**CIVIL ENGINEERING PhD PROGRAMME**

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| **First Year** |
| **I. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 501011101 | [THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS](#EN63) | 7.5 | 3+0 | 3 | **C** | Turkish |
| 503311604 | [ENGINEERING MATHEMATICS](#EN45) | 7.5 | 3+0 | 3 | **C** | Turkish |
|  | Elective Course-1 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-2 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of I. Semester  | 30 |  | 12 |  |  |
| **II. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of II. Semester  | 30 |  | 12 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 24 |  |  |

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| **Second Year** |
| **III. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503311801 | PhD PROFICIENCY  | 30 | 0+1 | - | **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 | **-** | **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 |
| 503311802 | PhD THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 503311803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | - | **C** | Turkish |
|  | Total of V. Semester  | 30 |  |  |  |  |
| **VI. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503311802 | PhD THESIS STUDY | 25 | 0+1 | - | **C** | Turkish |
| 503311803 | SPECIALIZATION FIELD COURSE | 5 | 3+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 |
| 503311802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 503311803 | SPECIALIZATION FIELD COURSE | 5 | 3+0 | **-** | **C** | Turkish |
|  | Total of VII. Semester | 30 |  |  |  |  |
| **VIII. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 503311802 | PhD THESIS STUDY | 25 | 0+1 | **-** | **C** | Turkish |
| 503311803 | SPECIALIZATION FIELD COURSE | 5 | 3+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 |
| 503312603 | [Artificial Intelligence in Structural Engineering](#EN57) | 7.5 | 3+0 | 3 | E | Turkish |
| 503312604 | [Deformation Properties of Construction Materials](#EN58) | 7.5 | 3+0 | 3 | E | Turkish |
| 503312602 | [EARTHQUAKE ANALYSE OF STRUCTURE](#EN38) | 7.5 | 3+0 | 3 | E | Turkish |
| 503311607 | [Fracture of Construction Materials](#EN59) | 7.5 | 3+0 | 3 | E | Turkish |
| 503312606 | [MULTI-CRITERIA DECISION MAKING TECHNIQUES IN CONSTRUCTION MANAGEMENT](#EN64) | 7.5 | 3+0 | 3 | E | Turkish |
| 503312605 | [Numerical Methods in Geotechnical Engineering](#EN62) | 7.5 | 3+0 | 3 | E | Turkish |
| 503311605 | [Open Channel Hydraulics](#EN60) | 7.5 | 3+0 | 3 | E | Turkish |
| 503311606 | [SOIL STRUCTURE INTERACTION](#EN61) | 7.5 | 3+0 | 3 | E | Turkish |
| 503311602 | [SOILS FAILURE MECHANISM](#EN41)  | 7.5 | 3+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** |  **CIVIL ENGINEERING (PhD)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  ENGINEERING MATHEMATICS |

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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 (√)]** |
|   | X |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 20 |
| Quiz |   |    |
| Homework | 5 | 40 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  NONE |
| **SHORT COURSE CONTENT** |  Finding roots of equations and solutions of linear equation systems with numerical methods, Interpolation, Curve fitting, Numerical differentiation and integration, Numerical and series solutions of ordinary and partial differential equations. |
| **COURSE OBJECTIVES** |  To teach numerical and analtical methods for solution of engineering problems by using mathematical software. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To gain students the ability to search for the solutions of graduate level engineering problems. |
| **LEARNING OUTCOMES OF THE COURSE** |  To understand numerical methods, To understand analytical methods, Ability to apply mathematical software to numerical and analytical methods, Ability to analyze, model and find the proper solution method for engineering problems. |
| **TEXTBOOK** |  Lecture notes |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fundamentals, Mathematical modelling, Error analysis, Introduction of mathematical software |
| 2 |  Finding roots of equations with numerical methods, Numerical solutions of linear equation systems |
| 3 |  Interpolation, Curve fitting |
| 4 |  Numerical differentiation and integration |
| 5 |  Numerical solutions of ordinary differential equations |
| 6 | Midterm Examination 1 |
| 7 |  Initial value, Boundary value and Eigenvalue problems |
| 8 |  Mathematical series |
| 9 |  Series solutions of ordinary differential equations |
| 10 |  Series solutions of ordinary differential equations |
| 11 | Midterm Examination 2 |
| 12 |  Numerical solutions of partial differential equations |
| 13 |  Series solutions of partial differential equations |
| 14 |  Series solutions of partial differential equations |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assist. Prof. Dr. Hakan ÖZBAŞARAN | **Date:** |  29.06.2015 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |  503302513 | **TITLE** |  Dam Failure |

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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 (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 20 |
| Quiz |   |    |
| Homework | 3 | 20 |
| Project | 1 | 30 |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 30 |
| **PREREQUISITE(S)** |  Geotechnics for Dam Enginering |
| **SHORT COURSE CONTENT** |  This course includes the factors acting on dam failures and damages, and discusses some case studies in the world. Especially it evaluates overtopping, earthquake and foundation soil problems such as internal erosion, seepage and leakage, etc. It discusses the failures of Teton, Vaiont, Malpasset, Saint Francis dams and lessons learnt. |
| **COURSE OBJECTIVES** |  This course gives more detailed information to design engineers about dam failures and their results, and analyzes the effect of innovative technology on dam failure modes. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |        |
| **LEARNING OUTCOMES OF THE COURSE** |  Scientific research and ability for evaluationAbility for using dataAbility for understandingIdeas and solutions for complicated situations      |
| **TEXTBOOK** |        |
| **OTHER REFERENCES** |  1.Jansen, R.B., 1988, Advanced dam engineering for design, construction and rehabilitation: Van Nostard Reinhold Co., New York, 811 p.2. Tosun, H., 2002, Dolgu Baraj Depremselliği ve Tasarım Esasları, DSİ Yayınları, 208 s. (in Turkish)3.UBGS1, 2007, Uluslar arası Katılımlı I: Ulusal Baraj Güvenliği Sempozyumu Bildiriler Kitabı, 28-30 Mayıs, Ankara (in Turkish).4.Tosun, H., Zorluer, İ, Savaş, H., Taşkıran, Ö., Demirkol, H., Kar, A., Temel sorunlarından oluşan baraj göçmeleri" Osmangazi Üniversitesi İnşaat Mühendisliği Bölümü, Geoteknik yayınlar serisi:99/l, Mayıs 1999, 95 sayfa (in Turkish) |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction: Dam failure, dam safety and public safety |
| 2 |  Factors acting on dam damage and failure |
| 3 |  Overtopping |
| 4 |  Internal erosion |
| 5 |  Seepage |
| 6 | Midterm Examination 1 |
| 7 |  Leakage |
| 8 |  Hydraulic fracturing |
| 9 |  Sliding and slope stability |
| 10 |  Failure of Teton dam |
| 11 | Midterm Examination 2 |
| 12 |  Failure of Malpasset dam |
| 13 |  Failure of Saint Fransis dam |
| 14 |  Other cases |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Dr. Hasan TOSUN | **Date:** |  17.04.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |  503302512 | **TITLE** |  Earth Structures |

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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 (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 20 |
| Quiz |   |    |
| Homework | 3 | 20 |
| Project | 1 | 30 |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 30 |
| **PREREQUISITE(S)** |  Measurements of soil propertiesGeotechnics for dam engineering |
| **SHORT COURSE CONTENT** |  This course includes the main requirement for designing the earth structures, gives more detailed information shear strength of soils and stress path concept, and introduces the methods of the slope stability and static deformation analysis for separate loading conditions (end of construction, operation stage, rapid drawdown and earthquake) and mentions the seismic hazard analysis for dam site      |
| **COURSE OBJECTIVES** |  This course supplies students on designing of the earth structures and supports dam on the methods for static stability analysis with considering an actual project.      |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |        |
| **LEARNING OUTCOMES OF THE COURSE** |  Scientific research and ability for evaluationAbility for using dataAbility for understandingIdeas and solutions for complicated situations      |
| **TEXTBOOK** |        |
| **OTHER REFERENCES** |  1.Corps of Engineers, 1970, “Engineering and design stability of earth and rockfill dams” EM 1110-02, Department of the Army Corps of Engineers, Washington.  2.Singh, B. and Sharma, H.D., 1976, “Earth and Rockfill Dams” Sarith Rakashan, Meerht, 566 p.3. Sowers, G.F., 1962, Earth and Rockfill Dam Engineering: ASIA Publishing House, London, 283 p. 4. USBR, 1987, Design of Small Dams: U.S. Bureau of Reclamation, Denver, 860 p.      |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Definition, classification of earth hydraulic structures |
| 2 |  Shear strength of clays |
| 3 |  Shear strength of sands |
| 4 |  Stress path method for isotropic soil conditions |
| 5 |  Stress path method for anisotropic soil conditions |
| 6 | Midterm Examination 1 |
| 7 |  Slope stability analysis for end of construction |
| 8 |  Slope stability analysis for operation |
| 9 |  Seismic hazard analysis for rapid drawdown and earthquake |
| 10 |  Design rules |
| 11 | Midterm Examination 2 |
| 12 |  Design rules |
| 13 |  Case study      |
| 14 |  Case study |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Dr. Hasan TOSUN | **Date:** |  17.04.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  Numerical Methods in Geotechnical Engineering |

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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 | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm |   |    |
| Quiz |   |    |
| Homework | 8 | 40 |
| Project |   |    |
| Report |   |    |
| Other (Presentation) | 1 | 20 |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Depending on numerical modeling applications in Geotechnical Engineering; the aim of this course is to define the geological properties of the soil by using finite elements and structural equations, to define the interface elements, interactions and discontinuities and to make the stress-strain analysis of the problem. The problems considered include infiltration, consolidation and excavation,etc. |
| **COURSE OBJECTIVES** |  The main objective of the course is to provide the most realistic and economic solutions for the practitioners by expanding their knowledge in identifying, analyzing and evaluating geotechnical engineering problems with the help of computer programs, modeling the problems they will face in practice. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Modeling the problems encountered in practice with the help of computer and searching for solutions |
| **LEARNING OUTCOMES OF THE COURSE** |  To learn some theoretical soil models and basic design concepts using numerical methods, to learn soil model approaches used in geotechnical programs that are used in practice and to investigate the existence of different methods and to reach the optimum solution in terms of economy and safety |
| **TEXTBOOK** |  1- Computational Geomechanics Series: Theory and Applications of Transport in Porous Media, Vol. 7 Verruijt, Arnold, Dordrecht : Kluwer, 1995. 2- Potts, D.M. and Zdravković L., 2001, Finite element analysis in geotechnical engineering: Application, Thomas Telford3- Potts, D., Axelsson, K., Grande, L., Schweiger, H., & Long, M. (Eds.) (2002). Guidelines for the use of advanced numerical analysis. (1 ed.) London: Thomas Telford. |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Classification of Geotechnical Problems |
| 3 |  Basic Concepts of Finite Element Method |
| 4 |  Stress-strain concepts in soils |
| 5 |  Stress-strain concepts in soils-Material Models |
| 6 |  One dimensional stable and unstable water flow analysis |
| 7 |  Two dimensional stress strain analysis |
| 8 |  Boundary Conditions |
| 9 |  Constitutive laws |
| 10 |  Use of interface elements |
| 11 |  Application of Slope Stability using Finite Element Method |
| 12 |  Application of Retaining Structures using Finite Element Method |
| 13 |  Finite Element Method for fillings and foundations |
| 14 |  Finite element theory for dynamic analysis |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Asst.Prof.Dr. Kamil Bekir Afacan | **Date:** |  31.10.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  SOIL STRUCTURE INTERACTION |

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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 (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm |   |    |
| Quiz |   |    |
| Homework | 1 | 40 |
| Project |   |    |
| Report |   |    |
| Other (Presentation) | 1 | 20 |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  None |
| **SHORT COURSE CONTENT** |  Observing SSI problems in practice, learning soil and structural dynamics seperately, understanding the impedence functions, inertial and kinematic interactions, direct and indirect methods, building codes and fem modeling |
| **COURSE OBJECTIVES** |  Understanding the framework of the soil-structure interaction using the soil dynamics and structural dynamics extensively. Evaluation of the Direct and Indirect methods to model the interaction. Using FEM programs to model a soil structure interaction. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The course aims professional users to understand the soil-structure interaction better in order to model their problem in the most complex way therefore they would estimate the forces that buildings will feel better. |
| **LEARNING OUTCOMES OF THE COURSE** |  Understanding the soil dynamics and wave propagation, understanding the structural dynamics and nonlinear behavior, direct and indirect methods used in the practice, soil structure interaction problems, modeling interaction using FEM models |
| **TEXTBOOK** |  1- Vibrations of Soils and Foundations,F. E., Jr. Richart, 1970, Prentice Hall 2- Dynamic Soil Structure Interaction, J.P. Wolf, 1985 Prentice Hall 3- Advanced Geotechnical Engineering Soil–Structure Interaction Using Computer and Material Models, C.S. Desai and M. Zaman, 2014, CRC Press 4- FEMA 356 (2000) and FEMA 440 (2005), NEHRP |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Observation of SSI Effect |
| 3 |  Fundemantals of Dynamic Systems |
| 4 |  Effect of SSI on Dynamic Behavior of Structures |
| 5 |  Impedance Function and Wave Propagation |
| 6 | Midterm Examination 1 |
| 7 |  Inertial and Kinematic Interaction |
| 8 |  SSI for Surface and Pile Foundations |
| 9 |  Nonlinear Behavior of Soils and Its Effect on SSI |
| 10 |  Direct and Indirect Methods |
| 11 | Midterm Examination 2 |
| 12 |  Finite Element Methods for Modeling SSI |
| 13 |  Building Codes for SSI |
| 14 |  Nonlinear Seismic Anaysis Procedures |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[ ]**  | **[x]**  |

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| **Prepared by :**  |  Assis. Prof. Dr. Kamil B. AFACAN  | **Date:** |  21.03.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  Open Channel Hydraulics |

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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 (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 2 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Introduction to gradually varied flow and determination of free surface profile with different methods, unsteady flow in open channel hydraulics, rapidly varied flow, flow structure on channel transition, analysing the dam break problem.  |
| **COURSE OBJECTIVES** |  Get across the open channel flow on different flow conditions and hydraulic structures. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Gain expertise on open channel hydraulics for graduate students and hydraulic engineers. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Students shall learn basic knowledge on principal equations on unsteady open channel flows.2. Students shall identify free surface profiles on different flow conditions and open channel structures.3. Students shall identify the location and length of hydraulic jump.4.Students shall learn basic knowledge on channel transitions. |
| **TEXTBOOK** |  Henderson, F. M., ‘Open Cahnnel Flow’, McMillian Company, New York, 1966 |
| **OTHER REFERENCES** |  Chow, V. T., ‘Open-Channel Hydraulics’, McGraw-Hill Kogakusha, Tokyo, 1959 Hydraulic Structures, P. Novak et. al, 2001French, R. H., ‘Open-Channel Hydraulics’, McGraw-Hill, Singapore, 1987 |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Hydraulics of non-uniform open channel flows  |
| 2 |  Rapidly varied flow |
| 3 |  Gradually varied flow |
| 4 |  Free surface profiles |
| 5 |  Computation of Gradually-Varied Flow |
| 6 |  Direct-Integration and Steps Methods |
| 7 |  Channel transitions |
| 8 |  Midterm |
| 9 |  Channel transitions (Subcritical nad Supercritical flow) |
| 10 |  Unsteady flow |
| 11 |  Unsteady flow |
| 12 |  Positive and Negative Waves |
| 13 |  The Dam-Break Problem |
| 14 |  Prcatical applications |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[x]**  | **[ ]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc. Prof. Ender Demirel | **Date:** |  05.04.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  Fracture of Construction Materials  |

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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 | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Fracture and its types, crack propagation mechanisms, linear elastic fracture mechanics, applications of fracture mechanics in concrete, nonlinear fracture models for concrete, test methods for determination of fracture parameters. |
| **COURSE OBJECTIVES** |  Introduction of fracture types occurring in engineering materials, explaining the mechanisms of crack propagation, determination of fracture parameters with various test methods. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To know the types of fracture, to determine the fracture parameters with various test methods, to develop the ability to make the fracture resistant design. |
| **LEARNING OUTCOMES OF THE COURSE** |  To know the fracture and its types, to understand the mechanisms of fracture progression, to analyze the fracture models and to gain the ability of designing and application of fracture resistant structures of the construction materials. |
| **TEXTBOOK** |  Oğuz, A. (1996). Kırılma Mekaniğine Giriş, Uludağ Üniversitesi, Bursa. Sih, G. C., & Ditomasso, A. (Eds.). (2012). Fracture mechanics of concrete: Structural application and numerical calculation: Structural Application and Numerical Calculation (Vol. 4). Springer Science & Business Media. |
| **OTHER REFERENCES** |  1. Paşa Yayla, (2007) Kırılma Mekaniği, Çağlayan Kitabevi, İstanbul 2. Shah, S. P., Swartz, S. E., & Ouyang, C. (1995). Fracture mechanics of concrete: applications of fracture mechanics to concrete, rock and other quasi-brittle materials. John Wiley & Sons. 3. Shah, S. P., & Taşdemir, M. A. (1994). Role of fracture mechanics in concrete technology. Advances in Concrete Technology, 161-202. 4.Van Mier, J. G. (2017). Fracture processes of concrete. CRC press. 5. Bazant, Z. P., & Planas, J. (1997). Fracture and size effect in concrete and other quasibrittle materials (Vol. 16). CRC press. 6. Fracture Mechanics: Fundamentals and Applications, Ted L. Anderson, Taylor and Francis, 2004. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Fracture and type of fructure |
| 2 |  Introduction to fracture-crack mechanics, Griffith-Irwin fracture theory  |
| 3 |  Linear Elastic Fracture Mechanics and Fracture Parameters  |
| 4 |  Stress Accumulation Severity Factor: Determination of basic modes (Modes I, II and III)  |
| 5 |  Mixed Mode Refraction and Superposition of Basic Modes  |
| 6 | Midterm Examination 1 |
| 7 |  Structure and fracture process of concrete |
| 8 |  Numerical and test methods for determination of fracture parameters |
| 9 |  Nonlinear fracture models for concrete  |
| 10 |  Fracture mechanics and compressive failure |
| 11 | Midterm Examination 2 |
| 12 |  Determination of the tension softening response of concrete |
| 13 |  Application of fracture mechanics to concrete structures |
| 14 |  Application to high performance cementitious materials |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Mehmet Canbaz | **Date:** |  25.03.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  Deformation Properties of Construction Materials |

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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 | 1 | 30 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Requirement for materials science, mechanical behaviour of solid materials, ideal materials and mechanical models, state of stress, state of strain, constitutive equations, rheological models, plastic strains, dislocations, strengthening of metallic materials, true stress-strain diagram of steel. |
| **COURSE OBJECTIVES** |  Beacuse of deformation properties of construction materials is important in choosing and using materials, behaviour of construction materials must be explained. It is aimed to give basic information about material behaviour in this course. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  To know the types of rheological models, to determine the model parameters with various test methods, developing the ability to develop models in accordance with material behavior. |
| **LEARNING OUTCOMES OF THE COURSE** |  Gaining knowledge and skills on basic information related with material behaviour, to determine the metarial parameters by using some mechanical models, to form the mechanical models for some material behaviours. |
| **TEXTBOOK** |  1)Hertsberg W., Richard, Deformations and Fracture Mechanics of Engineering Materials, (3rd ed.), John Wiley&Sons, 1989. 2) Hayden, H.W., Moffat, W.G. ve Wulff, J., Malzemelerin Yapı ve Özellikleri, Cilt III, Mekanik Özellikler, (Çev: K. Onaran, B. Erman)", İTÜ İnş. Fak. Matbaası, 1988. |
| **OTHER REFERENCES** |  1) Courtney T.H., Thomas, Mechanical Behavior of Materials, McGraw-Hill, New York, 1990. 2) Mc Clintock and Argon, Mechanical Behavior of Materials, Addison Wesley, 1966. 3) Postacıoğlu, B., Cisimlerin Yapısı ve Özelikleri, İTÜ Matbaası, 1981. 4)Courtney T.H., Thomas, Mechanical Behavior of Materials, McGraw-Hill, New York, 1990, 5)Onaran, K., Malzeme Bilimi, 8. Baskı, Bilim Teknik Yayınevi, 2000. 5) National and international periodical publications on the subject. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Factors affecting strength loss |
| 2 |  Mechanical behaviour of solid materials |
| 3 |  Ideal materials and mechanical models |
| 4 |  State of Stress |
| 5 |  State of strain, Constitutive Equations |
| 6 | Midterm Examination 1 |
| 7 |  Crystal structure, Viscoelasticity |
| 8 |  Rheological models |
| 9 |  Dislocations |
| 10 |  Slip planes and slip systems |
| 11 | Midterm Examination 2 |
| 12 |  Plastic deformation of polycrystalline metals |
| 13 |  Strengthening of metallic materials  |
| 14 |  True stress-strain diagram of steel |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Mehmet Canbaz | **Date:** |  30.10.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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| **COURSE** |
| **CODE** |        | **TITLE** |  Artificial Intelligence in Structural Engineering |

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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 (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm |   |    |
| Quiz |   |    |
| Homework | 2 | 20 |
| Project | 1 | 30 |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  None |
| **SHORT COURSE CONTENT** |  Programming with Python, artificial neural networks, heuristics, expert systems, artificial intelligence applications in structural engineering |
| **COURSE OBJECTIVES** |  The objectives of the course are to provide information on the artificial intelligence methods, and give the ability to use artificial intelligence methods to solve structural engineering problems to the students. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  The students can find better solutions to challenging structural engineering problems than that can be found by traditional methods; and therefore, they can design more efficient structures. |
| **LEARNING OUTCOMES OF THE COURSE** |  1. To undertand artificial neutal networks, and the ability to build artificial neural networks for structural engineering applications2. To understand heuristic algorithms, and the ability to apply heuristics to solve structural engineering problems3. To understand expert systems, and the ability to develop expert systems for structural engineering problems4. The ability to evaluate the suitability of artificial intelligence methods for a given structural engineering problem |
| **TEXTBOOK** |  Torkul, O., Gülseçen, S., Uyaroğlu, Y., Çağıl, G., Uçar, M. K., 2017, Mühendislikte Yapay Zeka ve Uygulamaları, Sakarya Üniversitesi Kütüphanesi Yayınevi, 168 p.Gülseçen, S., Fığlalı, A., Torkul, O., Selvi, İ. H., Çağıl, G., Uçar, M. K., 2018, Mühendislikte Yapay Zeka ve Uygulamaları 2, Sakarya Üniversitesi Kütüphanesi Yayınevi, 186 p. |
| **OTHER REFERENCES** |  Elmas, Ç., 2011, Yapay Zeka Uygulamaları, Seçkin Yayıncılık, 479 p. |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction and Main Principles |
| 2 |  Programming with Python I |
| 3 |  Programming with Python II |
| 4 |  Artificial Intelligence Concept and Existing Artificial Intelligence Methods |
| 5 |  Artificial Neural Networks I: Artificial neural network (ANN), concepts, and usage |
| 6 |  Artificial Neural Networks II: Training artificial networks with the backpropagation algorithm |
| 7 |  Artificial Neutal Networks III: Application - Building an ANN for a structural engineering problem |
| 8 |  Artificial Neural Networks IV: Deep neural networks and deep learning |
| 9 |  Presentations of the homeworks assigned in the sixth week |
| 10 |  Introduction of Heuristics, Heuristic, Metaheuristic, and Hyperheuristic concepts |
| 11 |  Metaheuristics I: Modern metaheuristic algorithms |
| 12 |  Metaheuristics II: Application - Solution of a structural engineering problem |
| 13 |  Expert Systems I: Introduction, concepts, and usage |
| 14 |  Expert Systems II: Application - Development of an expert system for a structural engineering problem |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assoc. Prof. Dr. Hakan ÖZBAŞARAN | **Date:** |  31.10.2019 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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

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

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

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

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

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| **COURSE** |
| **CODE** |  503312606 | **TITLE** |  Multi-Criteria Decision Making Techniques in Construction Management |

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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 | 40 |
| Quiz |   |    |
| Homework | 1 | 20 |
| Project |   |    |
| Report |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  AHP, ANP, TOPSIS, ELECTRE, PROMETHEE, Gray Relational Analysis methods and applications of Multi-Criteria Decision Making techniques |
| **COURSE OBJECTIVES** |  To provide practical techniques and decision support tools to assist in solving decision problems. To allow a logical and defensible integration of judgments with different types of information. To develop decision-making skills and to analyze problems systematically. Increasing self-confidence when making decisions |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students shall increase their ability of evaluating and managing any construction projects according to basic knowledge on information about decision making in construction project management provided by the course |
| **LEARNING OUTCOMES OF THE COURSE** |  1. Students will be able to identify errors and pitfalls that can prevent effective decision making.2. Students will be able to understand how the decision-making process works.3. Students will gain the ability to use multiple decision making techniques that will improve decision making efficiency.4. Students will gain the ability to choose among different alternatives in the decision-making process. |
| **TEXTBOOK** |  Çok Kriterli Karar Verme Yöntemleri, Bahadır Yıldırım, Emrah Önder |
| **OTHER REFERENCES** |  Çok Kriterli Karar Verme Yöntemleri ve Excel İle Problem Çözümü, Aşır ÖzbekKarar Destek Sistemlerinde Çok Amaçlı Yöntemler, Ayşe Kuruüzüm Yönetimde Çok Amaçlı Karar Verme, Füsun Ülengin, Ramazan Evren Multicriteria Decision Analysis-State of the Art Surveys, J.Figueira, S.Greco, M.Ehrgott |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Basic concepts in decision problems |
| 2 |  Decision theory |
| 3 |  Multi-criteria decision making |
| 4 |  Multi-criteria decision making – Creation of the decision model |
| 5 |  Analytical Hierarchy Process (AHP) Method |
| 6 |  Analytical Hierarchy Process (AHP) Method |
| 7 |  Analytical Network Process (ANP) Method |
| 8 |  Analytical Network Process (ANP) Method |
| 9 |  TOPSIS method |
| 10 |  TOPSIS method |
| 11 |  PROMETHEE method |
| 12 |  ELECTRE method |
| 13 |  Gray Relational Analysis method |
| 14 |  Gray Relational Analysis method |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE CIVIL ENGINEERING PhD PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (PhD)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | In civil engineering and related other fields, ability of understanding and applying mathematics, basic science and engineering science at high level | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | In civil engineering and related other fields, ability of reaching out new information and designing original research projects that bring innovation to science and technology individually, planning, managing, finalizing these projects and applying them in the field | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability of designing, planning, managing, finalizing and applying interdisciplinary and innovative projects  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Ability of presenting and publishing outcome of the academic research at all different kinds of academic meetings  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability of using at least one foreign language at a sufficient level, ability of communication and discussion in this language in verbal and writing at high level | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability of discussing, synthesizing and evaluating of new ideas and developments in his field | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability of evaluation of recent scientific, technologic, social, cultural and environmental developments; to be aware of being objective, ethical and responsible  | **[ ]**  | **[x]**  | **[ ]**  |

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| **Prepared by :**  |  Assist. Prof. Dr. Hakan KUŞAN | **Date:** |  13.10.2022 |

**Signature**: