COURSE DESCRIPTION CARD - SYLLABUS

Course name
Design in virtual reality environment [S1ZiIP2>PwSRW]

Course

Field of study
Management and Production Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

Lecturers

Prerequisites

The student has knowledge of information technology and knowledge of computer graphics and CAD systems. The student understands the concept of design and its purpose and place in the product development process. The student is able to develop a solid model of an object and assembly in a 3D CAD system. The student is open to the implementation of modern information technologies in science and technology. Is able to independently develop knowledge and skills in the subject. Is able to cooperate in a design team.

Course objective

To learn about the possibilities associated with the use of Virtual Reality as a tool for supporting the design and prototyping of industrial products and related processes. To learn about the state of the art in terms of hardware and methodologies and possibilities in the field of software development on various examples of products.

Course-related learning outcomes

Knowledge:
1. Defines the concepts of the scope of virtual reality (Virtual Reality). Is able to distinguish it from augmented reality (Augmented Reality) and mixed reality (Mixed Reality), is able to indicate common features and differences between technologies.

2. Indicates the place of immersive virtual reality and the types of its applications in a modern manufacturing enterprise, with particular emphasis on the design process.
3. Knows the state of the art in the field of virtual reality - recognizes various classes of VR systems, defines their elements, is able to indicate currently available technical solutions and provide the scope of their technical capabilities.
4. Knows the basic methods, tools and procedures for creating and implementing VR applications in design.

Skills:
1. Has the ability to develop 3D and 2D data for interactive VR applications
2. Is able to design an interactive VR application to present the characteristics of a specific product, activity or position.
3. Possesses the ability to program interactions with objects in the VR system.
4. Possesses the ability to economically analyze VR solutions in industrial design.

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 enterprise. Understands the need for continuous learning; is able to inspire and organize the learning process of team members, especially in the field of modern digital technologies such as VR
3. Is able to cooperate and work in a team, assuming various roles, including group leader.
4. Is able to present in an appropriate and creative way the advantages and disadvantages of using immersive virtual reality in a modern enterprise.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory: crediting based on the preparation of a report on laboratory exercises (preparation of reports from 100% of exercises is required - participation in each exercise, the report is credited when at least 50% of points are obtained for the assessment of its content)
Lecture: assessment based on a colloquium consisting of open and closed questions; the colloquium is passed after obtaining at least 51% of the points. A final colloquium is held at the end of the semester.
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 course "Design in Virtual Reality Environment" includes lectures and laboratories focused on the application of VR, AR and MR technologies in the industrial context. Lectures are given on the basic concepts of virtual reality, its application in prototyping and product design, and its integration with the concept of Industry 4.0. Participants of the course learn about various VR systems, hardware, software and VR interaction techniques. Within the framework of the laboratories, students prepare 3D data for import into the VR environment, program interactions between objects and create user interfaces. Practical classes include work with vision helmets, motion controllers and other VR devices, both individually and in teams of two.

Course topics

Lecture:
1. Basic concepts related to virtual reality (VR) and its connections with augmented reality (AR) and mixed reality (MR). Types of interactive VR applications used in industrial companies.
2. Application of VR environment in designing and prototyping new products. Virtual prototypes, their types and methods of design. Application of virtual prototypes at various stages of the product life cycle.
3. Industry 4.0, characteristic features and the place of VR technology in this concept.
4. Application of XR techniques at various stages of the product life cycle.
5. VR systems - hardware and software classes. State of the art in the field of projection devices and interaction techniques in VR systems.
6. Designing and building VR applications. Preparing data for creating virtual prototypes. Selected implementation cases.

Laboratory:
1. Methods of preparing 3D data for import into the VR environment. Import and adjustment of visual features of models displayed in the VR application (materials, textures, lighting). Methods of navigation in the VR environment.
2. Programming interactions between objects: displacements, rotations, dynamic changes in the shape and visual characteristics of objects.
3. Creating a user interface: graphical interface elements, communication with the VR application using pointing devices.
4. Application of VR equipment: preparation of applications for projection on a vision helmet (Head-Mounted Display devices connected to a PC), application of motion tracking controllers and other VR devices, programming of interactions (grabbing, touching, switching objects, etc.)
Independent work at a computer station (1-3) and work in two-person teams at stations with immersive VR helmets (4).

Teaching methods

- informative lecture
- multimedia presentation
- case study
- laboratory method

Bibliography

Basic:
1. F. Górski, Methodology of building open virtual reality systems: application in mechanical engineering, Poznań University of Technology Publishing House, 2019
2. G. Ćwikła, F. Górski, J. Patalas-Maliszewska, Information support for production managers, Polish Economic Publishing House, 2021
3. B. Arnaldi, P. Guitton, G. Moreau, Virtual Reality and Augmented Reality: Myths and Realities, Wiley, 2018

Additional:
1. SK Ong, AYC 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