# COURSE DESCRIPTION CARD - SYLLABUS

Course name
3D scanning [S2MiBM2-IWP>SkP]

## Course

Field of study
Mechanical Engineering

Year/Semester
2/3

Area of study (specialization)
Virtual Engineering Design

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
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

dr hab. inż. Michał Rychlik prof. PP
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## Lecturers

## Prerequisites

Knowledge: It has a basic knowledge of the following methods: computer aided design - CAD, solid modelling of construction in CAD systems, the basic measurement methods in the field of geometric metrology Skills: He can plan and carry out measurements, computer simulations and interpreted the results Social competencies: He can interact and work in a group.

## Course objective

Acquiring knowledge of Reverse Engineering (RE), its importance in the design and manufacturing. Get to know the three-dimensional scanning methods and the data processing and analysis.

## Course-related learning outcomes

Knowledge:
Knows the modern methods of engineering computer graphics and the theoretical foundations of engineering calculations using the finite element method.
Has general knowledge about the types of tests and methods of testing working machines using modern measuring techniques and data acquisition.
Has structured, theoretically based knowledge of the use of information systems in the design of

machines and technological processes.
Has detailed knowledge of metrology and measurement systems. Knows the mathematical apparatus used in experimental research and data analysis.

Skills:
Is able to carry out basic measurements of mechanical quantities on the tested working machine using modern measuring systems.
Is able to select and apply modeling methods in design for their practical engineering applications. Is able to evaluate various design variants and identify the optimal solution taking into account many different criteria. Able to interpret and produce detailed construction documentation.
Is able to use IT systems in the design of machines and technological processes relevant to mechanics and machine construction. Is able to use CAx systems to design machines and simulate engineering issues.

Social competences:
Is ready to critically assess knowledge and received content.
Correctly identifies and resolves dilemmas related to the profession.
Understands the need for lifelong learning; can inspire and organize the learning process of other people.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Assessment of individual work related to the operation of various scanning systems (methods: laser, structured light, contact), measurements and reconstruction of geometry in specialized software for Reverse Engineering (Reverse Engineering).
Practical tests of the tasks set before the student regarding the ability to work with a given type of 3D scanner - conducted every second week of lectures.
Mandatory laboratory reports - one report within a single workstation group ( refers to the laboratory).
The final exam in theoretical knowledge - written form, duration 1.5h. The exam is conducted after a whole series of lectures and laboratory classes. It includes a minimum of three questions after one of the knowledge: basic definitions of Reverse Engineering, construction and operation principles of the selected 3D scanner (due to the measurement method), methods of 3D geometry reconstruction based on data from 3D scanners. The individual elements of the exam/colloquium are evaluated on a point scale, to pass the exam/colloquium is required to accumulate at least 50% of the total score.
Laboratories: reports on completed laboratories, evaluation of activity in class, questions during laboratories. Points are awarded for these elements. Passing of laboratories after exceeding the threshold of 50% of the total number of points.
Grades: very good - if the ratio of sums of achieved and total points is bigger than 90,1%; good plus - if the ratio of sums of achieved and total points is between 80,1-90%; good - if the ratio of sums of achieved and total points is between 70,1-80%; satisfactory plus - if the ratio of sums of achieved and total points is between 60,1-70%; satisfactory - if the ratio of sums of achieved and total points is between 50,1-60%; if the sum is smaller than 50% - unsatisfactory.

## Programme content

Presentation of the basic knowledge and definitions in the field of Reverse Engineering. Presentation of the division and types of 3D scanners due to the measuring method, operating range and special purpose. Discussion of the structure and operation of 3D scanners: contact, laser, structured light, as well as photogrammetric methods. Acquainting with measurement techniques at laboratory stands equipped with 3D scanners: contact, laser and structured light. To introduce students to the process of reconstruction of the geometry of scanned objects depending on the type of data obtained. Acquainting with methods of geometry reconstruction and data processing from the point cloud to the surface type NURBS.

## Course topics

none

## Teaching methods

1. Lecture with multimedia presentation.
2. Laboratory exercises: multimedia presentation, performance of tasks given by the teacher using 3D scanners and specialized software for Reverse Engineering, implementation of individual measurement tasks indicated by the teacher of 3D objects.

## Bibliography

Basic:
1. Chlebus. E.: Techniki komputerowe CAx w inżynierii produkcji, WNT Warszawa 2000
2. Jakubiec W., Malinowski J.: Metrologia wielkości geometrycznych, WNT Warszawa 2007
3. Butowtt J., Kaczyński R.: Fotogrametria, Wojskowa Akademia Techniczna 2003
4. Gary Confalone, Brett Ellis, John Belding: 3D Scanning for Advanced Manufacturing, Design, and Construction, John Wiley and Sons Ltd, 2023

Additional:
Lecture materials and other thematic articles provided by the lecturer.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,00 |
| Classes requiring direct contact with the teacher | 45 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 55 | 2,00 |