

Course name **Manufacturing Technology I** Code **V.1** Credit points **6**

Language of instruction **English**

Programme Computer Modelling and Simulation (CMS)\*

Type of studies BSc\*

Unit running the programme Department of Polymer Processing and Production Management,  
Institute of Metal Forming, Quality Engineering and Bioengineering  
Institute of Machines Technology and Production Automation

Course coordinator and academic teachers **Elżbieta Bociąga, Assoc. Prof. (Coordinator)**  
Elżbieta Bociąga, Assoc. Prof. (Lec.), Tomasz Jaruga, PhD (Lec., Tut.), Andrzej Rygałło, PhD (Tut.)

Form of classes and number of hours

Semester	Lec.	Tut.	Lab.	Proj.	Sem.	Credit points
5	30		15	15		6

Learning outcomes

**Polymer processing:**

After finishing this course students have knowledge about polymer processing technologies principles: what are the machines for different technologies, how the processing tools are designed, what kinds of raw material are used for processing and what kinds of parts can be manufactured with what technology.

The students have also the skills in tool design for polymer processing technologies, coming out from the tutorials and project (one selected technology).

**Metal forming:**

The objectives of this course are designed to introduce engineering students to metal forming processes. Students will learn the basic parameters affecting metal formability. They get to know such processes as: sheet rolling, cutting and blanking, bending, sheet-metal forming, extrusion, and forging.

**Machining technology:**

After this course students have fundamental knowledge about machining technology, and construction and working of different types of metal processing machines.

Prerequisites (courses)

Course in CAD system (needed for the project).

Prerequisites

(mathematical tools)

- Basic mathematical knowledge and skills
- Basic knowledge of materials technology and physics
- Basic knowledge of machine building and machine parts assembly

## Course description

### LECTURE

#### **Polymer processing:**

Basics of different polymer processing technologies: injection moulding, extrusion, extrusion blow moulding, thermoforming, press moulding: compression and transfer moulding, welding, calendaring, casting.  
(machines, tools, raw material for processing).

#### **Metal forming:**

Introduction to Metal Forming. Metal forming as a science on metal deformation; basic definitions.

Plastic deformation. Mechanism of plastic deformation - slip and twinning. Measures of plastic deformation. Phenomenon associated with plastic deformation.

Basic technological processes. Rolling. Cutting and blanking. Bending Sheet metal forming. Extrusion. Forging.

#### **Machining technology:**

The main objectives of this part of course are concentrated in basics machining technology: description of metal processing with conventional machines, description and implementation of tools for metal processing, selection and optimization of cutting conditions parameters, working of different metal processing technologies: turning, milling, drilling, grinding

### LABORATORY:

#### **Polymer processing:**

Presentation of machines for different polymer processing technologies:

1. Injection moulding (thermoplastic polymers)
2. Extrusion (profile)
3. Blow moulding extrusion (PE-HD bottle and PE-LD film)
4. Press moulding (thermoset polymers and rubber)
5. Thermoforming (PET and PVC film on 3 different moulds)
6. Welding (welding of thermoplastic plates and PE film)
7. Coating of metal parts with PE using fluidization
8. Manufacturing parts from expanded polystyrene (EPS)
9. Cutting the EPS parts with thermo-resistive wire

#### **Machining technology:**

Working of machines for metal processing technologies:

1. Turning possibilities with use of conventional metal-turning lathe
  - facing turning, surfacing turning, taper turning, contour turning, multi tool turning, threading, roughing and finishing turning
2. Milling possibilities with use of conventional milling machine
  - out-cut milling, in-cut milling, face milling, profile milling, rotary planning milling, spiral milling, gang milling
3. Drilling possibilities with use of conventional drilling machine
  - solid drilling, rope drilling, reboring, slope drilling,
4. Grinding possibilities with use of conventional grinding machine
  - face grinding, centreless grinding, center-type grinding, internal grinding

### PROJECT:

Design of a product to manufacture with one selected technology. The product is designed in a CAD software – solid (3D) and draft (2D).

*Form of assessment* Exam

*Basic reference materials* **Polymer processing:**

1. Osswald T.A., Baur E., Brinkmann S., Oberbach K., Schmachtenberg E.: International Plastics Handbook, Hanser Publishers, Munich 2006.
2. Tadmor Z., Gogos C.G.: Principles of Polymer Processing, John Wiley & Sons, New York, Brisbane, Chichester, Toronto, 1979.
3. Kamal M.R (Editor), Isayev A.I, Liu S.J. (Co-Editors), White J.L (Series Editor): Injection Molding. Technology and Fundamentals, Hanser Publishers, Munich, Hanser Publications, Inc., Cincinnati, 2009.
4. Rauwendaal C.: Understanding Extrusion. 2<sup>nd</sup> Edition, Hanser Publishers, Munich, Hanser Publications, Cincinnati, 2010.
5. Menges G., Michaeli W., Mohren P.: How to make injection molds, Hanser Publishers, Munich 2001.
6. Stoeckhert, K. Menning, G.: Mould-Making Handbook, Hanser Publishers, Munich 1998.
7. Michaeli W., Dombrowski U.: Extrusion dies for plastics and rubber. Design and engineering computations, Hanser Verlag 2003.

**Metal forming:**

1. Set of lecture notes and problems for individual solution (based on literature presented below). Handouts for tutorial classes.
2. Marciniak Z., Duncan J.L., Hu S.J.: Mechanics of sheet metal forming, Butterworth-Heinemann, 2002
3. Blazynski T. Z.: Plasticity and modern metal-forming technology. New York, Elsevier Applied Science, 1989
4. Banabic D., Bunge H.-J., Pohlandt K., Tekkaya A.E.: Formability of metallic materials: plastic anisotropy, formability testing, forming limits. Springer-Verlag, 2000
5. Gorecki W.: English in mechanical engineering : handbook for students (Angielski w budowie maszyn) : Gliwice, Wydaw. Politechniki Śląskiej, 2003
6. Gorecki W.: Obróbka plastyczna metali: podstawowe słownictwo techniczne: ilustrowany słownik polsko-angielsko-niemiecko-rosyjski, Gliwice, Wyd.. Politechniki Śląskiej, 2000.

**Machining technology:**

1. Childs T., Maekawa K., Obikawa T., Yamane Y.: Metal Machining, Theory and Application. John Wiley and Sons, New York 2000.
2. Walsh Ronald A.: Handbook of Machining and Metalworking Calculations. MCGRAW-HILL. New York. 2001
3. L.N. Lopez de Lacalle, A Lamikiz Editors: Machine Tools for High Performance Machining. Springer 2009.

*Other reference materials*

For Polish-speaking students:

**Polymer processing:**

1. Zawistowski H., Frenkler D.: Konstrukcja form wtryskowych do tworzyw termoplastycznych, WNT, Warszawa 1984.
2. Sikora R.: Przetwórstwo tworzyw wielkocząsteczkowych, WE, Warszawa 1993.
3. Wilczyński K.: Przetwórstwo tworzyw sztucznych, praca zbiorowa pod red. K. Wilczyńskiego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2000.
4. Bociąga E.: Specjalne metody wtryskiwania tworzyw polimerowych, WNT, Warszawa 2008.

**Metal forming:**

1. Bednarski T.: Mechanika plastycznego pływnięcia w zarysie. PWN, Warszawa 1995.
2. Erbel S., Kuczyński K., Marciniak Z.: Obróbka plastyczna. PWN, Warszawa 1986.
3. Erbel S., Kuczyński K., Olejnik L.: Technologia obróbki plastycznej. Laboratorium. Oficyna Wydawnicza Politechniki Warszawskiej, 2003
4. Marciniak Z.: Konstrukcja tłoczników. Ośrodek Techniczny A. Marciniak Sp. Zo.o., Warszawa 2002
5. Mazurkiewicz A., Kocur L.: Obróbka plastyczna. Laboratorium, Wyd. Pol. Radomskiej, Radom 1999.
6. Romanowski W.P.: Tłoczenie na zimno, WNT, Warszawa, 1971.
7. Obróbka Plastyczna Metali (czasopismo - kwartalnik).
8. Informacja Ekspresowa Obróbki Plastycznej (biuletyn informacyjny - miesięcznik).

**Machining technology:**

1. Jemieliński K.: Obróbka skrawaniem - W Pol. Warszawskiej Warszawa 1998.
2. Wysiecki M.: Nowoczesne materiały narzędziowe WNT Warszawa 1997.
3. Hulboj S.: Obróbka ubytkowa Wydawnictwo Pol. Częstochowska Częstochowa 1997.
4. Praca zbiorowa: Poradnik inżyniera. Obróbka skrawaniem WNT Warszawa 1991.
5. Przybylski L.: Strategie doboru warunków skrawania współczesnymi narzędziami Wydawnictwo Pol. Krakowskiej Kraków 1999.
6. Grzesik W.: Podstawy skrawania materiałów metalowych WNT Warszawa 1998.

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Average student workload (teaching hours + individ. )	5 teaching hours per week + 7 individual work hours per week
Remarks:	
Updated on:	8 July 2011

\* - pozostawić tylko właściwe (tzn. dla przedmiotów wspólnych wszystkie, dla przedmiotów kierunkowych tylko daną specjalność, dla BSc przedmioty semestrów I – VII i dla MSc semestrów I - III)

\*\* - należy spełnić wymogi zawarte w akapicie „Efekty kształcenia – umiejętności i kompetencje” postulowane w opisie przedmiotów podstawowych i kierunkowych w standardach MNiSzW

\*\*\* - proszę w pierwszej kolejności podawać podręczniki które mają być kupione z projektu