**ESOGU MECHANICAL ENGINEERING DEPARTMENT**

**COURSE INFORMATION FORM**

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| **Course Name** | **Course Code** |
| Control Systems | 151816XXX |

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| **Semester** | **Number of Course Hours per Week** | **ECTS** |
| **Theory** | **Practice** |
| 6  | 3 | 0 | 5 |

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| **Course Category (Credit)** |
| **Basic Sciences** | **Engineering Sciences** | **Design** | **General Education** | **Social** |
| - | $$×$$ | $$×$$ | - | - |

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| **Course Language** | **Course Level** | **Course Type** |
| Turkish and/or English | Undergraduate | Compulsory |

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| **Prerequisite(s) if any** |  |
| **Objectives of the Course** | 1. Introduction to design, analysis, and synthesis of control systems.
2. To teach the fundamental concepts of mathematical modeling and Control of engineering systems
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| **Short Course Content** | The course aims to provide the student with the knowledge of designing systems which can be automatically controlled and of making design changes to a system to increase its performance. The specific topics addressed are: Classical control theory in the frequency and time domains, stability-performance methods based on Bode/Nyquist and Root-Locus diagrams, representation in state space, reduction of multiple subsystems, application of feedback analysis and design to physical systems with feedback. |

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| **Learning Outcomes of the Course** | **Contributed PO(s)**  | **Teaching Methods \*** | **Measuring Methods \*\*** |
| **1** | to obtain mathematical modeling of engineering systems, | 1, 2, 3, 7, 8  | 1, 4, 5, 8 | A, K |
| **2** | system representation by block diagrams, | 1, 2, 3, 4, 7 | 1, 4, 5 | A, K |
| **3** | time response analysis of dynamic systems,  | 1, 2, 5, 7 | 1, 5, 8 | A, K |
| **4** | stability analysis of systems, | 1, 2, 3, 7 | 1, 5, 8, 10 | A, K |
| **5** | performance specifications and analysis, | 1, 2, 3, 4, 5, 7, 8 | 1, 5, 8, 10 | A, K |
| **6** | frequency response of a system and frequency response analysis of existing systems (Bode & Nyquist methods),  | 1, 2, 3, 4, 5, 7, 8 | 1, 5, 8, 10 | A, K |
| **7** | Root Locus method for the control system design and analysis, | 1, 2, 3, 4, 5, 7, 8 | 1, 5, 10 | A, K |
| **8** | proportional, integral, and derivative (PID) control, | 1, 2, 3, 4, 5, 7, 8 | 1, 4, 5, 10 | A, K |
| **9** | knowledge of MATLAB “Control Toolbox” commands | 2, 3, 4, 5, 7, 8 | 1, 6, 8, 10 | A, K |

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| **Main Textbook** | Control Systems Engineering, Norman S. Nise |
| **Supporting References** | 1. Otomatik Kontrol Sistemleri, Benjamin C. Kuo & Farid Golnaragh
2. [Modern Control Engineering](http://www.pandora.com.tr/urun/modern-control-engineering-3e/51532), Ogata, K.
3. [Otomatik Kontrol / Sistem Dinamiği ve Denetim Sistemleri](http://www.pandora.com.tr/urun/otomatik-kontrol-sistem-dinamigi-ve-denetim-sistemleri/182854), İbrahim Yüksel
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| **Necessary Course Material** |  |

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| **Course Schedule** |
| **1** | Introduction to Control Systems |
| **2** | Mathematical Modeling: Modeling In the Time Domain: Simplification & Linearization, Mechanical Elements & Systems |
| **3** | Mathematical Modeling: Modeling In the Time Domain: Electrical, Electromechanical Elements & Systems; Thermal & Hydraulic Elements & Systems (if time permits) |
| **4** | Mathematical Modeling: Modeling In the Frequency Domain: Laplace Transform, Transfer Functions |
| **5** | Mathematical Modeling: Modeling In the Frequency Domain: Impedance Approach |
| **6** |  DC-Motor Transfer Function, Block Diagrams |
| **7** |  State-Space Model, Conversion to/From Transfer Functions, Stability, Routh Hurwitz (RH) Criteria |
| **8** | Mid-Term Exam |
| **9** | Time Response: Routh Hurwitz, Feedback Control & Steady-State Errors |
| **10** | Time Response: First, Second and Higher Order System Responses  |
| **11** | Time Response: Effects of Pole-Zero Additions, Nonlinearities; Frequency Response Analysis: Introduction |
| **12** |  Frequency Response Analysis: Bode Plots, Stability & Gain-Phase Margins |
| **13** |  Frequency Response Analysis: Nyquist Diagram, Stability & Margins |
| **14** |  Root Locus Analysis, Pole/Zero Effects  |
| **15** | Controllers: PID Controllers & Gain Adjustment (Tuning)  |
| **16,17** | Final Exam |

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| **Calculation of Course Workload** |
| **Activities** | **Number** | **Time (Hour)** | **Total Workload (Hour)** |
| Course Time (number of course hours per week) | 14 | 3 | 42 |
| Classroom Studying Time (review, reinforcing, prestudy,) | 14 | 4.5 | 63 |
| Homework |  |  |  |
| Quiz Exam |  |  |  |
| Studying for Quiz Exam |  |  |  |
| Oral exam  |  |  |  |
| Studying for Oral Exam  |  |  |  |
| Report (Preparation and presentation time included) |  |  |  |
| Project (Preparation and presentation time included) |  |  |  |
| Presentation (Preparation time included) |  |  |  |
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|  |  |  |  |
| Mid-Term Exam | 1 | 2 | 2 |
| Studying for Mid-Term Exam | 1 | 20 | 20 |
| Final Exam | 1 | 2 | 2 |
| Studying for Final Exam | 1 | 20 | 20 |
|  | **Total workload** | **149** |
|  | **Total workload / 30** | **4.96** |
|  | **Course ECTS Credit** | **5** |

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| **Evaluation** |
| **Activity Type** | **%** |
| Mid-term | 50 |
| Quiz |  |
| Homework |  |
| Bir öğe seçin. |  |
| Bir öğe seçin. |  |
| **Final Exam** | 50 |
| **Total** | 100 |

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| **RELATIONSHIP BETWEEN THE COURSE LEARNING OUTCOMES AND THE PROGRAM OUTCOMES (PO)** (5: Very high, 4: High, 3: Middle, 2: Low, 1: Very low) |
| **NO** | **PROGRAM OUTCOME** | **Contribution** |
| **1** | Sufficient knowledge of engineering subjects related with mathematics, science and … engineering; an ability to apply theoretical and practical knowledge on solving and modeling of … engineering problems. | 5 |
| **2** | Ability to determine, define, formulate and solve complex … engineering problems; for that purpose, an ability to select and use convenient analytical and experimental methods. | 5 |
| **3** | Ability to design a complex system, a component and/or an engineering process under real life constrains or conditions, defined by environmental, economic and political problems; for that purpose an ability to apply modern design methods. | 5 |
| **4** | Ability to develop, select and use modern methods and tools required for … engineering applications; ability to effective use of information technologies. | 4 |
| **5** | In order to investigate … engineering problems; ability to set up and conduct experiments and ability to analyze and interpretation of experimental results. | 4 |
| **6** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | 1 |
| **7** | Ability to communicate in written and oral forms in Turkish/English; proficiency at least one foreign language. | 5 |
| **8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | 4 |
| **9** | Understanding of professional and ethical issues and taking responsibility  | 1 |
| **10** | Awareness of project, risk and change management; awareness of entrepreneurship, innovativeness and sustainable development. | 1 |
| **11** | Knowledge of actual problems and effects of engineering applications on health, environment and security in global and social scale; an awareness of juridical results of engineering solutions. | 1 |
| **12** |  |  |

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| **LECTUTER(S)** |
| **Prepared by** | Naci Zafer | Sezcan Yılmaz |  |  |
| **Signature(s)** |  |  |  |  |

**Date:**09.07.2024