# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Additive technologies [S2MiBM2-INPR>TP]

## Course

Field of study
Mechanical Engineering

Year/Semester
2/3

Area of study (specialization)
Production Engineering

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
0

Tutorials
0

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

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## Lecturers

## Prerequisites

Knowledge in scope of information technologies, computer graphics and engineering drawing, CAD/CAM systems and manufacturing processes. Good skill to develop a solid 3D model of a prototype in a CAD 3D system. Being able to cooperate in a project team, awareness of responsibility for performed tasks and understanding of need of obtaining new knowledge.

## Course objective

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. Student describes place of prototyping in contemporary design process.
2. Student describes process basics of additive manufacturing, indicates individial properties of applied additive manufacturing methods (3D printing) and possibilities of their use in product development.
3. Student describes possibilities of application of Rapid Tooling and Rapid Manufacturing in product development, describes procedures used in Vacuum Casting process.

Skills:
1. Student builds 3D models, prepares and processes polygon mesh files (STL), selecting resolution for needs of additive manufacturing.
2. Student makes prototypes using additive manufacturing processes. Student prepares a batch file and selects process parameters, is able to perform post-processing of obtained physical models.
3. Student performs post-processing of additively manufactured elements.

Social competences:
1. Student is open on implementation of additive manufacturing (3D printing) in engineering activities.
2. Student is able to develop his knowledge in the subject on his own.
3. Student can work in a project team using techniques of rapid product development.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Partial marks:
a) lectures:
- on the basis of answers to questions regarding material from previous lectures
b) laboratories:
- on the basis of evaluation of current advancement in realization of given tasks
Summary mark:
a) lectures:
- evaluation of knowledge by written final test
b) laboratories:
- evaluation of preparation of student for individual laboratory classes and evaluation of skills presented in particular exercises
- continuous evaluation, each class (oral answers)

## Programme content

- Introduction to additive manufacturing - basic definitions and concepts.
- Discussion of the most important additive manufacturing methods.
- Application of additive manufacturing in engineering activities.

## Course topics

Lectures:
- Modern methods of production preparation.
- Additive technologies (3D printing) in Rapid Prototyping,
Rapid Manufacturing and Rapid Tooling, engineering applications.
- Preparation of data for RP processes. STL (polygon mesh) file format.
- Materials and devices used in RP/RT processes.
- Selected technologies: SLA, SLS, FDM, 3DP, LOM and similar.
- Post-processing (finishing treatment) of models.
- Principles and application of Vacuum Casting technology.
- Examples of use of 3D printed prototypes, Rapid Manufacturing and Rapid Tooling techniques.

Laboratory:
- Preparation of data for model manufacturing, STL file preparation and processing, resolution selection.
- Manufacturing of exemplary prototypes using FDM process.
- Post-processing of obtained prototypes.

## Teaching methods

Lecture part: mostly in the form of conventional lectures, content submitted in a form ready to remember; partly lectures take the form of a problem with active discussion with students. The lectures are suitable for online teaching.
Laboratory part: 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. E. Chlebus, Innowacyjne technologie Rapid Prototyping - Rapid Tooling w rozwoju produktu, Oficyna Wydawnicza Politechniki Wrocławskiej , Wrocław, 2003
2. P. Siemieński, G. Budzik, “Techniki przyrostowe. Druk 3D. Drukarki 3D”, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2015
3. Chua C. K., Leong K. F., and Lim C. S., 2010, “Rapid Prototyping: Principles and Applications”, World Scientific Publishing Co. Pte. Ltd., Singapore
4. Ian Gibson, David W. Rosen, Brent Stucker , 2010, Additive Manufacturing Technologies - Rapid Prototyping to Direct Digital Manufacturing, Springer, Boston, MA

Additional:
1. Pająk E., Dudziak A., Górski F., Wichniarek R., Techniki przyrostowe i wirtualna rzeczywistość w procesach przygotowania produkcji, Poznań 2011, ISBN 978 83 86912 56 8, Wydawnictwo Promocja 21
2. G. Budzik, J. Woźniak, Ł. Przeszłowski, "Druk 3D jako element przemysłu przeszłości. Analiza rynku i tendencje rozwoju", Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 2022
3. B. Evans, "Practical 3D Printers: The Science and Art of 3D Printing", Apress, New York, 2012

## 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 |