GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Subject name and code | Computer simulation and processes' optimization in production management, PG_00064730 | | | | | | |
| Field of study | Management and Production Engineering | | | | | | |
| Date of commencement of studies | February 2025 | | Academic year of realisation of subject | 2025/2026 | | | |
| Education level | second-cycle studies | | Subject group | Specialty subject group<br>Subject group related to scientific research in the field of study | | | |
| Mode of study | Full-time studies | | Mode of delivery | at the university | | | |
| Year of study | 1 | | Language of instruction | Polish<br>Polish | | | |
| Semester of study | 2 | | ECTS credits | 5.0 | | | |
| Learning profile | general academic profile | | Assessment form | exam | | | |
| Conducting unit | Department of Manufacturing and Production Engineering -> Faculty of Mechanical Engineering and Ship Technology | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Mieczysław Siemiątkowski | | | | | |
| | Teachers | | | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 15.0 | 0.0 | 30.0 | 0.0 | 75 |
| | E-learning hours included: 0.0 | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | | Participation in consultation hours | Self-study | | SUM |
| | Number of study hours | 75 | | 11.0 | 39.0 | | 125 |
| Subject objectives | Imparting structured knowledge in creating models, preparing experiments and conducting simulation analysis of production processes running in systems of different forms and layout organization as well as defining optimisation problems. Development of the ability to formulate optimisation models in the environment of interactive computer simulation and with the use of analytical approach, along with quantitative evaluation of the experimentation results, including the generated descriptive type statistics. | | | | | | |

## Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_W02] demonstrates structured and theoretically based knowledge covering key issues in the field of Management and Production Engineering allowing for modeling and analysis of stationary and non-stationary production processes and systems, devices and technological processes with continuous and discrete operation | Demonstrates an extended and structured knowledge of the theory of organization of the structures of production systems of different categories in association with relwevant aspects of their practical applications, as well as planning and multi-faceted analysis of discrete and continuous production process runs using simulation modeling methods, taking into account the needs of their structural and parametric optimization. | [SW1] Assessment of factual knowledge<br>[SW3] Assessment of knowledge contained in written work and projects |
| [K7_K01] is aware of the importance and understanding of non-technical aspects and effects of engineering/production activities, including its impact on the environment and the related responsibility for decisions made, demonstrating knowledge of actions aimed at reducing risk and anticipating the social and environmental effects of engineering/production activities | The student will understand the non-technical aspects and effects of working systems incl. their impact on the environment and the social effects resulting from engineering and production activities. He/she will make decisions taking into account publicly available information and opinions on production management limiting the scope for risky actions. | [SK3] Assessment of ability to organize work<br>[SK5] Assessment of ability to solve problems that arise in practice<br>[SK1] Assessment of group work skills |
| [K7_U04] creatively designs or modifies, in whole or at least in part, production and technological systems and processes, in accordance with the given specifications, taking into account technical and non-technical aspects, estimating costs and using known design techniques appropriate for tasks in the field of Management and Production Engineering | Is capable of developing a conceptual and computer model of variants of technological and production processes on the basis of specific specifications and technical-organisational conditions of operation research simulation analysis and non-technical aspects appropriate to the field of study. | [SU4] Assessment of ability to use methods and tools<br>[SU3] Assessment of ability to use knowledge gained from the subject<br>[SU2] Assessment of ability to analyse information |
| [K7_W13] explains the main principles of individual and teamwork organization, including various forms of entrepreneurship utilizing knowledge from the field of engineering and technical sciences and disciplines relevant to the course of study | Has adequate knowledge of the subject area relevant to the field of study necessary to understand the technical and economic conditions of production systems, including the principles of organisation of the product/process engineer's own work and activities in a team environment. | [SW1] Assessment of factual knowledge<br>[SW3] Assessment of knowledge contained in written work and projects |

## Subject contents

LECTURE: Structure and decomposition of discrete manufacturing processes (DPP). Computer simulation in the analysis and planning of DPP. Forms for representation and visualization of DPP runs. Scheduling of cellular DPP runs realise sequentially or in-prallel. Mapping the DPP organization using selected descriptive methods, i.e. IDEF0 (Integrated Definition for Function Modeling) and BPMN (Business Process Modelling Notation), Classification of simulation models in the analysis of system behaviour dynamics. Procedure for running a simulation project. Factorial analysis, developing its scenarios and organization of simulation experiment. Validation and verification in simulation modelling. Semantic and statistical interpretation of the results of simulation studies. Discrete linear programming in optimization tasks of planned DPP implementation. Comparative evaluation of analytical and simulation modelling applications in studying production runs.

EXECISES: Analysis and evaluation of functionalities and the capability of Witness® interactive simulation studies of discrete manufacturing processes (DPP). Analysis of material flow structures and optimisation of operational schedules for a specific production programme and system capacity within Preactor APS (Advanced Planning & Scheduling) software environment. Typical calculations of the parameters of running production processes and their relavant performance.

PROJECT ACTIVITIES: Conceptual modelling of process variants with resource-defined cellular machining system; development of a computer model development of its operation using libraries of structural objects and visualisation of DPP runs, considering the variability factors; validation and verification of models and experimentation with alternative process variant, generation of reports for quantitative evaluation of scheduled process runs. Parametric factorial analysis - and interpretation of generated descriptive statistics. Analysis and evaluation of fabrication processes of welded mechanical structures, incl. formulation of objective function and related constraints in analytical modelling; selection of optimised solutions for DPP organisation, using linear programming technique in discrete sets.

| | |
|---|---|
| Prerequisites and co-requisites | Knowledge of the basic issues of technological machinery features, process organization and operation of production systems, as well as operations research and statistical data analysis. |

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Report with results of computational task | 59.0% | 20.0% |
| Final report of design work | 59.0% | 40.0% |
| The written test for credit | 59.0% | 40.0% |

**Recommended reading**

Basic literature


1. Gola A.: Modelowanie i symulacja procesów wytwórczych (Workbook). Zintegrowany Program Rozwoju Polit. Lubelskiej, www.pl2022.pollub.pl, Lublin 2020.

2. Kusiak J., Danielewska-Tułecka A., Oprocha P.: Optymalizacja. Wybrane metody z przykładami.. Wyd. Naukowe PWN, Warszawa 2021.

3. Sawik T.: Optymalizacja dyskretna w elastycznych systemach produkcyjnych. WNT, Warszawa 1992.

4. Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji, z przykładami zastosowań technicznych. WNT, Warszawa 2006.


Supplementary literature


1. Antczak P., Antczak A., Witkowski T.: Optymalizacja przepływu produkcji seryjnej. PWE, W-wa 2016.

2. Zdanowicz R.: Modelowanie i symulacja procesów wytwarzania, Wyd. Politechniki Śląskiej, Gliwice 2002.

3. Witness Horizon v.24.0, Simulation modelling software, User manual & tutorials, www.lanner.com, Lanner Group Ltd, Redditch, Worcs 2021.


eResources addresses: Adresy na platformie eNauczanie:

**Example issues/ example questions/ tasks being completed**

Classification of production systems in terms of applications in the tasks of their simulation analysis.
Formulation of optimization models in linear programming for discrete variables.
Algorithmisation of discrete production processes (DPP) using Petri net formalism and the concept Grafcet.
Technical-organizational calculations for cellular - and flow-type organisation forms of production processes.
Descriptive formalisation of production process flow and the form of their representation as an object of simulation studies.
Graph modelling and formalization of activity network notation in the description of the courses of diverse categories of production processes.
The essence of deterministic and stochastic models, with a comparison of their usability in simulation analysis.
Specification of selected of production planning and systems engineering in terms of the adequacy in computerised discrete simulation.
Introduction of variability into the simulation model of discrete manufacturing systems: typical applications of random variable distributions for parameters with integer and real values.
The procedure of activities realised within a simulation project concerning the operation of a production system.
The principles of creating a plan for simulation studies of factors of variation in the alternative runs of production process.
The function and importance of validation and verification of dynamic simulation models of the manufacturing process.
Selected descriptive statistics of simulated production process runs and forms of their visualization and interpretation in an experiment.
Techniques for modelling and visualization of DPP runs for simulation

**Work placement**: Not applicable

Document generated electronically. Does not require a seal or signature.