Course description

1 General information

Course name	Modeling and Optimization of Production Systems
Course code	M6-MO
Level of study (B.Sc., M.Sc., Ph.D.)	B.Sc.
ECTS	3
Course manager	Ph.D. Eng. Waldemar Małopolski, Char of Production Engineering
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- Knowledge of production systems and intralogistics

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	14			14	14	

3 Contents

Lectures		
No.		Hours
1	Introduction to modeling and simulation of production systems. Basic definitions. Characteristics of discrete processes.	2
2	Principles and stages of building simulation models.	2
3	3D modeling and simulation of discrete production systems.	2
4	Modeling and simulation of logistics, transportation, and warehousing systems.	2
5	Model validation and conducting simulation experiments.	2
6	Objectives and methods of production system optimization; interpreting optimization results.	2
7	Advanced tools and techniques in simulation modeling.	2

Computer labs		
No.		Hours
1	Building 3D models and simulating the performance of production systems.	2
2	Input data parameterization; flow control; triggers; output data extraction and basic analysis.	2
3	Modeling and simulation of conveyor-based transport systems.	2
4	Modeling and simulation of discrete transport systems (forklift, AGV, AMR).	2
5	Modeling an integrated production system with an internal transport subsystem.	2
6	Advanced modeling using programming tools and presenting models through virtual reality demonstrations.	2
7	Developing a production system model and performing its optimization.	2

Project		
No.		Hours
1	Developing a model of a complex transportation system and simulating its operation.	4
2	Developing a complex production system model with an internal transport subsystem and running simulation experiments.	6
3	Optimization study for the complex production system (scenario design, KPIs, recommendation report).	4

3 Learning Outcomes (skills and knowledge):

- Student possesses the knowledge to explain key concepts of discrete-event production and logistics systems and the rationale for simulation-based decision support.
- Student possesses the knowledge to describe the workflow of simulation model development (conceptualization, data collection, verification/validation, experimentation) and select suitable tools.
- Student possesses the knowledge to build and debug 3D discrete-event simulation models of production, transport, and warehousing subsystems.
- Student possesses the knowledge to design simulation experiments, analyze model outputs (KPIs), and interpret optimization results to propose process improvements.

4 Assessment policy (examination):

- Lecture component: short tests/quizzes covering fundamental concepts.
- Computer labs: completion of practical tasks and submission of lab reports (each lab).
- Project: model quality, experiment/optimization design, written report and individual presentation.

5 Literature

1. Law A. M., Simulation Modeling and Analysis, (6th ed., 2024, McGraw-Hill),
2. Cassandras C. G., & Lafortune S., Introduction to Discrete Event Systems (3rd ed.,2021, Springer),
3. Greenwood A., FlexSim Simulation Software Primer (5th ed., 2025, Autodesk Inc.),
4. FlexSim Documentation (User Manual/Online Docs).