**ESOGU MECHANICAL ENGINEERING DEPARTMENT**

**COURSE INFORMATION FORM**

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| **Course Name** | **Course Code** |
| ADVANCED CALCULUS  | 151814235 |

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| **Semester** | **Number of Course Hours per Week** | **ECTS** |
| **Theory** | **Practice** |
| 4 | 3 | 0 | 5 |

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| **Course Category (Credit)** |
| **Basic Sciences** | **Engineering Sciences** | **Design** | **General Education** | **Social** |
| %25 | %75 |  |  |  |

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| **Course Language** | **Course Level** | **Course Type** |
| Turkish | Undergraduate | Compulsory |

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| **Prerequisite(s) if any** | None |
| **Objectives of the Course** | To provide the basic mathematical skills required of engineering students |
| **Short Course Content** | Complex analysis, Laplace Transforms, Inverse Laplace Transform, Solution of differential equations with Laplace Transform, Solution of variable coefficient differential equations with series methods, Matrices, Fourier series, Solution of differential equations with matrix methods |

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| **Learning Outcomes of the Course** | **Contributed PO(s)**  | **Teaching Methods \*** | **Measuring Methods \*\*** |
| **1** | Understands and uses series, infinite series, power series of functions, Taylor and MacLaurin series. | 1, 2, 6  | 1, 5, 6, 10, 11 | A, B, K |
| **2** | Uses analytical geometry with the help of vectors and interprets lines, planes and surfaces in 3-dimensional space. | 1, 2, 6 | 1, 5, 6, 10, 11 | A, B, K |
| **3** | Understand and use multivariable functions, partial derivatives, directional derivatives, gradient vectors, and tangent planes. | 1, 2, 6 | 1, 5, 6, 10, 11 | A, B, K |
| **4** | Finds local and absolute extreme values ​​of multivariable functions, uses Lagrange Factors and solves optimization problems, | 1, 2, 6 | 1, 5, 6, 10, 11 | A, B, K |
| **5** | Understands and uses double and triple integrals in different coordinate systems. | 1, 2, 4, 6 | 1, 5, 6, 10, 11 | A, B, K |

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| **Main Textbook** | Richard Bronson, Schaum’s Outlines Diferensiyel Denklemler. McGraw Hill-Nobel |
| **Supporting References** | Wylie and Barrett, Advanced Engineering Mathematics: Mc-Graw Hill Matematik Formülleri Tabloları El Kitabı, Murray R. Spiegel |
| **Necessary Course Material** | Projector, Computer |

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| **Course Schedule** |
| **1** | Complex numbers and their representation in the complex plane, polar form of complex numbers, nth root of a complex number, functions of a complex variable. |
| **2** | Cauchy Integral Theorem, finding singular and polar points of an analytic function. Residue Theorem. Residue calculation. Integral in the complex plane. |
| **3** | Laplace transform definition, Laplace transforms of functions, rules and theorems. |
| **4** | Inverse Laplace Transform |
| **5** | Solution of differential equations with constant coefficients by the Laplace transform method. |
| **6** | Solution of differential equations with variable coefficients by the Laplace transform method. |
| **7** | Solution of partial differential equations by the Laplace transform method. |
| **8** | Mid-Term Exam |
| **9** | Series solutions of quadratic differential equations with no singular points near x=a. |
| **10** | Series solutions of quadratic differential equations with singular points near x=a |
| **11** | Bessel differential equations and their solutions, Bessel functions of the first and second kind and their properties. |
| **12** | Fourier Series |
| **13** | Calculation of matrices, eigenvalues ​​and eigenvectors |
| **14** | Cayley-Hamilton Theorem and its applications |
| **15** | Solution of differential equations with matrix methods |
| **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 | 53 |
| Classroom Studying Time (review, reinforcing, prestudy,….) | 14 | 2 | 28 |
| Homework | 0 | 0 | 0 |
| Quiz Exam | 2 | 1 | 2 |
| Studying for Quiz Exam | 2 | 5 | 10 |
| Oral exam  | 0 | 0 | 0 |
| Studying for Oral Exam  | 0 | 0 | 0 |
| Report (Preparation and presentation time included) | 0 | 0 | 0 |
| Project (Preparation and presentation time included) | 0 | 0 | 0 |
| Presentation (Preparation time included) | 0 | 0 | 0 |
| Mid-Term Exam | 1 | 2 | 2 |
| Studying for Mid-Term Exam | 1 | 25 | 25 |
| Final Exam | 1 | 2 | 2 |
| Studying for Final Exam | 1 | 25 | 25 |
|  | **Total workload** | **136** |
|  | **Total workload / 30** | **4.533** |
|  | **Course ECTS Credit** | **5** |

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| **Evaluation** |
| **Activity Type** | **%** |
| Mid-term | 50 |
| **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 own branch; an ability to apply theoretical and practical knowledge on solving and modeling of engineering problems. | 4 |
| **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. | 3 |
| **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. | 2 |
| **4** | Ability to develop, select and use modern methods and tools required for engineering applications; ability to effective use of information technologies. | 3 |
| **5** | In order to investigate engineering problems; ability to set up and conduct experiments and ability to analyze and interpretation of experimental results. | 1 |
| **6** | Ability to work effectively in inner or multi-disciplinary teams; proficiency of interdependence. | 3 |
| **7** | Ability to communicate in written and oral forms in Turkish/English; proficiency at least one foreign language. | 3 |
| **8** | Awareness of life-long learning; ability to reach information; follow developments in science and technology and continuous self-improvement. | 2 |
| **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** | Asst. Prof. Dr. Zerrin SERT |  |  |  |
| **Signature(s)** |  |  |  |  |

**Date:** 21.11.2024