Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
IND375	Applied Mathematical Modeling	6	3	0	0	3	4

Prerequisites	IND371
Admission Requirements	IND371
Language of Instruction	French
Course Type	Elective
Course Level	Bachelor Degree
Objective	This course introduces several different types of mathematical models, which can be used to formulate real-life problems, and the softwares GAMS and MATLAB, which can be used to solve different types of problems including linear, non-linear, integer, etc. The aim is to introduce the logic of modeling, which can further be useful for academic studies and in industry. Hence, the objectives of the course are determined as follows: • Introduce how to build mathematical models of the real-life problems. • Enable students to use the softwares GAMS and MATLAB for programming and optimization. • Enable students to analyze and interpret the results of the optimization.
Content	Introduction to GAMS and solution of a simple transportation problem through GAMS Modeling of linear programming problems (Bazaraa, Jarvis & Sherali, Chapter 1, Bertsimas & Tsitsiklis, Chapter 1) and solving linear programming problems through GAMS Sensitivity analysis in linear optimization and analysis of the results of GAMS (Bazaraa, Jarvis & Sherali, Chapter 6) Modeling of integer and mixed integer programming problems (Wolsey, Chapter 1) and solving these problems through GAMS Introduction to MATLAB and the optimization toolbox Introduction to quadratic programming (Fletcher, Chapter 2) and solving these problems through MATLAB, Markowitz Portfolio Model Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB Karush-Kuhn-Tucker optimality conditions, Lagrange multipliers, and applications for quadratic programming (Fletcher, Chapter 9) Modeling of stochastic programming problems (Birge & Louveaux, Chapter 1) and solving these problems through GAMS
References	Bazaraa, M.S., Jarvis, J.J., Sherali, H.D., “Linear Programming and Network Flows”, 4. Edition, Wiley, New Jersey, 2010 Bertsimas, D., Tsitsiklis, J.N., “Introduction to Linear Optimization”, Athena Scientific Series in Optimization and Neural Computation, Massachusetts, 1997 Wolsey, L.A., “Integer Programming”, Wiley, New Jersey, 1998 Fletcher, R., “Practical Methods of Optimization”, 2. Edition, Wiley, Chichester, 2000 Birge, J.R., Louveaux, F., “Introduction to Stochastic Programming”, Springer, New York, 1997 Williams, H.P., “Model Building in Mathematical Programming”, 6. Edition, Wiley, Chichester, 2013 GAMS Manual, downloadable from http://www.gams.com/

Theory Topics

Week	Weekly Contents
1	Introduction to GAMS and solution of a simple transportation problem through GAMS
2	Modeling of linear programming problems (Bazaraa, Jarvis & Sherali, Chapter 1, Bertsimas & Tsitsiklis, Chapter 1) and solving linear programming problems through GAMS
3	Modeling of linear programming problems (Williams, Part 2) and solving linear programming problems through GAMS
4	Sensitivity analysis in linear optimization and analysis of the results of GAMS (Bazaraa, Jarvis & Sherali, Chapter 6)
5	Modeling of integer and mixed integer programming problems (Wolsey, Chapter 1) and solving these problems through GAMS
6	Modeling of integer and mixed integer programming problems (Williams, Part 2) and solving these problems through GAMS
7	Introduction to MATLAB and the optimization toolbox
8	Midterm
9	Introduction to quadratic programming (Fletcher, Chapter 2) and solving these problems through MATLAB, Markowitz Portfolio Model
10	Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB
11	Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB

Week	Weekly Contents
12	Karush-Kuhn-Tucker optimality conditions, Lagrange multipliers, and applications for quadratic programming (Fletcher, Chapter 9)
13	Modeling of stochastic programming problems (Birge & Louveaux, Chapter 1) and solving these problems through GAMS
14	Modeling of stochastic programming problems (Birge & Louveaux, Chapter 1) and solving these problems through GAMS