**DEPARTMENT of INDUSTRIAL ENGINEERING**
**COURSE CATALOGUE FORM**

| **Course Code**: INDE2002 | | | | **Course Title**: Operations Research II | | | |
|---|---|---|---|---|---|---|---|
| **Semester** | **L + R + L** | **Credits** | **AKTS** | **Language** | **Category** | **Instructional Methods** | **Prerequisites** |
| 4 | 3+0+2 | 4 | 7 | English | Required | Lecture+Lab. | INDE2001 |
| **Course Objectives** | | | To teach the main topics of Operations Research; Linear Programming, Nonlinear programming and Deterministic Dynamic Programming to the students. | | | | |
| **Course Content** | | | Network Models, shortest path, maximum flow, minimum-cost network flow problems, minimum spanning tree problem. Classical optimization, optimization in one variable, convexity, unconstrained and constrained optimization in many variables, Karush-Kuhn-Tucker optimality conditions; Nonlinear programming, direct search and gradient methods. Steepest ascent and Golden Section Search methods. Deterministic Dynamic Programming. | | | | |
| **Course Learning Outcomes** | | | Students, who pass the course satisfactorily:<br>1. Demonstrate the basics of various network model, shortest path, maximum flow, critical path, minimum cost network flow problems, minimum spanning tree problems. [2, 3]<br>2. Solve nonlinear optimization with one variable, several variable, golden section, steepest ascent, Lagrange multipliers, Kuhn-Tucker conditions, Quadratic Programming. [2, 3]<br>3. Demonstrate deterministic dynamic programming technique. [2, 3]<br>4. Formulate and model engineering and managerial problems as mathematical optimization problems. [2, 3]<br>5. Use software such as GAMS and Excel for the solution of optimization problems.[4]<br><br>[*Note: Numbers in brackets are indicating the related program outcomes*] | | | | |
| **ISCED Category of the course** | | | 52 Engineering | | | | |
| **Textbook** | | | "Operations Research: Applications and Algorithms," Winston. | | | | |
| **Supplementary Material** | | | Introduction to Operations Research by Hillier, Lieberman; Optimization in Operations Research Ronald Rardin; Operations Research: An Introduction by Hamdy Taha | | | | |

**COURSE PLAN**

| Week | Topics | Laboratory / Tutorial Work |
|---|---|---|
| **1** | Introduction and overview | Web: AGRODEP GAMS Training<br>Lesson 1A: Getting Ready<br>Structure of GAMS Model |
| **2** | Network Models; Shortest Path-Dijkstra Algorithm | Web: AGRODEP GAMS Training<br>Lesson 1B: GAMS Tour |
| **3** | Network models; Maximum Flow-Ford–Fulkerson Method | Web: AGRODEP GAMS Training<br>Lesson 2: An Introduction |
| **4** | Network models; CPM Critical Path Method | Web: AGRODEP GAMS Training<br>Lesson 3: Syntax Basics<br><br>Web: AGRODEP GAMS Training<br>Lesson 4: Output Files |
| **5** | Network models; MCNFP Min. Cost Network Flow Problem,<br>MST- Minimum Spanning Tree | **Web:** AGRODEP GAMS Training<br>Lesson 5: Intermediate Syntax |
| **6** | Nonlinear programming; Review Of Differential Calculus;<br>Introductory Concepts; NLP-Convex And Concave Functions;<br>Hessian | **Web:** AGRODEP GAMS Training<br>Compilation Output<br>Error Reporting |
| **7** | Nonlinear programming;<br>NLP-one Variabe; NLP golden Section Search | **Web:** AGRODEP GAMS Training<br>Lesson 6: Advanced Commands |
| **8** | Nonlinear programming; Unconstrained Maximization and | **Web**: AGRODEP GAMS Training |

| | | |
|---|---|---|
| | Minimization with Several Variables | Logical Conditions<br>Conditional Expressions |
| **9** | Nonlinear programming;<br>The Method of Steepest Ascent ; | Web: AGRODEP GAMS Training<br>The Loop Statement, The If-ElseIf-Else Statement, The While Statement, The For Statement |
| **10** | Nonlinear programming;<br>Lagrange Multipliers | Web: AGRODEP GAMS Training<br>Lesson 7: Advanced File Management |
| **11** | Nonlinear programming;<br>The Kuhn–Tucker Conditions: Quadratic Programming | GAMS: sample problems |
| **12** | Dynamic programming;<br>Shortest Path Problem | Excel Solver; Dynamic Programming Prb. |
| **13** | Dynamic programming;<br>Inventory Problem | Excel Solver; Dynamic Programming Prb. |
| **14** | Dynamic programming;<br>Resource-allocation Problems | Excel Solver; Dynamic Programming Prb. |

**COURSE ASSESSMENT SYSTEM**

| | **Activities** | **Contribution (%)** |
|---|---|---|
| **Semester Activities** | **Semester Written Exams** | 61 |
| | **Homework** | |
| | **Reports** | |
| | **Labs** | 14 |
| | **Seminars** | |
| | **Presentations** | |
| | **Term Project** | |
| | **Other (attendance, field trip etc.)** | |
| **FINAL EXAM** | | 25 |
| **Total** | | 100 |

## CONTRIBUTION of the COURSE on INDUSTRIAL ENGINEERING PROGRAM OUTCOMES

| | Program Outcomes | Low | High |
|---|---|---|---|
| 1 | Adequate knowledge in mathematics, science and subjects pertaining to Industrial Engineering; ability to use theoretical and applied knowledge in these areas in complex engineering problems. | | |
| 2 | Ability to identify, formulate, and solve complex Industrial Engineering problems; ability to select and apply proper analysis and modeling methods for this purpose. | | X |
| 3 | Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose. | | X |
| 4 | Ability to devise, select, and use modern techniques and tools needed for analyzing and solving problems encountered in engineering practice; ability to employ information technologies effectively. | | X |
| 5 | Ability to design and conduct experiments, gather data, analyze and interpret results for investigating complex engineering problems or discipline specific research questions. | | |
| 6 | Ability to work efficiently individually and in intra-disciplinary / multi-disciplinary teams. | | |
| 7 | Knowledge of Turkish and English languages; ability to communicate effectively orally, inscriptive and visually by using these languages (via business methods such as reports, presentations and instructions). | | |
| 8 | Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself. | | |
| 9 | Consciousness to behave according to ethical principles and professional and ethical responsibility; knowledge on standards used in engineering practice. | | |
| 10 | Knowledge about business life practices (management activities such as project, risk, change and quality etc.); awareness in entrepreneurship, innovation; knowledge about sustainable development. | | |
| 11 | Knowledge about the global and social effects of engineering practices on health, environment, economics and safety, and contemporary issues of the century reflected into the field of engineering; awareness of the legal consequences of engineering solutions. | | |

## ECTS - WORK LOAD TABLE

| COURSE ACTIVITIES | Quantity | Time (hr) | Work Load (hr) |
|---|---|---|---|
| **Lectures** | 14 | 3 | 42 |
| **Final Exam (Preparation included)** | 1 | 20 | 20 |
| **Semester Written Exams (Preparation included)** | 7 | 10 | 70 |
| **Out of class study time** | 14 | 1 | 14 |
| **Homework** | | | |
| **Reports** | | | |
| **Labs** | 14 | 2 | 28 |
| **Seminar** | | | |
| **Presentations** | | | |
| **Term Project** | | | |
| **Total Load (hr)** | | | 174 |
| **ECTS Credits of the course (Total Work Load / 25)** | | | 7 |

| Revision / Date | Coordinator / Prepared By | Approved By |
|---|---|---|
| 5/02/2020 | Seyhun Altunbay | Çağlar Aksezer |