GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling and simulation of manufacturing processes, PG_00040012		
Field of study	Management and Production Engineering, Management and Production Engineering		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
Education level	first-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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
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	dr inż. Mieczysław Siemiątkowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	30.0	0.0	60

E-learning hours included: 0.0

Address on the e-learning platform: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=12511

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

Transferring systematic knowledge in the field of modelling methods, data logging as well as conducting simulation experiments related to production system operation and related flow of discrete manufacturing processes. Developing skills concerning: formulation of objectives, development of relevant models mapping attributes and functions of individual system components, and logic of interrelated cooperation for the needs of intended simulation studies, along with the capabilities for quantitative evaluation of generated descriptive statistics .

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_K03	Adequate understanding the role of a graduate of a technical university in modern society, including the awareness of responsibility for decisions taken, within the scope of the professional activity, with regard to the natural environment; awareness of the need to formulate opinions on the technological achievements, and convey to the society adequate information on the benefits of their use and potential threats; Able to identify cases of ineffective actions in the area of production organisation and assertively postulate the need for changes.	[SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice

Subject contents	LECTURE: The essence and objectives of modeling and simulation applications. Computer simulation in the analysis of discrete production processes and systems (DPP/DPS). Forms of DPS representation. Production system as the object of modelling. Classification of DPS operation models. Deterministic, and probabilistic models. Static and dynamic analysis of operating system behaviour. The formalism of Petri nets and its applications in simulation analysis. Variability of parameters and stochastic processes in event-driven simulation. Operational procedure of a simulation project. Data logging and structuring. Techniques and tools for building descriptive models of real world systems. Queuing models and job sequencing. Creating scenarios and the organization of simulation experiments. Model validation and verification. Time-related process flow visualization. Semantic - and statistical interpretation of experimental results. LABORATORY: Studying the functionality and application capabilities of WITNESS® interactive computer simulation system appropriate for investigating discrete manufacturing processes (DPP). Formalisation of characteristics of a conceptual operation model of a flow-type machining system with conveyor transportation means. Technique for building computer model using libraries of structure modelling elements. Modelling the principles of machine resources operation, programming the logic of their interaction and the scheme for accomplishing the material flow , modelling the variability factor (randomness) in a simulation model; running simulation models in the selected software environment, event validation and verification of a dynamic model; techniques of experimenting with a simulation model, generating reports and visualisation of DPP runs under study along with their evaluation according to standard criteria of quantitative description. PROJECT ACTIVITIES: Modelling and simulation of discrete production processes, using WITNESS® (visual interactive simulation software).Definition of research objectives; decomposition of the structure and function of modelled cellular system and related DPP for the accomplishment of definite production programme (a chosen parts spectrum); compilation of data for variant runs of the. Formulation of relations among data and the logic concerning the system operation. Structural design of material flow, validation and verification of developed model. Selecting scenarios and the formalization of the simulation procedure. Pilot simulation and the proper simulation runs. Analysis and interpretation of the statistics generated, and quantitative evaluation of the DPP runs and the behaviour of the cellular system under study, using available techniques for graphical visualisation of the results rerived from simulation experiments.
Prerequisites and co-requisites	**Knowledge of the basic issues related to: production process organization, statistical data analysis and operations research.**

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Final report of design work	55.0%	35.0%
Report on laboratory execises	55.0%	25.0%
The written test for credit	55.0%	40.0%

Recommended reading

Basic literature	1 Hromada J., D. Plinta D.: Modelowanie i symulacja systemów produkcyjnych, Wydawnictwo Politechniki Łódzkiej, Bielsko- Biała 2000. 2. Praca zbiorowa.: Inżynieria produkcji. Planowanie, modelowanie, symulacja, Patalas-Maliszewska J., Jakubowski J., Kłos S. (red.), Uniwersytet Zielonogórski, II i ZP, Zielona Góra 2015. 3. Robinson S.: Simulation: The practice of model development and use, John Wiley & Sons Ltd., Chichester, England 2004. 4. Zdanowicz R.: Modelowanie i symulacja procesów wytwarzania, Wyd. Politechniki Śląskiej, Gliwice 2002
Supplementary literature	1. Gregor M.et al.: Simulation of manufacturing systems, Wydawnictwo Politechniki Łódzkiej, Filia w Bielsku-Białej, Bielsko-Biała 1998. 2. Lis S., Santarek K., Strzelczak S.: Organizacja elastycznych systemów produkcyjnych, PWN, Warszawa 1994. 3. Witness 2006. Visual Interactive Simulation Software, User manual, Lanner Group Ltd, Redditch, Worcs 2001-2006.
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Classification of production systems models considering their application to related computer aided simulation analysis. 2. Formalisation of system characteristics for a machine tools based manufacturing facility, and its representation schemes as an object of simulation analysis. 3. The usability of graph modeling and two other selected techniques (e.g. IDEF0 or EDPC Event driven Process Chain) applied to building static- type descriptive models of a manufacturing system operation. 4. Comparing the nature of deterministic and probabilistic models and their usefulness for efficacy of simulation investigation. 5. Specification of basic issues in the area of industrial and systems engineering giving reasons for a justifiable use of computer simulation. 6. Building variability into simulation model of a discrete production system: exemplary applications of integer and real distributions of process parameters. 7. The outline of consecutive activities in the frame of a simulation project related to studying the operation of production system. 8. General principles on building scenarios of simulation studies for determined factors of variability concerning realised production process flows. 9. The function and importance of validation and verification of dynamic simulation models in the production area. 10. Description of system modeling capabilities by Petri nets formalism with regard to machine tool stand operation with transportation facility and tended by human operator (a), or an industrial robot (b). 11. Criteria for quantitative assessment of production system operation and descriptive material flow statistics derived from simulation experimental process runs. 12. Graphical visualisation and statistical interpretation of output results gained in simulation experiments aimed at the analysis of manufacturing system operation.
Work placement	Not applicable