GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Integrated manufacturing systems, PG_00059368		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Part-time studies	Mode of delivery	blended-learning
Year of study	1	Language of instruction	Polish
Semester of study	1	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 dr inż. Dawid Zieliński	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	18.0	0.0	9.0	9.0	0.0	36
	E-learning hours included: 18.0						

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	36	10.0	54.0	100

Subject objectives	Transfer of systematized knowledge on design, planning, and operation of modern production systems based on flexible automation, and using means of logistic and informational integration for material flows. Presenting the possibilities for production rationalisation and optimisation based on available material handling and processing capabilities of machinery and related tooling, including practising with prototyping and quantitative analysis of generated process flow alternatives.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W06] possesses organized, profound knowledge necessary for designing and optimization of complex technological processes, modelling and calculations using numerical methods, knows modern manufacturing methods and tools for designing manufacturing processes of machines, devices, their elements and components	Possesses adequate knowledge of the factors determining the course of discrete production processes in mechanical technology and comparative analysis and evaluation of the effectiveness of variant solutions of production system structures for the production of a specific range of items, with the participation of solutions taking into account the introduction of specific process-type innovations, and aimed at improving the operation of this system.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
	[K7_U07] is able to perform a preliminary economic analysis of the undertaken engineering actions within the range of design, production and operation of machines and technical devices	Demonstrates the ability to quantitatively evaluate the performance of production systems and perform a preliminary economic analysis of planned engineering activities in the field of automation of production systems and the operation of machinery and technical equipment. Has knowledge of the operation of automated manufacturing systems and methods of selection of means of implementation of tasks and components of the process and planning its course in the conditions of systematic integration of production.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K7_W10] possesses knowledge on the methods of technical and economic analysis of industrial systems and optimization of manufacturing systems; is familiar with the general principles of initiating and developing forms of individual entrepreneurship, particularly for innovative projects using the knowledge	Knowledge acquired on available methods and technical solutions and the existing limitations in the scope of cooperation of technological machines performing operations of manufacturing process, equipment for material storage, means applied to the tasks of internal transport (related material flows), inspection control and supervision of the entire production process. The assimilated knowledge includes understanding the essence of operation of functionally integrated production systems for various forms of their organization in relation to encountered and representative solutions currently found in industrial practice.	[SW1] Assessment of factual knowledge

Subject contents

LECTURE: Components of a manufacturing process (definitions and terms). Contemporary concepts for the organisation of discrete manufacturing system and taxonomy of processing operations. fanctional an d information-based Integration of process components: machining (manufacturing), material flow (transportation), information flow and process control. Numerical control and automatic regulation. Automation components for machine tools and their systems. Automation versus flexibility and production scale. Productivity and the degree of system autonomy. Flexibly automated CNC machine tools, multi-tasking machines and autonomous stations for integrated manufacturing. Flexible manufacturing systems (FMS) technology. Measures for FMS integration: transportation and material (part/tooling) handling subsystems using manipulators and industrial robots. Integration of process flow functions. Typologies of production facility organisation. The stationary system layout. group-technology concepts by clustering objects. Cellular and linear forms of layout organisation.

PROJECT WORK: Parts spectrum selection for manufacture in a cellular-type manfacturing system. Formulating conditions for integrated group machining. Formalising the description of requirements and structures of processes and mapping the material flows using graph modelling. Selecting machine resources for realisation of technological operations. Selecting solutions concerning the transport structure, means of transport tasks execution and techniques for storage and palletising of semi-finished and finished products, under conditions of functional integration of system components. Basic manufacturing calculations in terms of discrete process flow for the established system layout and form of its organisation.

LABORATORY: Comparative analysis of capabilities of technological machines in automated process operation for various part classes based catalogues and internet databases. System development for with machine resources for integrated manufacturing. Parts spectrum formalisation for cellular manufacturing with established process sequences s and adequate material flows to be implemented in the environment of Preactor APS (Advanced Planning and Scheduling) softwaret. Visualisation of material flows and their quantitative evaluation. Deriving the experimental results in the form of operational schedules, including their proper interpretation and qyuantitative evaluation.

Prerequisites and co-requisites

Basic knowledge of manufacturing technologies, the structure and operation of machine tools as well as production organisation.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Reports of laboratory excercises	58.0%	25.0%
Final report of design work	58.0%	25.0%
Final written colloquium of lectures	58.0%	50.0%

Recommended reading

Basic literature

1. Charczenko A., Świć A., Taranenko W.: Obrabiarki i urządzenia technologiczne w produkcji elastycznej, Politechnika Lubelska, Lublin 2011
2. Groover M.P.: Automation, production systems, and computer-integrated manufacturing, 3rd Edition, Pearson Prentice - Hall, New Jersey 2008.
3. Honczarenko J.: Oraiarki sterowane numerycznie, Warszawa, WNT, Warszawa 2008.
4. Pająk E.: Zarządzanie produkcją. Produkt, tecnologia, organizacja, PWN, Warszawa 2013.

Supplementary literature

1. Design of flexible production systems, Methodologies and tools, T. Tolio (Editor), Springer-Verlag, Berlin Heidelberg, 2009.
2. Kalpakjian S., Schmid S.R.: Manufacturing Engineering and Technology, 7th Edition, Pearson Education, Inc 2014.
3. Machine tools for high performance machining, L.N. Lopez de Lacalle, A. Lamikiz (eds), Springer Verlag London Ltd. 2009.
4. Nasalski Z., Romaniuk K., Wichowska A., Chrobocińska K., Szczubełek G.: Zintegrowane systemy wytwarzania, UWM, Olsztyn 2014.
5. Preactor® APS (Advanced Planning & Scheduling), Operation manual, Preactor Intl. Ltd. UK, Chippenham, Wiltshire 2009.

eResources addresses

Adresy na platformie eNauczanie:

Zintegrowane Systemy Wytwarzania, w/l/p; MiBM, st. 2, SN, sem.01; letni 2022/2023 (PG_00059368) - Moodle ID: 29039
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29039

Example issues/ example questions/ tasks being completed	1. The concepts of concentration and differentiation of process operations in the view of the increase in its productivity. Measures taken to create structures of integrated operations in parts machining. 2. The idea of total (complete) machining and the possibilities for its realisation considering the processing capabilities of contemporary work centres. 3. Techniques and the means used in modelling manufacturing systems operation and related process flow. 4. The functional structure of a typical FMS, including basic means designated to perform those functions. 5. Quantitative metrics used in the description of automation level and flexibility attributes of process performance in single- and multi-machine parts manufacturing systems. 6. Geometric structures and kinematics of definite types of flexibly automated CNC machine tools applied to integrated manufacturing systems for: a) rotational , and (b) prismatic parts. 7. Technical and organisational conditionings determining the realisation capabilities of multi-part machining in integrated manufacture. 8. The determiners of manufacturing facility layouts along with machine tool selection versus production quantity and the requirements concerning the parts spectrum manufactured. 9. Layout classification and operational attributes of multi-machine integrated machining systems. 10. Classification factors for the typology of complex parts processing operations, performed in single-machine based FMSs 11. Palletization equipment and workpiece flow integration for machine tools operation in integrated production systems 12. Material handling techniques and capabilities of the resources concerning parts flow used in dedicated flexible manufacturing cells. 13. Classification scheme and related features of machines used in integrated manufacturing processes of differentiated parts spectrum. 14. Application features and criteria used in equipment selection for parts and tooling storage under the demands of integrated production. 15. Part inspection technologies and relevant measurement equipment used in automated and integrated systems of production.
Work placement	Not applicable