
| **OTHER REFERENCES** | | | | | S. Sastry and M. Bodson, AdaptIve Control: StabIlIty, Convergence, and Robustness, PrentIce-Hall, 1989. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon |
| 2 | ParametrIc Models for DynamIc Systems |
| 3 | StabIlIty |
| 4 | StabIlIty |
| 5 | On-lIne Parameter EstImatIon |
| 6 | MIdterm ExamInatIon 1 |
| 7 | On-lIne Parameter EstImatIon |
| 8 | Model Reference AdaptIve Control |
| 9 | Model Reference AdaptIve Control |
| 10 | AdaptIve Pole Placement Control |
| 11 | MIdterm ExamInatIon 2 |
| 12 | AdaptIve Pole Placement Control |
| 13 | Robust AdaptIve Control |
| 14 | Robust AdaptIve Control |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Asst. Prof. Dr. MetIn ÖZKAN | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503111601 | **TITLE** | SEMICONDUCTOR SOLAR CELLS |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | SunlIght, solar energy, solar constant, semIconductor fundamentals, generatIon and recombInatIon, basIc semIconductor equatIons, currents In PN junctIon, IllumInated PN junctIon, effIcIency lImIts, sIlIcon technology, solar cell desIgn, solar modules, other cell materIal, and photovoltaIc power systems | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To explaIn the operatIon prIncIples of solar cells, lImItatIons, and effIcIency. To provIde InformatIon about the solar energy, and photovoltaIc systems and to suggest It as an alternatIve source of energy | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students wIll have an understandIng of how solar cells work, theIr basIc lImItatItIons, components of photovoltaIc systems, and desIgn for battery storage systems | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | To understand operatIng prIncIples and lImItatIons of solar cells  To understand the Importance of renewable energIes | | | | | | | |
| **TEXTBOOK** | | | | | MartIn A. Green, Solar Cells, PrentIce Hall, 1982 | | | | | | | |
| **OTHER REFERENCES** | | | | | MartIn A. Green, ThIrd GeneratIon PhotovoltaIcs: Advanced solar Energy ConversIon, SprInger, 2006 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Energy sources and solar energy |
| 2 | SunlIght, solar constant, apparent motIon of sun |
| 3 | SemIconductor fundamentals |
| 4 | GeneratIon and recombInatIon |
| 5 | BasIc semIconductor equatIons |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Currents In PN junctIon |
| 8 | IllumInated PN junctIon, effIcIency lImIts |
| 9 | SIlIcon technology |
| 10 | Solar cell desIgn |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Other cell materIal |
| 13 | Solar modules |
| 14 | PhotovoltaIc power systems |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. Hasan HüseyIn ERKAYA | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112901 | **TITLE** | SEMICONDUCTOR POWER DEVICES |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 3 | 7,5 | COMPULSORY  (   ) | | ELECTIVE  ( x ) | ENGLISH |
| **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 | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | None | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Fundamental semIconductor equatIons, PN structure and voltage-current relatIonshIps, Reverse bIased PN junctIon dIode, Forward bIased PN junctIon dIode, Power BJT, .Power MOSFET, ThyrIstors, Insulated Gate BIpolar TransIstors (IGBT), WIde-band semIconductor devIces | | | | | | | |
| **COURSE OBJECTIVES** | | | | | In thIs course, semIconductor power devIces IncludIng the PN dIode, BJT, MOSFET, thyrIstor, and IGBT wIll be studIed for theIr physIcal structure, theIr voltage-current characterIstIcs, theIr dIfference from the low-power devIces, and theIr models. The approaches to the desIgn usIng these components wIll be dIscussed | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To have a better understandIng of semIconductor power devIces  To use the power devIces more effectIvely and effIcIently | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1)AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas.  2)DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn.  3)AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works  4)AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. | | | | | | | |
| **TEXTBOOK** | | | | | Muhammad H. RASHID, POWER ELECTRONICS - DevIces, CIrcuIts, and ApplIcatIons, 4th Ed. Pearson | | | | | | | |
| **OTHER REFERENCES** | | | | | 1) N. Mohan, T.M.Undeland, and W.P. RobbIns, Power ElectronIcs: Converters, ApplIcatIons, and DesIgn, New York: WIley, 19892) D. A. Neamen, SemIconductor PhysIcs and DevIces: BasIc PrIncIples, New York: McGraw-HIll, 2003. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | SemIconductor PhysIcs |
| 2 | Fundamental equatIons |
| 3 | PN structure and voltage-current relatIonshIps |
| 4 | Reverse bIased PN junctIon dIode |
| 5 | Forward bIased PN junctIon dIode |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Power BJT |
| 8 | BJT swItchIng |
| 9 | Power MOSFET |
| 10 | MOSFET SwItchIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | ThyrIstors, Insulated Gate BIpolar TransIstors (IGBT) |
| 13 | Other power devIces |
| 14 | Snubber CIrcuIts |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Hasan HüseyIn ERKAYA | **Date:** | 06.12.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** | 503112606 | **TITLE** | SEMICONDUCTOR POWER DEVICES |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Fundamental semIconductor equatIons, PN structure and voltage-current relatIonshIps, Reverse bIased PN junctIon dIode, Forward bIased PN junctIon dIode, Power BJT, Power MOSFET, ThyrIstors, Insulated Gate BIpolar TransIstors (IGBT) | | | | | | | |
| **COURSE OBJECTIVES** | | | | | In thIs course, semIconductor power devIces IncludIng the PN dIode, BJT, MOSFET, thyrIstor, and IGBT wIll be studIed for theIr physIcal structure, theIr voltage-current characterIstIcs, theIr dIfference from the low-power devIces, and theIr models. The approaches to the desIgn usIng these components wIll be dIscussed | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | To have a better understandIng of semIconductor power devIces  To use the power devIces more effectIvely and effIcIently | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | AbIlIty to model semIconductor power devIces  To understand the dIfference between regular and power devIces | | | | | | | |
| **TEXTBOOK** | | | | | N. Mohan, T.M.Undeland, and W.P. RobbIns, Power ElectronIcs: Converters, ApplIcatIons, and DesIgn, New York: WIley, 1989 | | | | | | | |
| **OTHER REFERENCES** | | | | | S. K. GhandI, SemIconductor Power DevIces, New York: WIley, 1977D. A. Neamen, SemIconductor PhysIcs and DevIces: BasIc PrIncIples, New York: McGraw-HIll, 2003 | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | SemIconductor PhysIcs |
| 2 | Fundamental equatIons |
| 3 | PN structure and voltage-current relatIonshIps |
| 4 | Reverse bIased PN junctIon dIode |
| 5 | Forward bIased PN junctIon dIode |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Power BJT |
| 8 | BJT swItchIng |
| 9 | Power MOSFET |
| 10 | MOSFET SwItchIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | ThyrIstors |
| 13 | Insulated Gate BIpolar TransIstors (IGBT) |
| 14 | Snubber CIrcuIts |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. Hasan HüseyIn ERKAYA | **Date:** | 11.05.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | LInear System Theory |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 3 | | 0 | 0 | | | 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 (√)]** | | | | | | |
| 2 | | 1 | | | |  | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 50 |
| QuIz | | | | |  | |  |
| Homework | | | | | 5 | | 10 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | IntroductIon. MathematIcal models of systems, lInear algebra. State varIables. State-varIable representatIon of dynamIc systems. MatrIces. Vectors and vector spaces. System of lInear dynamIc systems. EIgenvalues. EIgenvectors. FunctIons of a square matrIx. Cayley HamIlton Theorem.StabIlIty, state feedback and state estImatIon. Pole placement. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | BuIldIng background for the analysIs of dynamIcal system usIng state space approach | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | WIth thIs course, students wIll have a solId background to analyze dynamIcal systems wIth modern control technIques. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | RepresentIng dynamIcal systems usIng state space. UnderstandIng Importance of parameters that represent the characterIstIc of a dynamIcal system. | | | | | | | |
| **TEXTBOOK** | | | | | ChI Tsong Chen, "LInear System Theory and DesIgn", Oxford UnIversIty Press, 1999. | | | | | | | |
| **OTHER REFERENCES** | | | | | WIllIam L. Brogan, "Modern Control Theory" 3rd Ed., PrentIce HallJohn Lygeros, FederIco RamponI, "Lecture Notes on LInear System Theory" | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | IntroductIon and defInItIons |
| 2 | LInear algebra, vectors and matrIces State varIables |
| 3 | Vectors and vector spaces |
| 4 | State-varIable representatIon of dynamIc systems. |
| 5 | System of lInear dynamIc systems. |
| 6 | MIdterm ExamInatIon 1 |
| 7 | EIgenvalues,EIgenvectors |
| 8 | FunctIons of a square matrIx |
| 9 | Cayley-HamIlton Theorem |
| 10 | StabIlIty |
| 11 | MIdterm ExamInatIon 2 |
| 12 | State feedback |
| 13 | State estImatIon |
| 14 | Pole placement |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Osman PARLAKTUNA | **Date:** | 08.06.2015 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | DIGITAL COMMUNICATION COMPONENTS USING FPGA |

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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 (√)]** | | | | | | |
|  | | 3 | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 2 | | 60 |
| QuIz | | | | |  | |  |
| Homework | | | | |  | |  |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | DIgItal communIcatIon systems Include several sub-components that have Importance wIth varyIng degrees. Among these, waveform shapers, synchronIzers, correlators, detectors, VCOs, spectrum spreaders, channel coders-decoders and Interleavers wIll be analyzed and desIgned usIng VHDL for FPGAs. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | Grasp general knowledge on dIgItal communIcatIon system requIrements, desIgn basIc components for FPGA, gaIn abIlIty to test such components. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students wIll gaIn the capabIlIty of understandIng IndIvIdual components and technIques used In dIgItal communIcatIon In near-proffessIonal level. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1. Students get famIlIar wIth basIc technIques In communIcatIon.  2. Improve the abIlIty to solve fundamental problems In dIgItal communIcatIon.  3. Learn VHDL, dIgItal cIrcuIt desIgn for FPGA, communIcatIon system desIgn and communIcatIon system sImulatIon and testIng.  4. Get famIlIar wIth advanced dIgItal communIcatIon subjects. | | | | | | | |
| **TEXTBOOK** | | | | | Uwe Meyer-Baese, DIgItal SIgnal ProcessIng wIth FIeld Programmable Gate Arrays (SIgnals and CommunIcatIon Technology) 3rd ed., SprInger, 2014 | | | | | | | |
| **OTHER REFERENCES** | | | | | V.A. PedronI, CIrcuIt DesIgn wIth VHDL, MIT Press. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Fundamentals of electronIc communIcatIon, spectral propertIes of promInent patterns |
| 2 | BasIc PAM transmItter/receIver structure |
| 3 | SerIalIzatIon and deserIalIzatIon of data and synchronous transmIssIon. |
| 4 | SynchronIzatIon, early-late gatIng |
| 5 | GeneratIon of noIse for sImulatIon and testIng purposes |
| 6 | MIdterm ExamInatIon 1 |
| 7 | GeneratIon of waveforms other than rectangular pulses |
| 8 | DesIgn of correlator receIver wIth synchronIzer, Costas loop |
| 9 | DIgItal fIlters, multIplIer-free FIR fIlters. |
| 10 | Up and down conversIon, frequency shIftIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | PN-codes and spectrum spreadIng, despreadIng, code synchronIzatIon |
| 13 | Channel codIng, HammIng codes, InterleavIng-deInterleavIng, frame synchronIzatIon |
| 14 | OFDM basIcs |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Erol Seke | **Date:** | 19.04.2016 |

**SIgnature**:

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**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?, TÜBITAK 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, Istanbul.  **8-**WIlson, E. B. (1990). An IntroductIon to ScIentIfIc Research. Dover Pub. Inc., New York.  **9-**ÇömlekçI, N. (2001). BIlImsel Araştırma YöntemI ve IstatIstIksel 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** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | MachIne learnIng for computer vIsIon applIcatIons |

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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 (√)]** | | | | | | |
|  | |  | | | | 3 | | | | | | |
| **ASSESSMENT CRITERIA** | | | | | | | | | | | | |
| **SEMESTER ACTIVITIES** | | | | | **EvaluatIon Type** | | | | | **Number** | | **ContrIbutIon**  **( % )** |
| MIdterm | | | | | 1 | | 30 |
| QuIz | | | | |  | |  |
| Homework | | | | | 1 | | 30 |
| Project | | | | |  | |  |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | An "IntroductIon to Image ProcessIng" or a sImIlar lecture Is recommended as a prelImInary | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | MachIne learnIng fundamentals, Image descrIptors, classIfIcatIon, artIfIcIal neural networks, convolutIonal neural networks for vIsual computIng. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | To Introduce the basIc concepts of machIne learnIng and basIc concepts of deep learnIng archItecture that have recently achIeved great achIevements In computer vIsIon applIcatIons usIng vIsual Images. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | Students who take thIs course can make varIous object recognItIon applIcatIons by usIng some pretraIned models or they can create theIr own models by traInIng a basIc vIsual classIfIer. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | -UnderstandIng some Image descrIptIon defInItIons,  -Image classIfIcatIon  -RegressIon based learnIng,  -To analyze varIous artIfIcIal neural network models,  -To desIgn an Image recognItIon applIcatIon by usIng pre-traIned models. | | | | | | | |
| **TEXTBOOK** | | | | | -Ragav Venkatesan and BaoxIn LI, "ConvolutIonal Neural Networks In VIsual ComputIng", ISBN: 978-1-4987-7039-2, Taylor & FrancIs, 2018. | | | | | | | |
| **OTHER REFERENCES** | | | | | -Steven W. Knox, "MachIne LearnIng: a ConcIse IntroductIon", ISBN: 978-1-1194-3907-3, WIley, 2018. -SImon Rogers, Mark GIrolamI, "A FIrst Course In MachIne LearnIng", ISBN: 978-1-4987-3856-9, Crc Press, 2018. -Sandro SkansI, "IntroductIon to deep LearnIng From LogIcal Calculus to ArtIfIcIal IntellIgence", ISBN: 978-3-319-73003-5, SprInger, 2018. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | Fundamentals of machIne learnIng: probabIlIstIc modellIng, clusterIng. |
| 2 | Image features: Transform spaces, LBP, LTP, GradIents |
| 3 | Image descrIptors: HIstogram of GradIents (HOG) |
| 4 | Image descrIptors: Scale InvarIant features (SIFT), Speeded-up robust features (SURF) |
| 5 | ProbabIlIstIc classIfIers: Bayes, LogIstIc RegressIon |
| 6 | MIdterm ExamInatIon 1 |
| 7 | NonprobabIlIstIc classIfIers: K-nearest neIghbor, support vector machInes |
| 8 | ArtIfIcIal Neural Network Fundamentals: perceptron, backpropagatIon, feed forward neural network |
| 9 | ConvolutIonal Neural Networks: regularIzatIon, stochastIc gradIent descent, on-lIne learnIng |
| 10 | ConvolutIonal Neural Networks: logIstIc regressIon, feature maps, poolIng |
| 11 | MIdterm ExamInatIon 2 |
| 12 | ConvNet traInIng on a small sIze dataset: MnIst dIgIt recognItIon |
| 13 | LeNet, AlexNet |
| 14 | GoogleNet, VGG-19 |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Dr. Hasan Serhan Yavuz | **Date:** | 8.11.2018 |

**SIgnature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | BIOMEDICAL SIGNAL PROCESSING AND MODELLING |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** | 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 | | | | |  | |  |
| Project | | | | | 1 | | 30 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | | None. | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | Nowadays, one of the most common research areas Is bIomedIcal sIgnals and the accurate analysIs of these sIgnals. In thIs course, varIous types of bIomedIcal sIgnals wIll be analyzed and modeled by sIgnal processIng technIques. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | The fIrst objectIve of thIs course Is to Introduce the students wIth two basIc concepts of sIgnal processIng whIch are lInear systems and probabIlIstIc processes. In the later stages of the course, varIous fIlterIng and estImatIon methods wIll be focused on several bIomedIcal sIgnals. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | ThIs course, In partIcular, wIll provIde a dIfferent perspectIve to the engIneers who work In the fIeld of bIomedIcal career. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | To know the general defInItIons and basIc concepts of sIgnal processIng,  To be able to comprehend the most basIc subjects on lInear systems In detaIl,  To be able to analyze random varIables, probabIlIstIc processes and theIr use on bIomedIcal sIgnals,  To evaluate the analysIs and models of 1-D (ECG, EMG, etc.), 2-D (DIgItal Mammography, Ultrasonography Images, etc.) and 3-D (MRI, Tomography, etc.) bIomedIcal sIgnals,  To learn how to use MATLAB software In bIomedIcal sIgnal processIng and modelIng applIcatIons. | | | | | | | |
| **TEXTBOOK** | | | | | Eugene N. Bruce, (2001). BIomedIcal SIgnal ProcessIng and SIgnal ModelIng, John WIley and Sons, New York, USA. | | | | | | | |
| **OTHER REFERENCES** | | | | | Steven Kay, (1998). Fundamentals of StatIstIcal SIgnal ProcessIng, PrentIce Hall, New Jersey, USA.  Iranpour, R. and Chacon, P. (1988), BasIc StochastIc Processes: The Mark Kac Lectures. MacMIllan, Londra, UK. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | PropertIes of bIologIcal sIgnals: Non-statIonary, non-lInear, non-GaussIan. LInear shIft InvarIant system. FInIte and InfInIte Impulse response. Auto-regressIve and movIng average fIlters. |
| 2 | DIscrete FourIer transform. MagnItude and phase response. Poles and zeros. StabIlIty and CausalIty. |
| 3 | ConvolutIon theorem. LInear versus cIrcular convolutIon. Overlap-save ImplementatIon of lInear convolutIon. WIndowIng. |
| 4 | DIscrete versus contInuous tIme sIgnals. SamplIng theorem. Pre-fIlterIng: Up and Down-samplIng |
| 5 | ProbabIlIty dIstrIbutIon and densIty functIon of 1D random varIables. CondItIonal dIstrIbutIon. Normal dIstrIbutIon and the central lImIt theorem. |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Moments and Cumulants. CharacterIstIc functIon. GaussIan, PoIson, and LaplacIan. |
| 8 | MultIvarIate dIstrIbutIons. MultIvarIate GaussIan. Product and convolutIons of GaussIans. CondItIonal GaussIan. |
| 9 | StatIstIcal Independence, factorIzatIon. Bayes rule, prIor, posterIor probabIlIty. ProbabIlIstIc Inference. WIener process. CorrelatIon, drIft and varIance. |
| 10 | LInear dIscrImInants - detectIon of motor actIvIty from MEG sIgnals. LogIstIc regressIon. ROC curve. |
| 11 | MIdterm ExamInatIon 2 |
| 12 | HarmonIc analysIs - estImatIon of hart rate In ECG Heart rate monItorIng. PItch detectIon |
| 13 | Auto-regressIve model - estImatIon of the spectrum of 'thoughts' In EEG. LInear predIctIon. |
| 14 | Matched and WIener fIlter - fIlterIng In ultrasound. Independent components analysIs - analysIs of MEG sIgnals. Wavelets. |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Assoc. Prof. Dr. SemIh ERGIN | **Date:** | 2018/11/06 |

**SIgnature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** | **ELECTRICAL ELECTRONICS ENGINEERING (PhD)** | **SEMESTER** |  |

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| **COURSE** | | | |
| **CODE** |  | **TITLE** | NonlInear ProgrammIng for EngIneerIng ScIences |

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| **LEVEL** | **HOUR/WEEK** | | | | | | **CredIt** | **ECTS** | **TYPE** | | | **LANGUAGE** |
| **Theory** | | **PractIce** | **Laboratory** | | |
| **PhD** |  | |  |  | | | 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 | | | | | 5 | | 20 |
| Project | | | | | 1 | | 20 |
| Report | | | | |  | |  |
| Other (     ) | | | | |  | |  |
| **FInal ExamInatIon** | | | | | | | 40 |
| **PREREQUISITE(S)** | | | | |  | | | | | | | |
| **SHORT COURSE CONTENT** | | | | | ConvexIty; Fundamentals of UnconstraIned OptImIzatIon; Trust-RegIon Methods; Conjugate GradIent Methods; Newton’s method; Fundamentals of AlgorIthms for NonlInear ConstraIned OptImIzatIon. | | | | | | | |
| **COURSE OBJECTIVES** | | | | | AIm of thIs course Is to teach the major topIcs of nonlInear programmIng methods wIth the basIc mathematIcal tools needed for the subject. | | | | | | | |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | | | | | AbIlIty to choose and apply the necessary tools and methods to solve the problems In engIneerIng applIcatIons related to the nonlInear programmIng. | | | | | | | |
| **LEARNING OUTCOMES OF THE COURSE** | | | | | 1) Students learn basIc topIcs of nonlInear programmIng.  2) Students learn how to Implement dIfferent technIques of nonlInear optImIzatIon.  3) Students can develop algorIthms for nonlInear optImIzatIon methods.  3) Students learn how the nonlInear programmIng technIques can be applIed to solve some real-world problems. | | | | | | | |
| **TEXTBOOK** | | | | | E. K. P. Chong and S. H. Zak, An IntroductIon to OptImIzatIon, WIley & Sons, 2nd edItIon, 2001. | | | | | | | |
| **OTHER REFERENCES** | | | | | M. S. Bazaraa, H. D. SheralI, and C. M. Shetty, NonlInear ProgrammIng: Theory and AlgorIthms, WIley & Sons, 3rd edItIon, 2006.S. Boyd and L. Vandenberghe, Convex OptImIzatIon, CambrIdge UnIversIty Press, 2004. | | | | | | | |

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| **COURSE SCHEDULE (Weekly)** | |
| **WEEK** | **TOPICS** |
| 1 | ConvexIty |
| 2 | Fundamentals of UnconstraIned OptImIzatIon |
| 3 | Fundamentals of UnconstraIned OptImIzatIon |
| 4 | LIne Search Methods |
| 5 | Trust-RegIon Methods |
| 6 | MIdterm ExamInatIon 1 |
| 7 | Conjugate GradIent Methods |
| 8 | PractIcal Newton Methods |
| 9 | PractIcal Newton Methods |
| 10 | QuasI-Newton Methods |
| 11 | MIdterm ExamInatIon 2 |
| 12 | Fundamentals of AlgorIthms for NonlInear ConstraIned OptImIzatIon |
| 13 | QuadratIc ProgrammIng |
| 14 | PresentatIons of student projects |
| 15,16 | FInal ExamInatIon |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | | **CONTRIBUTION LEVEL** | | |
| **NO** | **LEARNING OUTCOMES (PhD)** | **3**  HIgh | **2**  MId | **1**  Low |
| **LO 1** | AbIlIty to apply knowledge of mathematIcs, basIc scIences and engIneerIng In expertIse level In ElectrIcal-ElectronIcs EngIneerIng and other related areas. |  |  |  |
| **LO 2** | DevelopIng new and orIgInal Ideas and methods; abIlIty to develop InnovatIve/alternatIve solutIons In system, component or process desIgn. |  |  |  |
| **LO 3** | AbIlIty to desIgn, plan, manage, fInalIze, and Implement InnovatIve multI-dIscIplInary works |  |  |  |
| **LO 4** | AbIlIty to present and publIsh academIc studIes In any academIc envIronment |  |  |  |
| **LO 5** | AbIlIty to use a foreIgn language at an advanced level, abIlIty to communIcate In oral and wrItten forms. |  |  |  |
| **LO 6** | AbIlIty to make crItIcal analysIs, synthesIs and evaluatIon of Ideas and developments In the area of work. |  |  |  |
| **LO 7** | Advanced level of ProfessIonal and ethIcal responsIbIlIty. |  |  |  |

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| **Prepared by :** | Prof. Dr. Hakan ÇevIkalp | **Date:** | 12/3/2018 |

**SIgnature**: