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SUBJECT:	Optimization and Operations Research
ECTS CREDITS:	6 ECTS
TEACHERS, UNIVERSITY AND EMAILS:	Rysbaiuly Bolatbek, (IITU, b.rysbaiuly@iitu.kz)
RESPONSIBLE TEACHER:	B.Rysbaiuly
LANGUAGE OF INSTRUCTION:	Russian (B.Rysbaiuly) English (B.Rysbaiuly)
ACADEMIC COURSE:	2016-17
NAME OF THE MASTER'S DEGREE:	Master's in Mathematical Engineering.

COURSE AIMS:

- Introducing students to the fundamentals of Linear Programming.
- Being able to construct the linear optimization models.
- Being able to get full analysis of model for sensitivity.
- Understanding the initial and dual problem.
- Understanding the properties of convergence and computing procedures requirements.
- Being able to apply various mathematical methods to solve the resulting problems, and be able to interpret the mathematical results physically and economically.

LEARNING OUTCOMES:

- acquire a good knowledge of problem solving with bringing solutions till the practically acceptable result;
- develop skills in full analysis of the model for sensitivity;
- develop skills in mathematical analysis of applied management and the ability to independently understand the mathematics.

COURSE SYLLABUS:

1. The Linear Programming problems

1.1. The mathematical formulation of the linear programming problem. Properties of solutions of a linear programming problem.

1.2. Construction of linear optimization models. The problem of resource allocation. Graphical method for solving the problem.

1.3. Sensitivity analysis to a change in the right sides of restrictions. Analysis of resource values. (Graphically method)

1.4. Simplex method.

1.5. Sensitivity analysis to a change in the right sides of restrictions. Analysis of resource values. (Simplex method)
1.6. A full analysis of model for sensitivity.
1.7. Initial and dual problem. The solution of the dual problem.
1.8. The compact matrix inversion methods. Penalty method. The area of applicability. Properties of convergence. Computing procedures requirements.

2. Methods for solving Transport problems.
2.1. Tasks of production planning and storage.
2.2. Construction of the basis plan. Least cost method.
2.3. Finding Initial Basic Feasible Solution. North-west corner method. Optimization of the basic plan. Solving LP by Excel.

3. Non-linear Problems of the Operation Research.
3.1. Integer programming problems. The first algorithm of Gomory.
3.2. The problem of convex programming. The Lagrange multiplier rule.
3.3. Network problem. Seasonal fluctuations in consumer demand and power suppliers. Capacity constraints.
3.4. Optimization of dynamic systems on the basis of the maximum principle.

LITERATURE:

- Basic literature:
  - [1] H.A.Taha, Operations research: an introduction.
  - [2] H.M.Wagner, Principles of operations research.
  - [3] David J. Rader, Deterministic Operations Research: Models and Methods in Linear Optimization, 2011.
  - [4] Nita H. Shah, Operations Research, 2007.
  - [5] Dimitri P. Bertsekas, Network Optimization: Continuous And Discrete Methods.
  - [6] P. Mariappan, Operations Research, 2013.
- Additional literature:
  - [7] F.S Hillier, G.J. Lieberman. Introduction to Operations Research. 7th edition. McGraw-Hill. 2001.
  - [8] J.W. Chinneck. Practical Optimization: a Gentle Introduction. 2000.
  - [9] Marc Goetschalckx, Supply Chain Engineering, 2011.
  - [10] Laurence A. Wolsey, Production Planning by Mixed Integer Programming (Hardcover), 2006.
  - [11] Singiresu S. Rao, Engineering Optimization: Theory and Practice, 1996.
  - [12] Dimitri Bertsekas, Convex Analysis and Optimization, 2003.
  - [13] Lucian Buşoniu, Reinforcement Learning And Dynamic Programming Using Function Approximators (Automation And Control Engineering), 2010.

TEACHING METHOD:

Face-to-face lectures, tutorial and lab classes, online lecture notes, tutorial solutions, peer mentoring, two office hours per week by tutors/lecturers. Videoconference to all CA partners.

METHOD OF ASSESSMENT:

60% for **Knowledge and understanding**:

- written examination which includes examination on theory taught in the lectures and practical/seminar/laboratory classes

40% for **Practical issues**:

- includes solved exercises on personal studies,
- attendance to the lab/practical/seminar classes
- Oral and written responses based on individual experience

Method of REASSESSMENT:
60% for **Knowledge and understanding**:

- written examination which includes examination on theory taught in the lectures and practical/seminar/laboratory classes

40% for **Practical issues**:

- written examination which includes solved exercises during the reassessment examination

STUDENT WORKLOAD:

On-site work at the classroom (attendance to classes and participation on them) = 60 hours.
Lecture hours: 1 hours per week
Practical and Laboratory hours: 3 hours per week
Mid term and end of term exam: 2 academic hours for each
Final exam: 2 academic hours

Self-study (autonomous study, doing exercises, programming, recommended readings) = 84 hours.

RECOMMENDATIONS:

OTHER COMMENTS: