"APPROVED"
Dean of the Faculty of New Technologies and Chemistry
Prof., PhD, Eng. Stanisław Cudziło

Course title: ***Materials Corrosion***
Course title in Polish: ***Korozja Materiałów***
Course Code: WTCNTCSM-MC2eng

Course details:

Entity offering the course: Faculty of New Technologies and Chemistry
Entity receiving the course: Faculty of New Technologies and Chemistry
Syllabus valid for enrolments as of: October 2016

Default type of the protocol:

graded course credit

Official language:

English

Short description:

Characteristics and distribution of corrosion. Review of methods of describing quantitatively corrosion including: open cell potential, corrosion potential, pitting and electric breakdown, corrosion current density, the phenomenon of passivation and repassivation. Methods of protecting materials against corrosion: at the manufacturing stage, by coating, using protectors. Methods of qualitative and quantitative evaluation of corrosion: Voltammetric, gravimetric, electrochemical impedance spectroscopy.

Description:

1. Basic physical and chemical theories of electrolytes, Nernst equation, galvanic series, the chemical potential and the Gibbs phase rule, overpotential, Tafel equation, Butler-Volmer equation, fundamentals of kinetics (including kinetic equations), thermodynamic justification of Pourbaix diagrams, ionic activity, activity coefficient, the number of ion mobility and transfer phenomenon in solutions, including dissociation, association, hydration, hydrolysis, theories electrolyte (DH DHO)
2. Assembly of galvanic cells and fuel cells
3. The laws of electrolysis
4. Theory of the electric double layer at the electrode-solution interface
5. Phenomena occurring on the electrodes and their theories: the evolution of gases, corrosion, passivation, re-passivation, hydrometallurgy
6. Mechanisms, determinants and effects of corrosion: electrochemical, chemical and gaseous
7. Methodology of corrosion including voltammetric methods, gravimetric, solutions composition analysis, as well as electrochemical impedance spectroscopy
8. Methods of corrosion protection: alloying elements, passivation, galvanic and conversion coatings, corrosion inhibitors etc. in the context of thermodynamics and kinetics.

The topics of the laboratory:

1. Determination of the voltammetric curves for non-alloy and alloy steels. Determination of Tafel curves. (4 hrs.).
2. Determination of Bode and Nyquist diagrams for materials with different corrosion resistance. (4 hrs.).
3. Study of corrosion resistance and impedance non-alloy steel produced with galvanic coatings (4 hrs.).

Bibliography:

Mandatory:

1. Marcel Pourbaix „Lectures on electrochemical corrosion" Springer 1973

Complementary:

1. P. Atkins, J. De Paula „Physical Chemistry" Oxford, 2010

Learning outcomes:

Symbol	Learning objectives and skills acquired	Reference to learning objectives in the given field of study
W1	The student has expanded and deepened knowledge of mathematics, physics, chemistry, materials science and other areas used as the basis for formulating and solving complex tasks in the field of materials science.	K_W02, K_W03, K_W04;
W2	It has a well-established expertise in materials science and physical chemistry. He has some knowledge of the mechanism of corrosion with the thermodynamic considerations.	K_W05;
W3	He knows the basics of building materials, the concept of the structure of materials, mechanisms of phase transitions in materials, the relationship between the parameters of the basic processes and structure of materials, and between structure and properties. He knows the relationship between the structure of materials and their resistance to corrosion phenomena.	K_W11;
W4	He knows the basics and rules of testing methods, measurement, analysis and description of corrosion, including the use of research voltammetric and impedance	K_W15;

U1	Is able to plan and carry out experiments, interpret the results and draw conclusions	K_U04, K_U07, K_U15;
U2	Student can evaluate methods and engineering tools suitability in process of engineering problem solving. One is able to solve complex and unusual issue related to materials engineering.	K_U08, K_U10, K_U14;
K1	He is aware of the level of their knowledge and skills, and can predict the directions of further learning and effectively implement learning process.	K_K01, K_K05;
K2	Student can think and act in creative and initiative way.	K_K07;

Assessment methods and criteria:

The course is evaluated by final written test.
Laboratory – completion of the exercise requires to get the positive mark from preliminary test before the exercise, the exercise execution and the laboratory report.
Completion of the course requires the positive assessments of laboratory exercises and to pass a written test including open questions and / or the multiple choice test.
- The effects of W1, W2, W3 and W4 are evaluated on a written quiz containing open questions.
- The effect of U1 and U2 checked orally during lab exercises.
- The effect of K1 and K2 is checked during lectures and laboratory exercises based on preparation and participation in the discussion.

score 2 - less than 50% of correct answers;
score 3 - 50 ÷ 60% of correct answers;
score 3.5 - 61 ÷ 70% of correct answers;
score 4 - 71 ÷ 80% of correct answers;
score 4.5 - 81 ÷ 90% of correct answers;
score 5 rating - above 91% correct answer

The very good mark is received by the student who possessed the knowledge, skills and competences foreseen by learning outcomes, and also shows interest in the subject, in a creative approaches to assigned tasks and shows independence in acquiring knowledge, is persistent in overcoming difficulties and systematic work.
The good mark is received by the student who possessed the knowledge and skills provided by a curriculum at a good level and is able to solve the tasks and problems of medium difficulty.
The satisfactory mark is received by the student who possessed the knowledge and skills provided by the curriculum sufficiently. Independently solves tasks and problems with a low degree of difficulty. His/Her knowledge and skills are noticeable gaps that can complement but under the guidance of a teacher.
The failing mark is received by the student who does not possess the necessary knowledge, skills and competences required.
The final evaluation consists of the evaluation obtained on the final test, evaluation of the laboratory and the commitment and approach to student learning.

Internship:

N/A

Study format

full-time studies

Level of the studies

Graduate degree

Course type

elective

Introductory courses and prerequisites

- name of the course: Mathematical Analysis I. Prerequisites: ability calculating derivatives and integrals, knowledge statements about logarithms
- Name of course: general chemistry and physical. Prerequisites: Basic knowledge of inorganic chemistry and the ability to perform basic chemical calculations (solution concentration, pH)

Programy

Field of study: Materials Science
Specialization: New Materials and Technologies

Form of teaching, lecture's number / qualification

Semester	x - examination, + - credit, # - project						ECTS points
	Total	lectures	exercises	laboratories	projects	seminars	
III	30	18/ +		12 / +			2

Author							
Dr. Wojciech S. Stępniowski							
ECTS Bilans							
Lp.	**Activity**					**Workload in hours.**	
1	Participation in lectures					18	
2	Individual studies of lecture topics					18	
3	Participation in exercises						
4	Individual preparation for exercises						
5	Participation in laboratory exercises					12	
6	Individual preparation for laboratory exercises					12	
7	Participation in seminars						
8	Individual preparation for seminars						
9	Implementation of the project						
10	Participation in consultations						
11	Preparation for the examination						
12	Participation in the examination						
						Hours.	**ECTS**
Student's aggregate workload						60	2
Classes with teachers: 3 + 1 + 5 + 7 + 9 + 10 + 12						30	1
Classes with practical aspects: 5 + 6 + 9						24	1
Classes related to scientific activity: 1 + 2 + 3 + 4 + 7 + 8						36	1

AUTHOR OF
COURSE INFORAMATION CARD

Dr Wojciech J. Stępniowski / *Dr* Małgorzata Norek

MANAGER OF THE UNIT
RESPONSIBLE FOR THE COURSE

Dr. Tomasz CZUJKO – prof. of MUT