GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of production processes, PG_00059496		
Field of study	Management and Production Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group 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
Semester of study	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Technologii Maszyn i Automatyzacji Produkcji -> Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mieczysław Siemiątkowski	
	Teachers	dr inż. Mieczysław Siemiątkowski	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	30.0	0.0	60
	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	60	7.0	33.0	100

Subject objectives	Transfer of systematized knowledge in the field of planning production and logistic processes realised in up-to-date manufacturing systems, for various types and forms of their organization, using methods and means of flexible automation and logistic and information integration of material flows. Presentation of the possibilities for rationalised and optimised production runs under the conditions of existing technological limitations of the criteria of efficiency and flexibility of product manufacturing.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U04] is able to plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and extract conclusions; can use analytical, simulation and experimental methods to formulate and solve engineering tasks	Students demonstrate the ability to develop a computer model of variant process runs based on of a specified conceptual model within the framework of a simulation analysis task, to carry out a cycle of assumed experimental studies of these runs according to formulated scenarios, and perform semantic and statistical evaluation of results derived; moreover, the have the ability to formulate optimization problems in the area of production engineering and solve them using analytical techniques of operations research.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K7_W02] has extended knowledge covering key issues characterizing production processes	Has an extended knowledge of the modelling the structures, planning and multi-faceted analysis of production and logistics process runs in the area of mechanical engineering using analytical and adequate simulation methods, taking into account the needs of structural and parametric optimization of material flows.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_K05] is able to integrate the possessed knowledge from various scientific disciplines, and in the innovative implementation of engineering tasks also take into account system and non-technical aspects, including ethical ones	In solving engineering tasks, is able to use the acquired technical knowledge from different fields, in a consistent manner and according to the system approach; in tasks that require an innovative approach - also take into account non-technical elements while demonstrating the characteristics of ethical conduct.	[SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills
[K7_K01] is aware of the need to expand knowledge and verify the methods of solving problems by consulting experts	Fully understands the need to constantly expand neccessary knowledge and develop skills to solve the engineering problems encountered and to consult experts in the wake of ongoing advances in the fields of technology, decision-making systems and information technology.	[SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills

Subject contents

LECTURE: Layout structure, classification and decomposition of discrete production processes (DPP). Models of DPP flows for typologies and forms of production organization, incl. those in terms of group technology. Planning production flow, its organization and system capacity. Scheduling DPP of the cellular- and flow- type. Algorithms and heuristics for scheduling production tasks. Dispatching rules for scheduling production orders. Operational scheduling optimization criteria. Parameters for evaluation of DPP implementations, utilization of worktime standards and system capacity, trade-off evaluation. Modelling algorithms for sequential and concurrent processes. Mapping DPP organization using selected descriptive methods, i.e. IDEF0 (Integrated Definition for Function Modeling) and BPMN (Business Process Modelling Notation). Modeling process runs using UML (Unified Modelling Language) activity diagrams, Petri net formalism and Grafcet approach. Analytical and simulation modelling in research and quantitative evaluation of production runs. Discrete linear programming in optimization tasks in planning DPP realisations

PROJECT WORK: Modelling production structures and rationale for planning organization of PP in terms of group technology, with the use of multidimensional data mining techniques in the environment of Statistica software package; construction and ranking evaluation of generated operational schedules of DPPs, using adequate task scheduling algorithms for a specific production program and system capacity characteristics in the environment of Preactor APS (Advanced Planning and Scheduling) program; modelling variant realisations of processes of fabrication of welded mechanical structures with the use of graph methods and flow networks, selection of means for accomplishing technological operations, transport tasks as well as storage and palletization of semi-finished products and end products; selection of optimized solutions for process organization with the use of linear programming technique in discrete sets.

Prerequisites and co-requisites

Essential knowledge of manufacturing techniques, features of technological machinery, production process organization and applications of basic operations research techniques.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Final report of design work	58.0%	50.0%
Final written colloquium	58.0%	50.0%

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Gawlik J., Plichta J., Świć A.: Procesy produkcyjne. PWE, W-wa 2013.

2. Lasota A.: Modelowanie procesów produkcyjnych z wykorzystaniem diagramów aktywności języka UML i sieci Petriego. Exit, W-wa 2012.

3. Mazurczak J.: Projektowanie struktur systemów produkcyjnych, Wyd. Politechniki Poznańskiej, Poznań 2002.

4. Sawik T.: Optymalizacja dyskretna w elastycznych systemach produkcyjnych. WNT, W-wa 1992.</td></tr>
<tr><td>Supplementary literature</td><td>1. Kost G., Łebkowski P., Węsierski Łukasz N.Automatyzacja i robotyzacja procesów produkcyjnych. PWE, W-wa 2013.

2. Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji , z przykładami zastosowań technicznych. WNT, W-wa 2006.

3. Zdanowicz R., Świder J.: Komputerowe modelowanie procesów wytwórczych. Wyd. Politechniki Śląskiej, Gliwice 2013.

4. Preactor® APS (Advanced Planning & Scheduling), Operation manual, Preactor Intl. Ltd. UK, Chippenham, Wiltshire 2013.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Modelowanie przebiegów procesów produkcyjnych, w, p, ZiIP, IPP, 2 st., sem. 02; zimowy 2023/2024 (PG_00059496) - Moodle ID: 34131 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34131</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Principles of rational organization of the production process.
Formulation of the production program and description of the level of production capacity of the system.
Organization of the production process flow according to the assumptions of group technology.
Formulation of optimization models in linear programming for discrete variables.
Assumptions and factors determining the selection of solutions in planning the production structures.
Algorithmization of discrete production processes (DPP) using Petri net formalism and Grafcet technique.
Assumptions of the concept of modelling production runs, using activity diagrams and principles of Unified Modelling Language (UML) approach.
Technical and organizational calculations for cellular flow organization forms of production.
Production process cycle planning for serial and concurrent manufacturing execution.
Graph modelling and formalization of activity network notation in describing the courses of various categories of production processes.
The essence of deterministic and probabilistic models with a comparison of their usefulness in simulation analysis.
Introduction of variability into the simulation model of a discrete manufacturing system: typical applications of random variable distributions of parameters with integer and real values.
Procedure of activities performed in the framework of a simulation project on the operation of a manufacturing system.
Principles of planning simulation studies for specific factors of variation in the course of the production process.
Techniques of modelling and visualization of DPP test runs for simulation studies.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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