Name of the subject: **Installations in Recycling of Metals**			
Course: **Management and Engineering of Production**			Code of subject: **1S**
Type of subject: **specialization**	Level of study: **II level**	Form of study: **intramural studies**	Year: **I** Semester: **II**
Course type: **Lecture, Lab., Seminar, Project**	Number of hours/week: **2, 1, 0, 0**		Number of points: **3 ECTS**

GUIDE TO THE SUBJECT

I CARD OF SUBJECT

AIM OF SUBJECT

C1. Knowledge of basic equipment and systems used in the metal recycling and recycling of product standards.

C2. Familiarize students with the structure and operation of equipment for metal recycling.

C3. The acquisition with practical knowledge by comparing the theoretical knowledge with practice in the observation of technological processes in the plant.

PREREQUISITES FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCE

1. Knowledge of physics and chemistry in the physical and chemical properties of metals .
2. Knowledge of mechanics and strength of materials.
3. Basic knowledge of the machine design.
4. Ability to work individually and in a group.
5. Ability to prepare reports on the implementation of the exercise.
6. Ability to use of literature sources and Internet resources.

EFFECTS OF LEARNING

EK 1 – The student knows the basic rules standardizing the scrap of metals, methods of its collection and storage.

EK 2 – The student knows the method of shredding waste recycled materials, their classification and enrichment.

EK 3 – The student knows the technical systems to prepare scrap through segregation and the characteristics of the equipment, including fines merge.

EK 4 – The student knows the structure and operation of basic furnaces for melting and refining of metals in the recycling method.

COURSE CONTENT

Course type – Lecture

W 1,2 Organization and logistics of obtaining recycled metals materials	**2 h**
W 3,4 Landfill recycled materials. Methods for preparation of scrap	**2 h**
W 5,6 Characteristics of equipment and machines for classification: screens, classifiers, hydraulic, air classifiers	**2 h**
W 7-10 Recycled materials enrichment	**4 h**
W 11,12 Equipment for shredding by crushing and grinding	**2 h**
W 13,14 Shredding the scrap of metal, construction and operation of shredders	**2 h**
W 15-16 Equipment Technical Systems of stream segregation of metallic and non-metallic materials	**2 h**
W 17-20 Furnaces for melting metals after separation with a refining fire	**4 h**
W 21-24 Equipment for metal recycling methods with hydrometallurgy	**4 h**
W 25-27 Devices to minimize the emission of harmful substances into the environment	**3 h**
W 28-30 Construction and operation of the landfill recycling unwanted products	**3 h**

COURSE CONTENT

Course type – Labolatory

L 1 ,2 Construction and operation of a jaw crusher equipped with a sieve classifier	**2 h**
L 3,4 Construction and leaching operation	**2 h**
L 5,6 Construction and operation of the rotary tube furnace	**2 h**
L 7-12 Activities in the field of lead and zinc smelter in the area: the use of a rotary kiln to the process of Waelz and become familiar with the production of zinc and lead in the recycling of zinc	**5 h**
L 13-15 Classes in a steel mill for preparation of melting scrap in electric arc furnaces process	**4 h**

TEACHING TOOLS

1. Lecture using a means of audiovisual
2. Instructions for performing laboratory
3. laboratory equipment (jaw crusher with classifier sieve, leaching stand, high temperature oven with rotating torque tube), additionally the ability to develop the program of activities outside the laboratory (plant)

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

F1 - assessment of preparations for the lab
F2 - assessment of the report from performed laboratory
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	**30W 15L →45**
Getting acquainted with the literature	**20**
Preparation for laboratory classes	**5**
Preparation of laboratory reports	**5**
Sum	**∑ 75**
The total number of ECTS points of course	**3 ECTS**

LITERATURE

1. Kucharski M.:Recykling metali nieżelaznych. Wydawnictwa AGH, Kraków 2010
2. Mróz J.: Recykling i utylizacja materiałów odpadowych w agregatach metalurgicznych. Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2006.
3. J. Borkiewicz: Gospodarka odpadami przemysłowymi, a ekologia. Bib. Fundacji „Silesia", Katowice 1993

4. M. Rodek: Maszyny i urządzenia metalurgiczne. PWSzZ, Warszawa 1973
5. Ulewicz M., Siwka J.: Procesy odzysku i recyklingu wybranych Materiałów. Wydawnictwo WIPMiFS Politechniki Częstochowskiej, Częstochowa 2010.
6. Praca zbiorowa pod red. S. E. Kempy: Gospodarka odpadami na wysypiskach. „Arka" Poznań, 1993.
7. Czasopisma: Recycling, Hutnik-Wiadomości Hutnicze oraz Rudy i Metale Nieżelazne

LECTURER (NAME, SURNAME, E-MAIL)

1. dr hab. inż. Marek Warzecha, warzecha@wip.pcz.pl

MATRIX EFFECTS OF EDUCATION

Effects of learning	The reference of the effects of learning to the effect defined for the entire program (PEK)	Aims of subject	Course content	Teaching tools	Methods of evaluation
EK1	K_W10, K_W19, K_W21, K_U08,K_U16, K_K12	C1	W1 – W4	**1**	P1
EK2	K_W08, K_W12, K_U13, K_K07	C1, C3	W5 – W12 L1 – L6, L13 – L15	**1, 2, 3**	F1, F2, P1
EK3	K_W13, K_W10, K_W38, K_U06, K_U11, K_U14	C1,C2, C3	W13 – W16 W21 – W24 L7 – L15	**1, 3**	F2, P1
EK4	K_W12, K_W13, K_W18, K_W22, K_U10	C2, C3	W17 – W20, W25 - W30 L7 – L12	**1, 3**	F2, P1

II. FORM OF EVALUATION - DETAILS

	Mark 2	Mark 3	Mark 4	Mark 5
EK1 The student knows the basic rules standardizing scrap metal, methods of its collection and storage	The student can not describe any standardized norms of metal scrap	The student can name and describe standardized norms of metal scrap	The student can also describe a system for collecting of recyclable metal-materials	The student can additionally describe the storage of recycled materials
EK2 The student knows the method of shredding waste recycled materials, their classification and enrichment	The student does not know of any method of grinding metal materials	The student knows the method of shredding equipment by cutting, crushing and grinding	The student knows the equipment and machines for classification	The student can explain and provide enrichment recycled metal
EK3 The student knows the technical systems to prepare scrap through segregation and the characteristics of the equipment, including fines merge	The student is not able to introduce any technical system to prepare scrap	The student can submit a technical system to prepare scrap	The student is able to present the construction and operation of the shredder	The student can additionally introduce a system of fines merge
EK4 The student knows the structure and operation of basic furnaces for melting and refining of recycled metals	The student does not know the construction and operation of any furnace for metal recycling	The student knows design and operation of a furnace for metal recycling	The student can also describe the construction and operation of a short rotary furnace with oxygen torch	The student can additionally describe the construction and operation of the furnace for refining molten metals

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.