Course unit title : **Modelling of plastic working processes (BSc)** ***Modelowanie procesów przeróbki plastycznej***			
Field of study: **Metallurgy / Metalurgia**			Course unit code: **71F5100**
Type of course unit: **optional**	Level of study: **Study I level**	Type of study: **Stationary studies**	Year: ..... Semester: .....
Teaching method: **Lecture, Tutorials, Laboratory, Seminar, Project**	Number of hours per week: **1, 0, 1, 0, 0**		Number of ECTS credits: **4 ECTS**

COURSE GUIDE

I. COURSE CARD

COURSE PURPOSES

C1. To acquaint the students with the basic tests to determine the plasticity of the material.
C2. Providing students with knowledge about the basic methods of numerical and physical modeling of plastic working processes.
C3. To acquaint the students with programs and devices for numerical and physical modelling of plastic working processes.
C4. The use of tools for numerical and physical modelling of plastic working processes.

INITIAL REQUIREMENTS FOR THE KNOWLEDGE, ABILITIES AND OTHER COMPETENCES

1. Student has basic knowledge in mathematics, physics and numerical methods.
2. Student knows the basics of technology of plastic working processes.
3. Student has the ability to use CAD computer programs.
4. The student has the ability to use various sources of information, including instructions, technical documentation and online resources.
5. The student has the ability to work independently and in a group.
6. The student has the skills to correctly interpret and present research results.

THE EFFECTS OF TEACHING

EK1 - Student knows the basic tests to determine the plasticity of the material.
EK2 - Student knows the basics of numerical and physical modelling methods of plastic working processes.
EK3 - Student is able to design numerical and physical modelling of a selected plastic working process
EK4 - Student is able to analyze of the obtained test results and draw conclusions.

COURSE CONTENT

Teaching method – LECTURES

W 1 – Basic tests to determine the plasticity of the material.	**1 h**
W2 – Numerical modelling of plastic working processes - basics, methods.	**2 h**

W3, W4 – Tools (computer softwares) for numerical modelling of plastic working processes. Preparation of initial data for numerical modelling.	**2 h**
W 5 – Numerical modelling of selected plastic working processes.	**2 h**
W 6, W 7 – Analysis and interpretation of the numerical modeling results. The use of numerical modelling results.	**3 h**
W 8 – Physical modelling of plastic working processes - devices, methods.	**2 h**
W 9 – Physical modelling of selected plastic working processes.	**2 h**
W 10 – Analysis and interpretation of physical modeling results. The use of physical modeling results.	**1 h**

Teaching method – LABORATORY

L 1, L2 – Determination of material plasticity - selected methods.	**2 h**
L 3, **L 4 –** Preparation of input data for numerical modelling. Determination of initial and boundary conditions, determination of rheological properties of the material. Introduction of the rheological properties (mathematical model) of the examined material to the material database of the numerical modelling software.	**3 h**
L 5, L 6 – Numerical modelling of selected plastic working process.	**3 h**
L 7 – Data handling and analysis of numerical modelling results. The use of numerical modelling results.	**2 h**
L 8, L 9 – Physical modelling of selected plastic working process.	**3 h**
L 10 – Data handling and analysis of physical modelling results. The use of physical modelling results.	**2 h**

TEACHING TOOLS

1. – lecture using audiovisual means
2. – prepared by the teacher teaching materials
3. – Mechanical Properties Testing Laboratory
4. – Plastometric Research Laboratory
5. – Laboratory of Numerical Modelling of Plastic Working Processes
6. – Laboratory of Physical Simulations of Plastic Working Processes
7. – Dilatometric Testing Laboratory
8. –Top Layer Structural Analysis Laboratory

WAYS OF ASSESSMENT (F – FORMING, P – SUMMARY)

F1 - assessment of activity during classes
P1 - assessment of mastery of the teaching material that is the subject of lectures - colloquium

STUDENT WORKLOAD

Activity type	**Average number of hours to complete the activity**
Contact hours with the teacher	**15L, 15Lab → 30 h**
Getting acquainted with the indicated literature	**20 h**
Preparing to the laboratory	**25 h**
Preparing to pass the course	**20 h**
Total numbers of hours	**∑ 95 h**
TOTAL NUMBER OF ECTS CREDITS FOR THE COURSE	**4 ECTS**

BASIC AND SUPPLEMENTARY LITERATURE

1. Milenin A.: Podstawy metody elementów skończonych. Zagadnienia termomechaniczne. Wydawnictwa AGH, Kraków 2010.
2. Malinowski Z.: Numeryczne modele w przeróbce plastycznej i wymianie ciepła. Uczelniane Wydawnictwa

Naukowo-Dydaktyczne, Kraków 2005.
3. Danchenko V., Dyja H., Lesik L., i inni : Technologia i modelowanie procesów walcowania w wykrojach, Wyd.P.Cz. Seria: Metalurgia Nr 28, Częstochowa 2002.
4. Dyja H.S., Banaszek G.A., Grynkevych V.A., Danchenko V.A.: Modelowanie procesów kucia swobodnego, Wydawnictwo Wydziału Inżynierii Procesowej, materiałowej i Fizyki Stosowanej, Seria Metalurgia nr 42, 2004, ISBN 83-87745-52-9.
5. Deviatov V., Dyja H.S., Stolbov V.Y., Trusov P.V., Łabuda E.T.: Matematyczne modelowanie i optymalizacja procesów wyciskania., Wydawnictwo Wydziału Inżynierii Procesowej, materiałowej i Fizyki Stosowanej, Seria Metalurgia nr 38, 2004, ISBN 83-87745-27-8.
6. Sińczak J. i inni: Procesy przeróbki plastycznej. Wyd. AGH, Kraków 2003.
7. Dyja H., Gałkin A., Knapiński M., Reologia metali odkształcanych plastycznie, Seria Monografie Nr 190, Wyd. Politechniki Częstochowskiej, Częstochowa 2010
8. Praca zbiorowa, FIMM2011, Fizyczne i matematyczne modelowanie procesów obróbki plastycznej, Prace Naukowe, Mechanika, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2011
9. Grosman F., Hadasik E.: Technologiczna plastyczność metali. Badania plastometryczne. Wyd. Politechniki Śląskiej , Gliwice 2005

LEADING TEACHER (NAME, SURNAME, E-MAIL ADDRESS)

1. Konrad Laber Ph.D, D.Sc., konrad.laber@pcz.pl

THE MATRIX OF EDUCATION EFFECTS REALISATION

The effect of teaching	The reference of the effect to the effect defined for the entire program (PEK)	Course purposes	Course content	Teaching tools	Ways of assessment
EK1	K_W01, K_W03, K_W05, K_W06, K_W08, K_U07	C1	W1, L1, L2	1,2, 3, 4, 6	F1,P1
EK2	K_W06, K_W09, K_W10, K_W12	C2, C3	W2÷W5, W8, L3, L4	1,2, 5, 6, 7	F1,P1
EK3	K_W06, KU_01, K_U03, K_U04, K_U07, K_U10	C3, C4	W5, W9, L5, L6, L8, L9	1,2, 5, 6, 7	F1,P1
EK4	KU_01, K_U02, K_U10	C2÷C4	W6, W7, W10, L7, L10	1, 2, 8	F1,P1

II. ASSESSMENT FORM - DETAILS

	For grade 2	For grade 3	For grade 4	For grade 5
EK1 Knowledge of the basic tests to determine plasticity of the material	Student does not know the basic tests to determine the plasticity of the material	Student has basic knowledge of the basic tests to determine the plasticity of the material	Student has good knowledge of the basic tests to determine the plasticity of the material	Student is fluent in the basic tests to determine the plasticity of the material
EK2 Knowledge of the basics of the numerical and physical modelling methods of plastic working processes	Student does not know the basics of numerical and physical modelling methods of plastic working processes	Student has basic knowledge of the basics of numerical and physical modelling methods of plastic working processes	Student has good knowledge of the basics of numerical and physical modelling methods of plastic working processes	Student is fluent in the basics of numerical and physical modelling methods of plastic working processes
EK3 Ability to design numerical and physical modelling of a selected plastic working process	Student is not able to design numerical and physical modelling of a selected plastic working process	Student is able to design numerical and physical modeling of a selected plastic forming process at a basic level	Student is able to design numerical and physical modeling of a selected plastic forming process at a good level	Student is fluent in design numerical and physical modelling of a selected plastic working process
EK4 Ability to analyze of the obtained test results and	Student is not able to analyze of the obtained test results and draw	Student is able able to analyze of the obtained test results and draw	Student is able able to analyze of the obtained test results and draw	Student is fluent in analyse of the obtained test results and draw

draw conclusions	conclusions	conclusions at a basic level	conclusions at a good level	conclusions

III. OTHER USEFUL INFORMATION ABOUT THE COURSE (Web site of FPE&MT

1. Information where presentation of classes, instruction, subjects of seminars can be found, etc
2. Information about the location of the classes
3. Information about the date of the course (day of the week/time)
4. Information about the consultation (time and place)