COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced methods of removal manufacturing and addditive processes

Course

Field of study
Mechatronics

Year/Semester
1/1

Area of study (specialization)
-

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr inż. Marek Rybicki

dr hab. inż. Damian Przestacki

Wydział Inżynierii Mechanicznej

Instytut Technologii Mechanicznej

Responsible for the course/lecturer:
dr inż. Radosław Wichniarek

dr inż. Wiesław Kuczko

Wydział Inżynierii Mechanicznej

Instytut Technologii Materiałów

Prerequisites

1) The student has basic knowledge of physics, mathematics, mechanics, the basics of material removal manufacturing processes

2) The student is able to use the acquired knowledge to analyze new manufacturing techniques and knows how to use information obtained from the library and the Internet

3) The student is independent in solving problems, acquiring and improving the acquired knowledge and skills, understanding the need to learn

4) Knowledge in scope of information technologies, computer graphics and engineering drawing, CAD/CAM systems and manufacturing processes

5) The student is able to cooperate in a project team

Course objective

Acquaintance with tendencies in manufacturing processes, mechatronic tools and tooling equipment, machine tools for complex, micro and erosion machining. Acquiring skills of modern removal and additive manufacturing technology selection of parts with specified shape and surface layer properties.

Obtaining knowledge and skills about techniques of Rapid Prototyping, Rapid Tooling and Rapid Manufacturing using additive manufacturing technologies (3D printing).

Course-related learning outcomes

Knowledge

1) He has extensive knowledge of manufacturing techniques of mechanical parts, mechatronics devices including world trends, micromachining applications and microtools, high speed machining processes, processing of constructional materials by energy beam (laser, plasma, water jet, ultrasonic etc.), economic and quality aspects of mechatronic product design.

2) Student describes place of prototyping in contemporary design process.

3) Student describes process basics of Rapid Prototyping, indicates individial properties of applied additive manufacturing technologies (3D printing) and possibilities of their use in product development.

Skills

1) He is able to obtain information from the Internet, literature, databases and other properly selected sources (mostly in English) in the field of mechatronics; He can integrate obtained information, interpret it, draw conclusions as well as formulate and justify the opinions.

2) He is able to choose advanced machining methods to make mechanical parts mechanical parts of mechatronic devices.

3) Student builds 3D models, prepares and processes polygon mesh files (STL), selecting resolution for needs of additive manufacturing.

4) Student makes prototypes using 3D Printing, FDM and DLP processes. Student prepares a batch file and selects process parameters, is able to perform post-processing of obtained physical models.

Social competences

1) Correctly identifies and resolves dilemmas related to the profession.

2) Student is open on implementation of RP/RM (3D printing) technologies in engineering activities

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written examination (in case of answer on: from 50 to 60% questions – satisfactory, above 60 to 70% – satisfactory plus, above 70 to 80% – good, above 80 to 90% – good plus, above 90 to 100% – very good grade)

Laboratory: Reports from the classes. Absence from the classes must not cross 1/3 to pass it, continuous evaluation, each class (oral answers).

Programme content

1) Introduction on the classification and essence of removal and additive manufacturing techniques

2) High Efficiency Machining (High Speed Machining HSM, High Performance HPM, High Feed Machining HFM, High Efficiency Machining HEM, new high performance cutting tools)

3) New cooling / lubrication techniques of cutting zone (minimum lubrication and cooling MQL and MQC, high pressure liquid cooling HPC, gaseous cooling by air, CO2 and LN2)

4) Complete machining (examples of structures and new machining cycles of modern turning and milling centres, enabling: milling, grinding, turn-milling, machining of gears and cams as well as erosive machining).

5) Micromachining (micro-cutting, processing with pico and femtosecond lasers, techniques LIGA, EFAB etc.)

6) Basics of erosion machining: electro-erosion (sinking and wire cutting), electro-chemical machining and stream-erosion (cutting by waterjet, abrasive waterjet and plasma, laser: cutting, cleaning, texturing, marking, cladding, drilling, selective sintering SLS)

7) Combined and hybrid machining (machining and electro-erosion with ultrasonic assistance UAM and EDUM, laser assisted machining LAM, electrochemical grinding ECG and others)

8) Modern methods of production preparation. Additive technologies (3D printing) in Rapid Prototyping, Rapid Manufacturing and Rapid Tooling, engineering applications

9) Preparation of data for RP processes. STL (polygon mesh) file format

10) Materials and devices used in RP/RT processes. Selected technologies: SLA, SLS, FDM, DLP and similar

11) Examples of use of 3D printed prototypes, Rapid Manufacturing and Rapid Tooling techniques.

Teaching methods

Lecture: multimedia presentation, discussion

Laboratory: performing laboratory exercises and developing reports according to the instructions in the outline, presentation by the teacher of practical issues related to additive manufacturing and independent work of students at research positions with supervision of the teacher.

Bibliography

Basic

1. Cichosz P.: Nowoczesne procesy obróbki skrawaniem. PWN, 2022

2. Cichosz P., Kuzinovski M., Sterowane i mechatroniczne narzędzia skrawające, PWN. 2016

3. Grzesik W., Ruszaj A.: Hybrydowe metody obróbki materiałów konstrukcyjnych, PWN. 2021

4. Jóźwicki R.: Technika laserowa i jej zastosowania. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2009

5. Żebrowski H.: Techniki wytwarzania. Obróbka wiórowa, ścierna i erozyjna. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004

6. Chlebus E.: Innowacyjne technologie Rapid Prototyping - Rapid Tooling w rozwoju produktu. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2003

7. Chua C. K., Leong K. F., and Lim C. S.: Rapid Prototyping: Principles and Applications. World Scientific Publishing Co. Pte. Ltd., Singapore, 2010

8. Gibson I., Rosen D.W., Stucker B.: Additive Manufacturing Technologies, Rapid Prototyping to Direct Digital Manufacturing. Springer, Boston, MA, 2010

Additional

1. Oczoś K.: Efektywność innowacyjnych technologii na przykładzie wybranych sposobów obróbki strumieniowo-erozyjnej. Mechanik, 2003 nr 8-9, s. 463-468

2. Filipowski R., Marciniak.: Techniki obróbki mechanicznej i erozyjnej. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2000

3. Erbel J.: Encyklopedia technik wytwarzania w przemyśle maszynowym tom II. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001

4.Ruszaj A.: Niekonwencjonalne metody wytwarzania elementów maszyn i narzędzi. Wydawnictwo Instytutu Obróbki Skrawaniem, Kraków 1999

5. Siwczyk M.: Obróbka elektroerozyjna. Technologia i zastosowanie. WNT, Warszawa 1981

6. Pająk E., Dudziak A., Górski F., Wichniarek R.: Techniki przyrostowe i wirtualna rzeczywistość w procesach przygotowania produkcji. Wydawnictwo Promocja 21, Poznań 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	47	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	28	1,0

[1] delete or add other activities as appropriate