Name of the subject: **Computer Designing of the Metal Forming Processes**			
Course: **Metallurgy**			Code of subject: **M2.G.D2.5**
Type of subject: **specialization**	Level of study: **II level**	Form of study: **intramural studies**	Year: **II** Semester: **IV**
Course type: **Lecture, Lab., Seminar, Project**		Number of hours/week: **1, 1, 0, 0**	Number of points: **2 ECTS**

GUIDE TO THE SUBJECT

I CARD OF SUBJECT

AIM OF SUBJECT

C1. Knowledge of selected numerical methods used in solving problems of modelling metal forming processes.

C2. Knowledge selected application examples of numerical modelling of forming processes

C3. The acquisition of ability to use a CAD software and create technical documentation.

PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCE

1. Knowledge of mathematics in the field of differential equations, integrals, and of operator.
2. Knowledge of the theoretical basis of metal forming processes.
3. Knowledge of the metal forming processes technology.
4. Ability to work individually and in a group.
5. Ability to use of literature sources and Internet resources.

EFFECTS OF LEARNING

EK 1 – The student knows the numerical methods applied to computer-aided design work in elementary plastic forming of metals.

EK 2 – The student can apply advanced numerical methods for modelling of metal forming processes.

EK 3 – The student can use numerical methods to solve the basic technological problems.

EK 4 – The student can model the technological processes.

EK 5 – The student can use computer-aided design technology of metal forming processes based on data obtained by computer simulation.

COURSE CONTENT

Course type – Lecture

W 1 2 Finite Element Method (FEM) – introduction	**2 h**
W 3 4 Plastometric tests and approximation of the results	**2 h**
W 4 5 Approximation of plastometric tests results using the program “Reoroll"	**2 h**
W 7 8 – Mathematical modeling of three-dimensional deformation of the metal during groove-rolling.	**2 h**
W 9 10 – The structure of the three-dimensional computer program to numerical modelling of metal forming processes Forge2011®	**2 h**
W 11 – Numerical modelling of the rolling process of bimetallic rods	**1 h**
W 12 – Numerical modelling of the rolling process of ribbed bimetallic rods	**1 h**
W 13 14 – Numerical modelling of the ribbed rods rolling process with the longitudinal band separation	**2 h**
W 15 – Numerical modelling of microstructure evolution during rolling processes	**1 h**

COURSE CONTENT

Course type – Labolatory

L 1	**-** Finite Element Method (FEM) – introduction, (base on the simply examples)	**1 h**
L 2,3	**-** Approximation method of the tests results and analysis	**2 h**
L 4,5	**-** Approximation of plastometric tests results using the numerical methods and spreadsheets	**2 h**
L 6,7	**-** The structure of the three-dimensional computer program to numerical modelling of metal forming processes Forge2011®	**2 h**
L 8,9	**-** Numerical modelling of the rolling process of bimetallic rods	**2 h**
L 10-12	**-** Numerical modelling of the ribbed rods rolling process with the longitudinal band separation	**2 h**
L 13-15	**-** Numerical modelling of the rolling process of drawing and extrusion	**3 h**

TEACHING TOOLS

1. Lecture using a means of audiovisual
2. 20 computer stations with a CAD and FEM software (*Open Office, SciLab, Forge 3D, Rhinoceros,AutoCad)*

METHODS OF EVALUATION (F – FORMING, P - SUMMARY)

F1 - assessment of preparations for the lab
F2 - assessment of the project
P1 - assessment of mastery of the material that is the subject of theoretical lectures - final test

STUDENT WORKLOAD

Form of activity	**Average number of hours to realize the activity**
Contact hours with the teacher	**15W 15L →30**
Getting acquainted with the literature	**30**
Sum	**∑ 60**
The total number of ECTS points of course	**2 ECTS**

LITERATURE

1. Dyja H., Mróz S., Rydz D.: Technologia i modelowanie procesów walcowania wyrobów bimetalowych. Politechnika Częstochowska, Prace Naukowe Wydziału Inżynierii Procesowej, Materiałowej i Fizyki Stosowanej, Seria: Metalurgia Nr 33, Częstochowa 2003
2. Mróz S.: Proces walcowania prętów z wzdłużnym rozdzielaniem pasma, Wydawnictwo Politechniki Częstochowskiej, Seria: Monografie nr 138, Częstochowa 2008.
3. Pietrzyk M., Metody numeryczne w przeróbce plastycznej metali, Skrypt AGH, Kraków 1992.
4. Morawiecki M., Sadok L., Wosiek E., Przeróbka plastyczna - podstawy teoretyczne, Śląsk, Katowice 1986.
5. Danchenko V., Dyja H., Lesik L., i inni : Technologia i modelowanie procesów walcowania w wykrojach, Wyd. P.Cz. Seria: Metalurgia Nr 28, Częstochowa 2002

LECTURER (NAME, SURNAME, E-MAIL)

1. dr hab. inż. Sebastian Mróz, prof. PCz mroz@wip.pcz.pl
2. dr inż. Piotr Szota, pszota@wip.pcz.pl

MATRIX EFFECTS OF EDUCATION

Efekt kształcenia	Odniesienie danego efektu do efektów zdefiniowanych dla całego programu (PEK)	Cele przedmiotu	Treści programowe	Narzędzia dydaktyczne	Sposób oceny
EK1	K_W01, K_W04, K_W05, K_U09	C1	W1, W2, W3, W4, W5	**1,2**	F1
EK2	K_W01, K_W04, K_U09	C2	W6,	**1,2**	F1
EK3	K_W02, K_W04	C2	W7	**1,2**	F1,F2
EK4	K_W02, K_W04	C2	W8	**1,2**	F1,F2
EK5	K_W02, K_W04	C2	W9, W10,	**1,2**	P1

EK 5 – The student can use computer-aided design technology of metal forming processes based on data obtained by computer simulation.

II. FORM OF EVALUATION - DETAILS

	Mark 2	Mark 3	Mark 4	Mark 5
EK1 The student knows the numerical methods applied to computer-aided design work in elementary plastic forming of metals	The student can not name and describe any numerical methods applied to computer-aided elementary design work in metal forming of metals	The student can name and describe two numerical methods applied to computer-aided elementary design work in metal forming of metals	The student can name and describe more then two numerical methods applied to computer-aided elementary design work in metal forming of metals	The student can name and describe more then two numerical methods applied to computer-aided elementary design work in metal forming of metals and can their practical application in metal forming processes
EK2 The student can apply advanced numerical methods for modelling of metal forming processes	The student can not apply any numerical method to solve selected technological problems	The student can apply two numerical method to solve selected technological problems	The student can name and describe the use of numerical methods to solve selected technological problems, but has difficulty applying them to the analysis of data	The student can name and describe the use of numerical methods to solve selected technological problems, and applying them to the analysis of data
EK3 The student can use numerical methods to solve the basic technological problems	The student can not use numerical methods to solve the basic technological problems	The student can describe the selected technological processes and describe a model for one process	The student can describe the selected technological processes and describe a model for two processes	The student can describe the selected technological processes, describe a model for two processes and develop an algorithm
EK4 The student can model the technological processes	The student can not model any technological processes	The student can develop a computer model for thermo-mechanical modeling of the selected technological process	The student can model the selected technological process	The student can model the selected technological process with making a complete analysis of the results
EK5 The student can use computer-aided design technology of metal forming processes based on data obtained by computer simulation	The student can not use computer-aided design technology of metal forming processes based on data obtained by computer simulation	The student can use computer-aided design technology of metal forming processes based on data obtained by computer simulation	The student can use computer-aided design technology of groove-rolling process based on data obtained by computer simulation	The student can use computer-aided design technology of groove-rolling process and make use of quantitative tools wear based on data obtained by computer simulation

III. OTHER USEFUL INFORMATION ABOUT THE SUBJECT (www.wip.pcz.pl)

1. Information about the location event venue course according to the information on the www.wip.pcz.pl.
2. Term course (day of week / time) according to the plan which is stated on the www.wip.pcz.pl.
3. Consultation of the course (hours + place) according to the information on the www.wip.pcz.pl.