GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Integrated manufacturing systems, PG_00064823		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
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	Full-time studies	Mode of delivery	at the university
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	Division of Manufacturing and Production Engineering -> 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 dr inż. Ewa Kozłowska	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	15.0	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	6.0	34.0	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_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study	Be able to critically evaluate the applicability of contemporary approaches and technological innovations when applied to the tasks of planning and analysis of modern manufacturing systems operation in the field of mechanical engineering.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K7_U04] creatively designs or modifies devices, processes or systems specific to Mechanics and Mechanical Engineering, using computer-aided design systems in the form of technical documentation, taking into account aspects of economic analysis, using appropriate tools and techniques	Demonstrates the ability to carry out a critical, economically justifiable selection of technological machines and related equipment, to develop structures of automated manufacturing systems and to plan the runs of discrete manufacturing processes appropriate to the field of study, using contemporary techniques for analysing and documenting technical solutions and the means of computer support.	[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_W02] demonstrates a structured and theoretically grounded knowledge of the key topics in Mechanical Engineering enabling the analysis and modelling of mechanical systems, processes and devices	Demonstrates a systematic knowledge, based on familiarity with the theoretical underpinnings, of the key issues in the field of the represented field of study, and which is necessary for the analysis of the interoperability of technological machines in manufacturing systems, modelling of diverse forms of their organisation and the multi-faceted studies of discrete process flows.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
[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 of team-working.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents

LECTURE: Elements of a manufacturing process (definitions and terms). The structure and functions of a production system. Integration forms of process components: machining (manufacturing), material flow (transportation), information flow and process control. Classification of machine tool control technologies. 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, machining centers and autonomous machining stations in integrated manufacturing systems (IMS). Flexible manufacturing systems (FMS). Factors and measures for FMS integration: transportation and material (part/tooling) handling subsystems using manipulators and industrial robots. Integration of process flow functions. Surveillance and diagnosis in FMS. FMS operation and process flow control. Typologies of production facility organisation. The stationary system layout. Cellular and linear forms of layout organisation. The means for hybrid manufacturing technology realisation.

PROJECT WORK: Criteria-based selection of prts spectrum and specific assortment items manufactured in cellular type manfacturing system. Development of 3-D models for parts - representatives of different technological types. Formulating conditions for integrated group machining by the model of flexibly automated production. 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 pattern and form of its organisation.

LABORATORY: Comparative analysis of capabilities of technological machines in operations of automated machining of objects of various classes using catalogue resources and internet databases. Construction of a system using a defined set of resources for the realisation of tasks of functionally integrated manufacturing. Development of a relational database structure model for specific lists of machine resources of a functionally integrated manufacturing system of the socket type, established sequences of technological operations and adequate material flows with the implementation in the Preactor APS (Advanced Planning and Scheduling) software environment. Visualisation of material flows and their quantitative evaluation. Analysis of conditions concerning the changeover of system resources. Analysis of variant solutions of the manufacturing process taking into account flexibility and system integration conditions. Generation of results of production system operation in the form of operational schedules and their interpretation. Analysis and assessment of conditions of realisation of different concepts of operation of the examined manufacturing system.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">Basic knowledge of manufacturing technologies, the structure and operation of machine tools as well as production organisation.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Final written colloquium of lectures</td><td>58.0%</td><td>50.0%</td></tr>
<tr><td>Raports of laboratory activities</td><td>58.0%</td><td>25.0%</td></tr>
<tr><td>Final report of design work</td><td>58.0%</td><td>25.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Design of flexible production systems, Methodologies and tools, T. Tolio (Editor), Springer-Verlag, Berlin Heidelberg, 2009.
2. Groover M.P.: Automation, production systems, and computer-integrated manufacturing, 3rd Edition, Pearson Prentice - Hall, New Jersey 2008.
3. Honczarenko J.: NC controlled machine tools (in Polish), Warszawa, WNT, Warszawa 2008.
4. Stephens M. P., Meyers F. E.: Manufacturing facilities design and material handling. Pearson Education Intl. 2010.</td></tr>
<tr><td>Supplementary literature</td><td>1. Kalpakjian S., Schmid S.R.: Manufacturing Engineering and Technology, 7th Edition, Pearson Education, Inc 2014.
2. Machine tools for high performance machining, L.N. Lopez de Lacalle, A. Lamikiz (eds), Springer Verlag London Ltd. 2009.
3. Pająk E.: Production management. Product, technology, organisation (in Polish), PWN, Warszawa 2013.
4. Preactor® APS (Advanced Planning & Scheduling), Operation manual, Preactor Intl. Ltd. UK, Chippenham, Wiltshire 2009.
5. Rembold U., Nnaji B.O., Storr A.: Computer-integrated manufacturing and engineering, Addison-Wesley Publishers Ltd., 1999.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Integrated Manufacturing Systems, w/l/p; MiBM, IDE, st. 2, sem. 01; letni 2024/2025 (PG_00064823) - Moodle ID: 45322
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45322</td></tr>
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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

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