AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: VRP and Supply Chain Optimization Models

Academic year: 2019/2020 Code: ZZIP-1-614-s ECTS credits: 4

Faculty of: Management

Field of study: Management and Production Engineering Specialty: —

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

Lecture language: English Profile of education: Academic (A) Semester: 6

Course homepage: —

Responsible teacher: dr inż. Sawik Bartosz (BSawik@zarz.agh.edu.pl)

Module summary

This course will consist of two parts.
The first part includes introduction to optimization models for transportation: classification and different types of Vehicle Routing Problems (VRP). Presentation of typical applications for Vehicle Routing Problems.
In the second part includes introduction to optimization models for supply chain: classification and different types of models with considering disruptions risk: risk-neutral models, risk-averse models, mean-risk models.

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: is able to			
M_K001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	ZIP1A_U02, ZIP1A_W07	Involvement in teamwork
Skills: he can			

M_U001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	ZIP1A_U02, ZIP1A_W07	Execution of a project
M_U002	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	ZIP1A_U02, ZIP1A_W07	Execution of exercises
Knowledge: he knows and understands			
M_W001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	ZIP1A_U02, ZIP1A_W07	Test

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
60	30	0	0	0	0	0	0	0	30	0	0

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	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												

M_K001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	+	-	-	-	-	-	-	-	+	-	-
Skills: he can												
M_U001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	+	-	-	-	-	-	-	-	+	-	-
M_U002	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	+	-	-	-	-	-	-	-	+	-	-
Knowledge: he knows and understands												
M_W001	Student is able to acquire knowledge by oneself. Student is able to identify the type of VRP and Supply Chain optimization models. Student is able to identify and explain mathematical formulation of VRP and Supply Chain optimization models. Student is familiar with VRP and Supply Chain optimization models. Student knows VRP and Supply Chain optimization models.	+	-	-	-	-	-	-	-	+	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	60 h
Preparation for classes	20 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	28 h
Realization of independently performed tasks	8 h
Examination or Final test	2 h
Contact hours	2 h
Summary student workload	120 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

This course will consist of two parts. The first part includes introduction to optimization models for transportation: classification and different types of Vehicle Routing Problems (VRP): Green VRP (G-VRP), H-VRP, VRP with time window (VRPTW), the capacitated VRP (CVRP), the multi-depot VRP (MDVRP), the site-dependent VRP (SDVRP), the open routing problem (OVRP) and more. Presentation of typical applications for Vehicle Routing Problems, such as: Distribution plan for a Wholesale dealer, Garbage Disposal, Mail delivery, Mailbox collection, Security company’s rounds, Elevator maintenance, School bus routing, Airline Schedules, Snow Plows and more. In the second part includes introduction to optimization models for supply chain: classification and different types of models with considering disruptions risk: risk-neutral models, risk-averse models, mean-risk models. Optimal supplier selection problems. Selection of resilient supply portfolio under disruption risk. Disruption-driven supply chain (re)-planning and performance impact assessment with consideration of pro-active and recovery policies.

Workshops

This course will consist of two parts. The first part includes introduction to optimization models for transportation: classification and different types of Vehicle Routing Problems (VRP): Green VRP (G-VRP), H-VRP, VRP with time window (VRPTW), the capacitated VRP (CVRP), the multi-depot VRP (MDVRP), the site-dependent VRP (SDVRP), the open routing problem (OVRP) and more. Presentation of typical applications for Vehicle Routing Problems, such as: Distribution plan for a Wholesale dealer, Garbage Disposal, Mail delivery, Mailbox collection, Security company’s rounds, Elevator maintenance, School bus routing, Airline Schedules, Snow Plows and more. In the second part includes introduction to optimization models for supply chain: classification and different types of models with considering disruptions risk: risk-neutral models, risk-averse models, mean-risk models. Optimal supplier selection problems. Selection of resilient supply portfolio under disruption risk. Disruption-driven supply chain (re)-planning and performance impact assessment with consideration of

pro-active and recovery policies.

Teaching methods and techniques:
Lectures: Nie określono
Workshops: Nie określono

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:
W przypadku nieuzyskania zaliczenia w wymaganym terminie, każdemu studentowi przysługuje jeden termin zaliczenia poprawkowego na zasadach ustalonych z prowadzącym.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:
Lectures:
– Attendance is mandatory: No
– Participation rules in classes: Nie określono
Workshops:
– Attendance is mandatory: Yes
– Participation rules in classes: Nie określono

Method of calculating the final grade
Exercises 35%, project (case study) 35%, written tests 30%.

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:
W przypadku nieobecności na zajęciach decyzja o możliwości i formie uzupełnienia zaległości należy do prowadzącego zajęcia, z zastrzeżeniem zapisów wynikających z Regulaminu Studiów.

Prerequisites and additional requirements
This course is addressed to students of management, engineering and computer science.
Knowledge of English on communicative level.
Basics of mathematics including logic and algebra are required to participate.

Udział w wykładach nieobowiązkowy.
Udział w zajęciach obowiązkowy.

Recommended literature and teaching resources
ANBUUDAYASANKAR S. P., GANESH K., MOHAPATRA S. (2014). Models for Practical Routing Problems in Logistics: Design and Practices, Springer, London, UK.
SAWIK B. (2018). Weighted-Sum Approach for Bi-Objective Optimization of Fleet Size with Environmental Aspects. chapter in: Lawrence K.D., Kleinman G. (Eds.) Applications of Management Science (Vol. 19) Applications of Management Science. Bingley, UK: Emerald Group Publishing Limited, Bingley, UK, pp. 101-116
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). Multi-Criteria Optimization for Fleet Size with Environmental Aspects, Transportation Research Procedia, Vol. 27: 61-68
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). A Multicriteria Analysis for the Green VRP: A Case Discussion for the Distribution Problem of a Spanish Retailer, Transportation Research Procedia, Vol. 22: 305-313
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). Multi-Objective Traveling Salesman and Transportation Problem with Environmental Aspects. chapter in: Lawrence K.D., Kleinman G. (Eds.) Applications of Management Science (Vol. 18) Applications of Management Science. Bingley, UK: Emerald Group Publishing Limited, Bingley, UK, pp. 21-56
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). Selected Multi-Criteria Green Vehicle Routing Problems, chapter in: Lawrence K.D., Kleinman G. (Eds.) Applications of Management Science (Vol. 18)

Applications of Management Science. Bingley, UK: Emerald Group Publishing Limited, Bingley, UK, pp. 57-84
SAWIK T. (2018). Supply Chain Disruption Management Using Stochastic Mixed Integer Programming, Springer, New York, USA.

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

ANBUUDAYASANKAR S. P., GANESH K., MOHAPATRA S. (2014). Models for Practical Routing Problems in Logistics: Design and Practices, Springer, London, UK.
SAWIK B. (2018). Weighted-Sum Approach for Bi-Objective Optimization of Fleet Size with Environmental Aspects. chapter in: Lawrence K.D., Kleinman G. (Eds.) Applications of Management Science (Vol. 19) Applications of Management Science. Bingley, UK: Emerald Group Publishing Limited, Bingley, UK, pp. 101-116
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). Multi-Criteria Optimization for Fleet Size with Environmental Aspects, Transportation Research Procedia, Vol. 27: 61-68
SAWIK B., FAULIN J., PÉREZ-BERNABEU E. (2017). A Multicriteria Analysis for the Green VRP: A Case Discussion for the Distribution Problem of a Spanish Retailer, Transportation Research Procedia, Vol. 22: 305-313
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SAWIK T. (2018). Supply Chain Disruption Management Using Stochastic Mixed Integer Programming, Springer, New York, USA.

Additional information

None