COURSE DESCRIPTION CARD - SYLLABUS

Course name
Virtual and augmented reality in the enterprise [S2ZiIP2>RWRP]

Course

Field of study
Management and Production Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student has knowledge of information technology and computer graphics and CAD systems. Knows the basic stages of the product life cycle and understands the concepts of design and prototyping. The student is able to develop a solid 3D model of an object and assembly in a CAD system. The student is open to the implementation of modern information technologies in science and technology and also able to independently develop knowledge and skills in the subject. Student is able to cooperate in a project team.

Course objective

Main aim of the course if familiarizing the students with the possibilities associated with the industrial use of XR techniques, i.e. virtual reality, mixed and augmented reality (VR, MR, AR), especially in aid of manufacturing processes in an enterprise. Detailed goals include learning about the main classes of equipment used in all techniques and the methodology of creating applications intended for use at various stages of industrial production.

Course-related learning outcomes

Knowledge:
1. Defines, distinguishes and classifies concepts in the field of virtual reality, augmented reality and

mixed reality, is able to indicate common features and differences between technologies from the XR spectrum.
2. Indicates the place of XR techniques in the spectrum of modern technologies and the types of their applications in a modern production company, taking into account the concept of Industry 4.0 and its characteristic features.
3. Knows the state of the art in the field of virtual, augmented and mixed reality - recognizes various classes of XR systems, defines their elements, is able to indicate currently available technical solutions and characterize their features and parameters.
4. Knows the basic methods, tools and procedures for creating and implementing industrial XR applications.
5. Has knowledge of product design, including the use of virtual reality.

Skills:
1. Is able to select technology from the XR spectrum for a given stage of the product life cycle.
2. Is able to develop a model of activities carried out in production processes and develop their simulation model using XR techniques.
3. Is able to operate and program the implementation of selected XR hardware solutions.

Social competences:
1. Has the knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activities.
2. Understands the need to make changes in production processes and in the company. Understands the need for continuous learning; can inspire and organize the learning process of team members, especially in the field of modern digital technologies such as XR.
3. Is able to cooperate and work in a team, assuming various roles, including the group leader.
4. Is able to present in an appropriate and creative way the advantages and disadvantages of using XR systems in the modern production industry.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory: assessment based on the preparation of a report on laboratory exercises (required to prepare reports on 100% of exercises - participation in each exercise, the report is passed when obtaining at least 50% of points for assessing its content)
Lecture: assessment based on a test consisting of open and closed questions; The test is evaluated positively after obtaining at least 51% of the points. The examination test is conducted at the end of the semester. Passing the lecture if obtaining at least 50.1% correct answers. Assignment of grades to percentage ranges of results: <90–100> very good; <80–90) good plus; <70–80) good; <60–70) satisfactory plus; <50–60) satisfactory; <0–50) unsatisfactory.

Programme content

The subject encompasses the basics and applications of VR, AR, and MR technologies in modern production companies, with a focus on their role in Industry 4.0 and various stages of the product lifecycle. Lectures cover XR technology concepts, hardware and software, and real-world case studies, while laboratory exercises involve hands-on experience in building VR, AR, and MR applications for product visualization, assembly instructions, device operation, and training simulations.

Course topics

Lecture:
1. Basic concepts related to virtual reality (VR), augmented reality (AR) and mixed reality (MR) and the notion of "XR technology".
2. The place of different technologies in the XR spectrum. Types of interactive applications.
3. Applications of VR and AR in a modern production company.
4. Industry 4.0, characteristics and place of XR techniques in this concept.
5. Application of XR techniques at various stages of the product life cycle.
6. XR systems - MR, AR, VR hardware and software classes.
7. State of the art in the field of projection devices and interaction techniques in VR and AR systems.
8. Designing and planning the life cycle of XR applications in the production area.

9. Selected cases of VR and AR implementation in industry.
Lab:
Carrying out 7 laboratory exercises using VR/AR/MR equipment in groups of 2-3 people.
1. Building a VR application - product visualization.
2. Building a VR application - assembly instructions.
3. Building a VR application - device operation simulator.
4. Building an AR application - operating a production machine.
5. Building an AR application - presentation of the selected product.
6. Building a MR application - configurator and simulator of the use of the selected product.
7. Building a MR application - training visualization.

Teaching methods

- informative lecture - lecture
- multimedia presentation - lecture
- case study - lab
- laboratory method - - lab
Lecture conducted remotely using the synchronous access method.

Bibliography

Basic:
1. F. Górski, Metodyka budowy otwartych systemów rzeczywistości wirtualnej: zastosowanie w inżynierii mechanicznej, Wyd. Politechniki Poznańskiej, 2019
2. G. Ćwikła, F. Górski, J. Patalas-Maliszewska, Wspomaganie informacyjne menedżerów produkcji, Polskie Wydawnictwo Ekonomiczne, 2021
3. B. Arnaldi, P. Guitton, G. Moreau,Virtual Reality and Augmented Reality: Myths and Realities, Wiley, 2018

Additional:
1. S.K. Ong, A.Y.C. Nee, Virtual and Augmented Reality Applications in Manufacturing, Springer, London, 2004

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00