AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Discrete optimisation

Academic year: 2016/2017 Code: ZIPM-3-001-s ECTS credits: 3

Faculty of: Management

Field of study: Industrial Engineering of Non-Ferrous Metals Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: prof. zw. dr hab. inż. Sawik Tadeusz (sawik@zarz.agh.edu.pl)

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Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Understands the importance of advanced decision making methods in modern enterprise.	IPM3A_K02	Examination
Skills			
M_U001	Is able to interpret solutions of discrete optimisation problems.	IPM3A_U01	Examination
Knowledge			
M_W001	Knows basic models and algorithms of discrete optimisation.	IPM3A_W02, IPM3A_W01	Examination
M_W002	Knows modelling techniques and tools applied in discrete optimisation.	IPM3A_W03	Execution of a project

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Understands the importance of advanced decision making methods in modern enterprise.	-	-	-	-	+	-	-	-	-	-	-
Skills												
M_U001	Is able to interpret solutions of discrete optimisation problems.	-	-	-	-	+	-	-	-	-	-	-
Knowledge												
M_W001	Knows basic models and algorithms of discrete optimisation.	-	-	-	-	+	-	-	-	-	-	-
M_W002	Knows modelling techniques and tools applied in discrete optimisation.	-	-	-	-	+	-	-	-	-	-	-

Module content

Conversation seminar

Discrete Optimization is an advanced course on combinatorial optimization and mixed integer programming applications in the area of production engineering and operations management.
The course consists of two parts:
1. Mixed integer programming models and algorithms.
2. Combinatorial optimization and optimization on graphs.
Highlights
• The most important production and operations management problems can be modeled as mixed integer linear programs or combinatorial and graph optimization problems.
• A comprehensive knowledge in discrete and combinatorial optimization is required to build efficient mathematical models for production and operations management problems.
Topics
3. Introduction to combinatorial optimization and mixed integer programming.
4. Problems with indivisibilities: binary vs, integer knapsack problem, bin packing problem vs. cutting stock problem. Applications of greedy and FFD heuristics.
5. Mixed integer programs for linear and quadratic assignment problems.
6. Traveling salesman problem. Subtour elimination constraints: Miller–Tucker–Zemlin vs. Dantzig–Fulkerson–Johnson formulations. Symmetric vs. asymmetric problem, vehicle routing vs. multiple traveling salesman.

7. Set covering/partitioning problem.
8. Resource and task allocation problems. Mixed integer programs for machine loading, assembly line balancing and routing problems.
9. Fixed charge problems. Mixed integer programs for location, production and inventory planning, robotized assembly cell design and loading problems.
10. Optimization on graphs: introduction to the theory of graphs and basic definitions.
11. Network flow problems. Linear programs and graph-theoretic algorithms.
12. Minimum spanning tree, maximum matching, minimum covering. Integer programs and graph-theoretic algorithms.
13. Arc routing problems. Mixed integer programs and graph-theoretic algorithms: undirected and directed chinese postman problems.

Method of calculating the final grade

Assessment (1 ECTS):
Written test. Requirements: Understanding of a few basic problems and models.
Exam (3 ECTS):
Written exam. Requirements: Understanding of all considered problems and models.

Prerequisites and additional requirements

Prerequisites and additional requirements not specified

Recommended literature and teaching resources

1. T. Sawik (1998): Badania operacyjne dla inżynierów zarządzania. (Operations Research for Industrial Engineers). AGH University Press, Kraków. (textbook in Polish).
2. T. Sawik (1999): Production Planning and Scheduling in Flexible Assembly Systems. Springer, Berlin.
3. T. Sawik (2011): Scheduling in Supply Chains Using Mixed Integer Programming. John Wiley & Sons, Inc., Hoboken, NJ (USA).

Scientific publications of module course instructors related to the topic of the module

1. T. Sawik (1999): Production Planning and Scheduling in Flexible Assembly Systems. Springer, Berlin.
2. T. Sawik (2011): Scheduling in Supply Chains Using Mixed Integer Programming. John Wiley & Sons, Inc., Hoboken, NJ (USA).

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in conversation seminars	14 h
Realization of independently performed tasks	28 h
Summary student workload	42 h
Module ECTS credits	3 ECTS