Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Physical Education 1**		
Code	MSE_1A_S_A01a		
Field of specialisation			
Administering faculty	Studium Wychowania Fizycznego i Sportu		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	30	0,0	1,00	K	credits

Leading teacher	Trubiłko Joanna (Joanna.Walczak@zut.edu.pl)
Other teachers	Olszewska Tamara (Tamara.Olszewska@zut.edu.pl)

Prerequisites	
W-1	no health contraindications to exercise
W-2	students completely exempt from physical exercise

Module/course unit objectives	
C-1	C1 - teaching technical elements of the chosen sports discipline. C2 - to care for one's own health through exercise as a preventive measure against diseases of the motor, respiratory, circulatory, nervous and other systems. C3 - increasing the value of motor skills: strength, speed, endurance, agility, power. C4 - develop the habit of using motor exercises for recreational purposes.Transfer of knowledge about physical culture, the organization of sporting and tourist events and the rules of basic sports disciplines. C5 - to oppose social pathologies /alcoholism, drug addiction, nicotinism/ by proposing participation in widely understood physical activity.
C-2	To awaken care for one's own health through the use of exercises as a preventive agent for disorders of the systems; motor, respiratory, blood, nervous and other. Mobilization for pro-health attitudes. To acquaint students with the history of physical culture and sport, the regulations of selected sports disciplines and the transfer of knowledge about the organization of sports, recreational and tourist events.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	1 - course content dependent on the type of sport and in accordance with the curricula.The student selects one of the available sports. 2 - lectures for students with semester and full year medical exemptions; -health effects of physical activity - physical activity and addictions - place of physical activity among health determinants - the influence of physical exercise on the physiological state of the body /heart rate, blood pressure, breathing, posture defects, immunity / - body weight control - history of the olympic games - physical exercise as a form of combating stress	30

Student workload - forms of activity		*Number of hours*
A-A-1	Group exercises, sports training, participation in tourist events and sports camps.	30

Teaching methods / tools	
M-1	teaching method for movement tasks; synthetic, analytical, mixed and comprehensive; practical method: presentation; delivery method: lecture, description, talk, explanation; activating method; didactic discussion, task-oriented, direct purposefulness of the movement; reconstructive method; task-oriented; peripheral-station method; training method;
M-2	conversational lecture; multimedia presentation

Evaluation methods (F - progressive, P - final)		
S-1	F	student's assesment based on his/her progress; involvement and activity in classes, as well as movement skills in the field of selected sports disciplines/ written test; test
S-2	F	colloquium, test on knowledge of physical culture

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
MSE_1A_A04-1_U01 Has motor skills in selected forms of physical activity - can correctly perform technical elements of selected sports disciplines	MSE_1A_U10 MSE_1A_U13	P6S_UO P6S_UU		C-1	T-A-1	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_A04-1_K01 Has the ability to engage in a pro-healthy lifestyle. Knows the relationship between physical activity and health. Can select physical activity according to health condition, age, gender and promote it	MSE_1A_K01	P6S_KK	P6S_WK	C-1	T-A-1	M-1 M-2	S-1 S-2
MSE_1A_A04-1_K02 He or she can apply the acquired motor, technical and tactical skills in various sports disciplines and in tourist and recreational activities. He or she can work and cooperate in a group according to the "fair play" rule both on the sports field and in everyday life.	MSE_1A_K03	P6S_KO	P6S_WK	C-1	T-A-1	M-1 M-2	S-1 S-2
MSE_1A_A04-1_K03 He or she has knowledge in the field of physical culture, history of sport, regulations of sport disciplines, can organize and co-organize sport-recreational and tourist events. He or she is an active participant of sports life at the university and in his or her environment. He or she promotes the social and cultural significance of sport. He or she takes care of their own tastes in physical culture.	MSE_1A_K03	P6S_KO	P6S_WK	C-1	T-A-1	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
MSE_1A_A04-1_U01	*2,0*	
	3,0	The student has basic technical skills of various sports disciplines; the exercoses are carried out with technical errors
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A04-1_K01	*2,0*	
	3,0	- knows basically the basis concepts and issues regarding health promotion; - he/she can not put his/her skills into practice;
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A04-1_K02	*2,0*	
	3,0	- understands the principle of "fair play" at the basic level;
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A04-1_K03	*2,0*	
	3,0	- manifests interest in various forms of physical activity at the basic level
	3,5	
	4,0	
	4,5	
	5,0	

Supplementary reading

Supplementary reading
1. S.Owczarek, Atlas ćwiczeń korekcyjnych, WSiP, Warszawa, 2005
2. R.Trześniowski, Gry i zabawy ruchowe, WSiP, Warszawa, 2005
3. J.Sobotta, Atlas anatomii człowieka, Urban i Partner, Wrocław, 1994
4. G.Gracz, Emocje przedstartowe oraz ich związek z aspiracjami sportowców, AWF Poznań, Poznań, 1980
5. Z.Stawczyk, Gry i zabawy lekkoatletyczne, AWF Poznań, Poznań, 1998
6. J.Mazurek, Gimnastyka podstawowa, WSiT, Warszawa, 1980
7. przekład J.Grabowski, J.Szopa, Eurofit, europejski test sprawności fizycznej, AWF Kraków, Kraków, 1989
8. K.Zuchora, Podstawowy test sprawności fizycznej, 2010
9. I.Talaga, A - Z sprawności fizycznej, Warszawa, 1995
10. J.Talaga, Sprawność fizyczna ogólna - testy, Zysk i S-ka, Poznań, 2004
11. J.Bahrynowicz-Fic, Właściwości ćwiczeń fizycznych, ich systematyka i metodyka, PZWL, Warszawa, 1987
12. R.Karpiński, Nauczanie pływania, AWF Katowice, Katowice, 1995

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Physical Education 2**		
Code	MSE_1A_A_A01b		
Field of specialisation			
Administering faculty	Studium Wychowania Fizycznego i Sportu		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	2	30	0,0	1,00	K	credits

Leading teacher	Trubiłko Joanna (Joanna.Walczak@zut.edu.pl)
Other teachers	Olszewska Tamara (Tamara.Olszewska@zut.edu.pl)

Prerequisites	
W-1	no health contraindications for physical exercise
W-2	Students completely exempt from physical exercise

Module/course unit objectives	
C-1	C1 - teaching technical elements of the chosen sports discipline. C2 - to care for one's own health through exercise as a preventive measure against diseases of the motor, respiratory, circulatory, nervous and other systems. C3 - increasing the value of motor skills: strength, speed, endurance, agility, power. C4 - develop the habit of using motor exercises for recreational purposes.Transfer of knowledge about physical culture, the organization of sporting and tourist events and the rules of basic sports disciplines. C5 - to oppose social pathologies /alcoholism, drug addiction, nicotinism/ by proposing participation in widely understood physical activity.
C-2	To make students aware of their own health through exercise as a preventive measure against diseases of the motor, respiratory, circulatory, nervous and other systems. to acquaint students with the history of physical culture and sport, regulations of chosen sport disciplines and to convey knowledge about organization of sport, recreation and tourist events.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	1 - course content dependent on the type of sport and in accordance with the curricula.The student selects one of the available sports. 2 - lectures for students with semester and full year medical exemptions; -health effects of physical activity - physical activity and addictions - place of physical activity among health determinants - the influence of physical exercise on the physiological state of the body /heart rate, blood pressure, breathing, posture defects, immunity / - body weight control - history of the olympic games - physical exercise as a form of combating stress	30

Student workload - forms of activity		*Number of hours*
A-A-1	1.group exercises, sports training, participation in tourist events and sports camps. 2. participation in classes for students with semester and year-long medical exemptions	30

Teaching methods / tools	
M-1	teaching method for movement tasks; synthetic, analytical, mixed and comprehensive; practical method: presentation; delivery method: lecture, description, talk, explanation; activating method; didactic discussion, task-oriented, direct purposefulness of the movement; reconstructive method; task-oriented; peripheral-station method; training method;
M-2	conversational lecture; multimedia presentation

Evaluation methods (F - progressive, P - final)		
S-1	F	student's assesment based on his/her progress; involvement and activity in classes, as well as movement skills in the field of selected sports disciplines/ written test; test
S-2	F	colloquium, test on knowledge of physical culture

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
MSE_1A_A04-2_U01 has movement skills in selected forms of physical activity - can correctly perform technical elements of selected sports disciplines	MSE_1A_U10	P6S_UO		C-1 C-2	T-A-1	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_A04-2_K01 Has the ability to engage in a pro-healthy lifestyle. Knows the relationship between physical activity and health. Can select physical activity according to health condition, age, gender and promote it	MSE_1A_K01	P6S_KK	P6S_WK	C-1 C-2	T-A-1	M-1 M-2	S-1 S-2
MSE_1A_A04-2_K02 The student can apply the acquired movement, technical and tactical skills in various sports disciplines and in tourist and recreational activities.	MSE_1A_K01	P6S_KK	P6S_WK	C-1 C-2	T-A-1	M-1 M-2	S-1 S-2
MSE_1A_A04-2_K03 With knowledge in the field of physical culture, history of sports, regulations of sports disciplines, he/she is able to organize and co-organize sports, recreational and tourist events.He/she is an active participant of sports life at the university and in his/her environment.He/she promotes the social and cultural significance of sports.He/she cultivates his/her own tastes in physical culture.	MSE_1A_K03	P6S_KO	P6S_WK	C-1 C-2	T-A-1	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
MSE_1A_A04-2_U01	*2,0*	
	3,0	The student has basic technical skills of various sports disciplines. The exercises are carried out with technical errors
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A04-2_K01	*2,0*	
	3,0	- knows basically the basis concepts and issues regarding health promotion; - he/she can not put his/her skills into practice;
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A04-2_K02	*2,0*	
	3,0	- understands the principle of "fair play" at the basic level;
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A04-2_K03	*2,0*	
	3,0	- manifests interest in various forms of physical activity at the basic level
	3,5	
	4,0	
	4,5	
	5,0	

Supplementary reading
1. S.Owczarek, Atlas ćwiczeń korekcyjnych, WSiP, Warszawa, 2005

Supplementary reading
2. R.Trześniowski, Gry i zabawy ruchowe, WSiP, Warszawa, 2005
3. J.Sobotta, Atlas anatomii człowieka, Urban i Partner, Wrocław, 1994
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5. Z.Stawczyk, Gry i zabawy lekkoatletyczne, AWF Poznań, Poznań, 1998
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7. przekład J.Grabowski, J.Szopa, Eurofit, europejski test sprawności fizycznej, AWF Kraków, Kraków, 1989
8. K.Zuchora, Podstawowy test sprawności fizycznej, 2010
9. I.Talaga, A - Z sprawności fizycznej, Warszawa, 1995
10. J.Talaga, Sprawność fizyczna ogólna - testy, Zysk i S-ka, Poznań, 2004
11. J.Bahrynowicz-Fic, Właściwości ćwiczeń fizycznych, ich systematyka i metodyka, PZWL, Warszawa, 1987
12. R.Karpiński, Nauczanie pływania, AWF Katowice, Katowice, 1995

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**European History**		
Code	MSE_1A_S_A02a		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	1	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	1	45	4,0	1,00	K	credits

Leading teacher	Czech Zbigniew (psa_czech@wp.pl)
Other teachers	Czech Zbigniew (psa_czech@wp.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites	
W-1	Basic knowledge of European history at high school graduate level is required.

Module/course unit objectives	
C-1	A concise presentation of the European History from ca. 800 to the present days, from the perspective of political, religious, social, economic, cultural, diplomatic, and intellectual history.
C-2	Consolidation of knowledge related to the basic facts and interpretation.
C-3	Developing student’s ability to historical argumentation in writing and discusing.
C-4	Improving student’s awareness of the need for continuous education and professional development.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Medieval Review: Manor, Feudalism, and Church, 100 Years’ War, The Black Death, The Great Schism;	2
T-W-2	Renaissance: The Five Main Ideals: Individualism, Secularism, Humanism, Virtu, and Historical Consciousness, Arts and Sciences , Italy’s Political Decline & Revival of Monarchy in Northern Europe;	2
T-W-3	The Reformation: Questioning the Church (Luther, Zwingli, Calvin, and the Anabaptists), The English Reformation, Catholic Counter-Reformation;	2
T-W-4	The Age of Religious Wars: The French Wars of Religion; Spain and Philip II; The Revolt of the Netherlands; Elizabethan England, The 30 Years’ War;	2
T-W-5	Absolutism and Constitutionalism: Stuart England and the English Civil War, The Restoration and the Glorious Revolution, Louis XIV of France, Hohenzollerns and Hapsburgs, Russia and Peter the Great;	2
T-W-6	Early Modern Thought and Culture: The Medieval World View, The Scientific Revolution, Writers and Philosophers;	2
T-W-7	The Transatlantic Economy, Trade Wars, and Colonial Rebellion: Mercantilism and Early Colonialism, Black African Slavery, Plantation System, and the Atlantic Economy, Mid-Eighteenth Century Wars and the American Revolution;	2
T-W-8	The French Revolution: The Ancien Regime/Financial Crisis, Early Stages of the Revolution, The Reign of Terror, Thermidorean Reaction and Results;	2
T-W-9	The Napoleonic Era: The Rise of Napoleon and the Consulate of France, Haitian Revolution and Napoleon’s Empire, Napoleon’s Defeat and the Congress of Vienna;	2
T-W-10	The Age of Metternich: Romanticism, Nationalism, and Revolt: The Romantic Movement, The Conservative Order and the Emergence of Nationalism, Revolts of the 1820s and 1830s, Revolts of 1848;	2
T-W-11	Industrial Change and Social Unrest: Life in the 18th Century, The Agricultural Revolution, The Industrial Revolution, Industrial Society and the Labor Force, Socialism: Utopian Socialism, Anarchism, and Marxism;	2
T-W-12	The Age of Nation-States: The Eastern Question and the Crimean War, Italian Unification, German Unification, France, The Habsburg Empire, and Russia, Great Britain –Toward Democracy;	2
T-W-13	The US History: Europeans vs. Native Americans, Characteristics of the 13 British Colonies, Causes of the Revolutionary War, Westward Expansion, Causes of the Civil War, Industrialization, The Interwar Period, Social Movements, The Post-Cold War World;	2

Course content divided into various forms of instruction		*Number of hours*
T-W-14	Society and Politics Leading to World War I: The Second Industrial Revolution, The Middle Class and Urban Life, Women's Experiences in the Late Nineteenth Century, Jewish Emancipation, Labor, Socialism, and Politics to WWI;	2
T-W-15	Philosophy and Ideas Pre-WWI: Positivism and Science, Christianity and the Church Under Siege, Art and Architecture, Nietzsche and Freud, The Women's Movement;	2
T-W-16	Imperialism, Militarism, and Nationalism Lead to War: The British Empire in India, Asia, and Africa, Empires of France, Belgium, and others, Bismarck and the Balance of Power, Causes of World War I, Militarism and the New Industrialized War, Results of the War;	2
T-W-17	The Russian Revolution: Lenin and the Bolsheviks;	2
T-W-18	The Interwar Years: The Treaty of Versailles, It's Impact on Germany, Depression in Europe, Eastern Europe, Russia and the Rise of Stalin, The Rise of Mussolini, The Rise of Hitler and Nazism;	2
T-W-19	World War II: Causes, At War, Racism and the Holocaust, Domestic Fronts, Results and Peace Talks;	2
T-W-20	The Cold War: Causes and the Emergence of the Cold War, Khrushchev and Brezhnev, The 1960s and 70s, Decolonization, The Collapse of European Communism, The Breakup of Yugoslavia, Resurgence of Russia, Rise of Radical Political Islamism;	2
T-W-21	Social, Cultural, and Economic Challenges in the West through the Present: The Twentieth – Century Movement of Peoples, The Welfare State and Work Patterns, Transformations in Knowledge and Culture, Art, Religion, Technology, The European Union and Financial Crisis;	2
T-W-22	The Poland History: Baptism: The Beginning of the Polish State, Union with Lithuania & the Golden Age, The Deluge1, Reforms & Constitution of 1791, Poland vanishes from maps for 123 years, Regaining Independence: The Second Polish Republic, World War II, People's Republic of Poland, Workers protests: Solidarity, The Third Polish Republic.	3

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	45
A-W-2	Self-study of the literature	60
A-W-3	Consultations	15

Teaching methods / tools	
M-1	Lecture

Evaluation methods (F - progressive, P - final)		
S-1	P	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_A02a_W01 Students familiarize themselves with the main resources of the European History knowledge in order to acquire this basic literacy and develop a set of foundational skills to be applied to further history study. The main skills to be focused on this semester include those listed in the following learning outcomes.	MSE_1A_W10	P6S_WK	P6S_WG	C-1 C-2 C-3 C-4		M-1	S-1
Skills							
MSE_1A_A02a_U01 The ability to describe, analyze, and make critical assessments of historical facts. Students will work to recognize the diverse sources of a historical knowledge. will be asked to apply this knowledge to unfamiliar phenomena in order to be able to make well-founded critical and aesthetic judgments of diverse facts in future study or professional work.	MSE_1A_U10	P6S_UO		C-1 C-2 C-3 C-4		M-1	S-1
Social competences							
MSE_1A_A02a_K01 Thinking critically about the global context and being able to successfully communicate these thoughts to. Students learn to approach the relationship between historical knowledge and broader cultural contexts and ideas with a critical mind that helps to develop skills that can be applied to a broad range of interdisciplinary studies and career activities.	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2 C-3 C-4	T-W-1 T-W-12 T-W-2 T-W-13 T-W-3 T-W-14 T-W-4 T-W-15 T-W-5 T-W-16 T-W-6 T-W-17 T-W-7 T-W-18 T-W-8 T-W-19 T-W-9 T-W-20 T-W-10 T-W-21 T-W-11 T-W-22	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A02a_W01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of historical knowledge.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_A02a_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of historical knowledge.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A02a_K01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of historical knowledge.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. https://www.e-booksdirectory.com/listing.php?category=110
2. https://www.europeana.eu

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**European Art and Music**		
Code	MSE_1A_S_A02b		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	1	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	1	45	4,0	1,00	K	credits

Leading teacher	Czech Zbigniew (psa_czech@wp.pl)
Other teachers	Czech Zbigniew (psa_czech@wp.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites	
W-1	Basic knowledge about European art and music at high school graduate level is recommended, but not required.

Module/course unit objectives	
C-1	Learn new musical repertoire and new pieces of visual art.
C-2	Grasp the historical trajectory of both Western art music and of the visual arts.
C-3	Learn how to think critically of arts as dynamic cultural products.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Reflect on the common elements and differences between visual arts and music. The beginnings – Greek and Roman heritage. Basic introduction to the elements of music: Instrumentation, Harmony Tonality, Melody, Rhythm and Metre. Listening: Excerpts from: Promenade. 1. The Gnome from Pictures at an Exhibiton, Modest Mussorgsky (1874) The Sugar Plum Fairy, Act II, from The Nutcracker, Pyotr Ilyich Tchaikovsky (1892) Epitaph of Seikilos, 2nd Century BC, Stasimon of Orestes, 5th Century BC Bolero, Maurice Ravel (1928)	4
T-W-2	The Middle Ages: The role of the church in arts - a highly religious art, characterised by iconographic paintings illustrating scenes from the Bible, manuscript illumination, church architecture and sculpture. Gregorian chant, development of notation in churches and monasteries. Architecture of Gothic cathedrals and the parallels between the development of Gothic architecture and polyphony in France. Ars subtilior Listening: Anonymous, Gregorian Chant Puer Natus est Nobis Anonymous, Gregorian Chant Ut Queant Laxis Anonymous, Gregorian Chant Viderunt omnes Leoninus, Viderunt omnes (Notre Dame de Paris) (c. 1160) Perotinus, Viderunt omnes (Notre Dame de Paris) (c. 1198) Guillaume de Machaut, Kyrie from the Messe de Notre Dame (Cathedral de Reims) (c. 1364) Baude Cordier, Belle, Bonne, Sage (14th C.) Jacob Senleches, La harpe de melodie (14th C.)	4

Course content divided into various forms of instruction		*Number of hours*
T-W-3	The Renaissance: The Renaissance in arts and its reflection to music in Italy. Court patronage, co-existence of musicians, architects and artists. Leonardo da Vinci, Michelangelo and Raphael. Architects Alberti, Brunelleschi and Bramante. Guillaume Dufay's Nuper Rosarum Flores and the Cathedral of Florence. 'Cori Spezzati': Venetian Polychoral Music at Venice's St. Mark's Cathedral. Palladio's villas in the Veneto. The Sistine Chapel in the Vatican and Palestrina's music. Listening: Guillaume Dufay, Nuper Rosarum Flores (1436) Guillaume Dufay, Lamentatio sanctae matris ecclesiae Constantinopolitanae (1454) Josquin Deprez, Illibata Dei Virgo nutrix (c.1492) Giovanni Pierluigi da Palestrina, Missa Papae Marcelli - Kyrie (1557) Giovanni Gabrieli, Salvator Noster (b.1612) Claudio Monteverdi, Vespro della Beata Vergine, Psalm I - Dixit Dominus (1610)	4
T-W-4	The Baroque Period I: Early Baroque - The birth of Opera, Oratorio and Cantata. Italian court patronage, the academies and the development of monody. Drama, movement and expressivity in visual arts: Caravaggio, Velazquez, Bernini, Borromini. New musical genres in the early 1600s in Italy: Music for the courts (opera and cantata) and music for the prayer hall (oratorio). Public Opera in the 17th Century in Venice. The French Tragedie en musique in the context of Louis IVth's palaces and André Le Notre's garden designs for Versailles and Chantilly. Listening: Excerpts from Claudio Monteverdi, Orfeo (1607): Toccata, Vi ricorda o boschi ombrosi, Ahi, caso acerbo!, Tu sei morta, E la virtute un raggio Monteverdi or colleague, Pur ti Miro from L'Incoronazione di Poppea (1642) Giacomo Carissimi, Historia di Jephta (1648) Luigi Rossi, Occhi Belli (c.1640) Jean-Baptiste Lully, Armide (1686): Ouverture, Les plaisirs ont choisi pour asile (Air) Act 5, Scene 2	4
T-W-5	The Baroque Period II: The High Baroque Music for different performance contexts and spaces, the different cases of J.S Bach, Vivaldi and Handel. Vivaldi in Venice at the Pietà. J.S. Bach in Weimar, Köthen and Leipzig. Handel's music for the Opera and the conception of Oratorios for London. Listening: Antonio Vivaldi, Gloria in excelsis Deo - I (1715) Antonio Vivaldi, Four Seasons, Spring Op. 8 RV 269 (1723) Antonio Vivaldi, Four Seasons, Winter 1st Mov. Op. 8 RV 269 (1723) J.S. Bach, The Toccata and Fugue in D minor, BWV 565 (c.1710) J.S. Bach, Brandenburg Concerto No. 4 in G major, 1. Mov., BWV 1049 (1715–1721) J.S. Bach Ich habe genug, 1. Aria, BWV 82 (1727) J.S. Bach Matthaus Passion, 1. Chorus BWV 82 (1727) J.S. Bach Matthaus Passion, Aria Erbarme Dich (1727) George Friderich Handel, Rinaldo (1711): Cara Sposa, Venti, turbini, Lascia ch'io pianga George Friderich Handel - Hallelujah from the Messiah HWV 56 (1742)	4
T-W-6	Classical Period: The Enlightenment, balance, clarity and elegance in music, parallel to Neoclassical art and architecture, including Canova's sculptures and Jacques-Louis David's paintings. Sonata, symphony and the sonata form. Haydn's early symphonies composed at the Esterhazy Palace (Neoclassical Architecture). Mozart, the piano concerto and the Singspiel. Transition from Classical to Romantic music with Beethoven. Listening: Joseph Haydn, Symphony No. 6 in D major Le matin (Morning). (Hoboken 1/6) (1761) Joseph Haydn, Symphony No. 94 in G Major (Surprise) II. Andante Joseph Haydn, Symphony No. 45 in F♯ minor (Farewell) IV. Finale Wolfgang Amadeus Mozart, Piano Concerto No. 20 in D Minor I. Allegro Wolfgang Amadeus Mozart, Symphony #40 in G Minor, K 550 - 1. Molto Allegro (1788) Wolfgang Amadeus Mozart, The Magic Flute, Queen of the Night's aria (1791) Ludwig van Beethoven, Symphony No. 3 "Eroica" I. Allegro con brio (1824) Ludwig van Beethoven, Sonata No. 14 "Moonlight" 1: Adagio sostenuto and 3: Presto agitato Ludwig van Beethoven, Symphony No. 9 "Choral" (Finale) (1824)	4
T-W-7	Romanticism I: Expansive symphonies, virtuosic piano music, passionate songs which took inspiration from art and literature. Delacroix's paintings of themes from Romantic poetry. Caspar David Friedrich and J.M.W. Turner, John Constable's romantic landscape painting. First class to concentrate on songs and piano works. Schubert, Mendelssohn, Schumann and Brahms' lieder. Chopin, Schumann and Listz' music for the piano. Listening: Franz Schubert, Erlkönig, D. 328 (1815) Franz Schubert, Du bist die Ruh, D. 776 (1823) Franz Schubert, Gute Nacht from Winterreise (1827) Felix Mendelssohn, Auf Flügeln des Gesanges (On Wings of Song) (1834) Robert Schumann, Im wunderschönen Monat Mai from Dichterliebe Op. 48 (1840) Johannes Brahms Wie Melodien zieht es mir Opus 105 N. 1 (1888) Frédéric Chopin Nocturne Op. 9 No. 2 (1830-32) Frédéric Chopin Mazurka No. 5, Op. 7 No. 1 (1830-32) Robert Schumann, Träumerei from Kinderszenen, Op. 15 No. 7 (1838) Franz Liszt - Consolation No. 3, S. 172 (1849-50)	4

Course content divided into various forms of instruction		*Number of hours*
T-W-8	Romanticism II: Expansive symphonies after Beethoven's 9th, the contributions of Brahms and Mahler. Wagner and the Gesamtkunstwerk - Festspielhaus Bayreuth. Verdi and nationalism in music in Italy. Listening: Richard Wagner, Tannhauser - Overture (1845) Richard Wagner, Tristan und Isolde - Prelude to Act 1 (1857-1859) Richard Wagner, Der Ring des Nibelungen (The Ring of the Nibelung) - Die Walküre (The Valkyrie), WWV 86B - The Ride of the Valkyries (1870) Giuseppe Verdi, Va Pensiero, Nabucco (1842) Giuseppe Verdi, La Traviata, Brindisi (1853) Johannes Brahms, Symphony no. 1 in c minor Op. 68- 1st and 4th movements (1876) Johannes Brahms, Symphony no. 3 in F major Op. 90, 3. Poco Allegretto (1883) Gustav Mahler - Symphony no. 5, c sharp minor, 4. Adagietto (1901-2)	4
T-W-9	Impressionism: Impressionism in fine arts, Monet, Degas, Pissarro and Renoir. The influence of the Gamelan and of Japanese prints. The French composers Claude Debussy, Gabriel Fauré and Maurice Ravel's music in relation with French "Symbolist" literature - Verlaine, Mallarmé, etc. Listening: Claude Debussy, Pagodes from Estampes (Prints), L.100 (1903) Claude Debussy, Nuages (Clouds) from Nocturnes L. 91 (1899) Claude Debussy, Prélude à l'après-midi d'un faune (1894) - on a poem by Mallermé. Gabriel Fauré Clair de lune, Op. 46 No 2 (1887) – melodie/chanson - on a poem by Verlaine. Maurice Ravel, Oiseaux Tristes (Sad birds) from Miroirs (Mirrors) (1904-1905)	4
T-W-10	Modernism I: Pre–and Post–World War I art experiments: New forms to express modern life. A precursor to Modernism: Art Nouveau in Europe and the Beethoven Frieze at the Secession in Vienna. The German Expressionists and Strauss's Salome. The Austrian Expressionists and the 2nd Viennese School (Arnold Schoenberg, Alban Berg, Anton Webern). Kandinsky's relationship with Schoenberg. Paris and the Ballets Russes (Matisse and Picasso's projects with Diaghilev). Stravinsky's Le Sacre du printemps (1913). Listening: Richard Strauss, Dance of the Seven Veils from the opera Salome (1915) Arnold Schoenberg Three Piano Pieces, Opus 11, 1st and 3rd Movements (1909) Arnold Schoenberg Pierrot Lunaire (Moonstruck Pierrot), Opus 21, Movement 1, Moondrunk (1912) Alban Berg, Wozzeck (1922) Anton Webern, Symphonie, Opus 21, 1st Movement (1928) Igor Stravinsky, Le Sacre du printemps (1913)	3
T-W-11	Modernism II: World War II, post-war art experiments. The Nazi Regime in Germany and Stalin in the U.S.S.R. Abstract Expressionism in art in the USA. John Cage and Chance music in relation with American Abstract Expressionists. New sound materials, electronic music and space as a compositional parameter at the Philips Pavilion in Brussels. Ligeti and new sonorities. Listening: Olivier Messiaen, Quartet for the End of Time (1941) Richard Strauss, Metamorphosen (1945) Dmitri Shostakovich, Lady Macbeth of Mtsensk District (1934) Dmitri Shostakovich, The Suite for Variety Orchestra, Movement 7. Waltz 2 (1956) Krzysztof Penderecki, Threnody to the Victims of Hiroshima (1960) Benjamin Britten, Dies İrae and Lacrimosa from The War Requiem (1961-2) John Cage, Ryoanji (1983, 1985) John Cage, 4'33' (1952) Iannis Xenakis, Metastaseis (1953-54) Iannis Xenakis, Concrete PH (1958) Edgard Varèse, Poème électronique (1958) György Ligeti, Atmospheres (1961) and Kyrie (from Requiem (1963-5)	3
T-W-12	Post-Modernism and after: Minimalism in Music, from the 1970s: Steve Reich, Philip Glass, Terry Riley, John Adams, related to Minimalism in art, which emerged as a movement in the 1950s and continued through the Sixties and Seventies. Ellsworth Kelly, Frank Stella, Dan Flavin, Donald Judd. Opera in the last few decades. Contemporary classic music in film scores.	3

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	45
A-W-2	Self-study of the literature	60
A-W-3	Consultations	15

Teaching methods / tools	
M-1	Lecture

Evaluation methods (F - progressive, P - final)		
S-1	P	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							

MSE_1A_A02b_W01 Students familiarize themselves with the main resources of the European Art and Music knowledge in order to acquire this understanding and develop a set of foundational skills to be applied to further study. The main skills to be focused on this semester include those listed in the following learning outcomes.	MSE_1A_W10	P6S_WK	P6S_WG	C-1 C-2 C-3	T-W-1	M-1	S-1
Skills							
MSE_1A_A02b_U01 The ability to describe and analyze a musical and art phenomenons. Students will work with the diverse sources of the art. Will be asked to apply this knowledge to make well-founded critical and aesthetic judgments of the cultural events.	MSE_1A_U10	P6S_UO		C-1 C-2 C-3	T-W-1 T-W-2 T-W-12	M-1	S-1
Social competences							
MSE_1A_A02b_K01 Open-minded thinking about the global context of the culture and being able to successfully communicate these thoughts to. Students learn to use these knowledge to further studies and career activities.	MSE_1A_K01 MSE_1A_K04	P6S_KK P6S_KR	P6S_WK	C-1 C-2 C-3	T-W-5 T-W-6 T-W-12	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A02b_W01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of culture.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_A02b_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of culture.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A02b_K01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of culture.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. https://www.europeana.eu
2. http://youtube.com

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intellectual Property and Standarization (ISO, EU)**		
Code	MSE_1A_S_A03		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	polish
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	1	15	1,0	1,00	K	credits

Leading teacher	Czech Zbigniew (psa_czech@wp.pl)
Other teachers	Czech Zbigniew (psa_czech@wp.pl)

Prerequisites

W-1	none

Module/course unit objectives

C-1	The aim of the course is to get knowledge in the field of intellectual property law and EU/ISO standardization.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Introduction to the course: definitions of intellectual property, industrial property, non-material goods, standards and standardization systems in EU and over the world.	2
T-W-2	Preliminary characterisation of intellectual property types: patents, property rights, industrial models, trade-marks, computer software etc.	2
T-W-3	Protecting intellectual property to encourage innovation	1
T-W-4	The protection of Intelectual property and abuses.	1
T-W-5	Entities involved in the protection of intellectual property.	1
T-W-6	Negotiation and exploitation of industrial property rights and copyright.	1
T-W-7	The right balance between freedom of access to the internet respect for privacy and prorection of intelectual property	1
T-W-8	Significance of intellectual property of trademarks, designs, patents, copyrights for innovation growth and competitiveness.	1
T-W-9	Standardization and standards from the engineer's point of view.	1
T-W-10	ISO and CEN, international standardization system, ESS, national standards, industrial standards etc.	1
T-W-11	European Standardization as a key instrument for the Single Market	1
T-W-12	Standards as a valuable source of information necessary to improve performance and safety of the production. Examples of EN / ISO standards with discussion.	2

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	15
A-W-2	Self-study of the literature	10
A-W-3	Consultations	5

Teaching methods / tools

M-1	Lecture

Evaluation methods (F - progressive, P - final)

S-1	P	Written test

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_A03_W01 The student has a basic knowledge about intellectual property law and about standards and standardization.	MSE_1A_W08	P6S_WG		C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1
Skills							
MSE_1A_A03_U01 The student has the skills to evaluate creative works and projects in terms of intellectual property law. He can also search, collect and interpret information from standards	MSE_1A_U12	P6S_UO		C-1		M-1	S-1
Social competences							
MSE_1A_A03_K01 The student understands the important role of intellectual property law and standardization system from the point of view the future engineer.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A03_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_A03_U01	*2,0*	
	3,0	
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A03_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Norman Helen, Intellectual Property Law Directions, OUP, Oxford, 2014
2. www.cencenelec.eu
3. https://ec.europa.eu/growth/single-market/european-standards_en
4. https://www.iso.org/standards.html

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**OHS and Ergonomics**		
Code	MSE_1A_S_A04		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	polish
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	1	15	1,0	1,00	K	credits

Leading teacher	Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl)
Other teachers	Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl)

Prerequisites

W-1	none

Module/course unit objectives

C-1	Gaining knowledge about the problems of occupational health and safety and ergonomics

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Legal regulations in the field of occupational health and safety in the law of the European Union and Poland	3
T-W-2	Ergonomics	2
T-W-3	Interaction between Human and Technical Systems	1
T-W-4	Work with dangerous chemicals or processes	2
T-W-5	Workplace diagnostics	2
T-W-6	Certification of products, machines and devices to meet safety requirements	1
T-W-7	Accidents at work	1
T-W-8	Occupational disease, occupational risk	2
T-W-9	Safety Management	1

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	15
A-W-2	Preparation for tests	13
A-W-3	Individual consultations	2

Teaching methods / tools

M-1	lecture

Evaluation methods (F - progressive, P - final)

S-1	P	Test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_A04_W01 Student knows the problems of occupational health and safety and ergonomics	MSE_1A_W09	P6S_WK		C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9	M-1	S-1

Skills
Social competences

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A04_W01	*2,0*	
	3,0	Student knows the problems of occupational health and safety (test score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
Other social competences		

Required reading
1. Benjamin O. Alli, Fundamental Principles of Occupational Health and Safety, International Labour Office, Geneva, 2008

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Library Orientation/Library Skills Training**		
Code	MSE_1A_S_A05		
Field of specialisation			
Administering faculty	Biblioteka Główna		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	5	0,0	1,00	K	credits

Leading teacher	Arabczyk-Mosiewicz Anna (Anna.Arabczyk@zut.edu.pl)
Other teachers	Jankowska Elżbieta (Elzbieta.Jankowska@zut.edu.pl)

Prerequisites

W-1	Knows the basics of using computer and www network

Module/course unit objectives

C-1	To acquaint users with the organization, functioning and principles of using the library, its collections and services

Course content divided into various forms of instruction		*Number of hours*
T-A-1	The Main Library implements "Library Training" online as an aid to familiarize users with the organization, operation, and use of the library, its collections and services. The training can be found on the university website www.zut.edu.pl Under E-services / E-education in the course categories please indicate General courses, and in them the course ZUT Main Library - Library training Training program: 1. general information about the library: library collection, organizational structure and location, opening hours Rules of using the library's collections and services, with particular emphasis on the rules of making collections available: user registration, using the reading room, borrowing, interlibrary loans 3. basic sources of scientific information, databases Using the Aleph online catalog: simple and complex searching, indexes, functions available after logging in to the system: placing orders for the lending library and reading room, deleting orders, extending the loan period, checking one's library account, managing it.	5

Student workload - forms of activity		*Number of hours*
A-A-1	To become familiar with the contents of the online "Library Training" and the "Regulations for the use of the collections and services of the Main Library of the West Pomeranian University of Technology in Szczecin" - Annex to the Order No. 58 of the Rector of ZUT dated 25 September 2019.	2
A-A-2	written test	1

Teaching methods / tools

M-1	online training

Evaluation methods (F - progressive, P - final)

S-1	F	Test passed on the basis of 70% correct answers

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_A14_W01 the student knows the regulations in force in the Main Library and the rules of using library services	MSE_1A_W08	P6S_WG		C-1	T-A-1	M-1	S-1

Skills							
MSE_1A_A14_U01 The student knows how to use the library's collections and the Aleph system (searching, ordering, reserving books for borrowing or as part of presenting books - on the spot in the reading room). He knows the basic scientific databases.	MSE_1A_U10 MSE_1A_U11	P6S_UK P6S_UO P6S_UW		C-1	T-A-1	M-1	S-1
Social competences							
MSE_1A_A14_K01 He knows the information and library system of ZUT and knows how to use it	MSE_1A_K01	P6S_KK	P6S_WK	C-1	T-A-1	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A14_W01	*2,0*	
	3,0	Correct answers to 70% of the test questions
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_A14_U01	*2,0*	
	3,0	70% correct answers to test questions
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A14_K01	*2,0*	
	3,0	Passing the test on the basis of 70% correct answers
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. "Regulamin korzystania ze zbiorów i usług Biblioteki Głównej Zachodniopomorskiego Uniwersytetu Technologicznego w Szczecinie" - załącznik do zarządzenia nr 58 Rektora ZUT z dnia 25 września 2019 r., 2019

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**OHS Training**		
Code	MSE_1A_S_A06		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	1	5	0,0	1,00	K	credits

Leading teacher	Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl)
Other teachers	Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl)

Prerequisites

W-1	none

Module/course unit objectives

C-1	To acquaint students with the knowledge of OSH legislation
C-2	To acquaint students with the knowledge of dealing with threats
C-3	To acquaint students with the knowledge of first aid

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Selected legal issues	1
T-W-2	Threats to life and health	1
T-W-3	Protection against threats	1
T-W-4	Dealing with threats	1
T-W-5	First aid	1

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	5

Teaching methods / tools

M-1	Lecture

Evaluation methods (F - progressive, P - final)

S-1	P	Test
S-2	F	Participation in lectures

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_A06_W01 Student knows the problems of occupational health and safety	MSE_1A_W09	P6S_WK		C-1 C-2 C-3	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1	S-1 S-2
Skills							
Social competences							

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A06_W01	*2,0*	
	3,0	Student knows basic problems of occupational health and safety (test score => 50%). Participation in lectures: 100%
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
Other social competences		

Required reading
1. -, selfmade materials, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Mathematics 1**		
Code	MSE_1A_S_B01a		
Field of specialisation			
Administering faculty	Studium Matematyki		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	30	2,0	0,41	K	credits
lecture	W	1	30	4,0	0,59	K	examination

Leading teacher	Iglewska-Nowak Ilona (Ilona.Iglewska-Nowak@zut.edu.pl)
Other teachers	Iglewska-Nowak Ilona (Ilona.Iglewska-Nowak@zut.edu.pl)

Prerequisites

W-1	Knowledge of mathematics at A level.

Module/course unit objectives

C-1	The target is that the students have knowledge and abilities to use mathematical methods to describing physical and chemical processes, as well as kowledge about basic mathematical tools necessary for further studies.
C-2	Awareness of the need of fair and systematic work.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Exercise solving and problem discussion regarding topics from the lecture.	26
T-A-2	Tests.	4
T-W-1	Algebraic calculation programs: introduction to Mathematica.	2
T-W-2	Elementary functions: linear and power functions, polynomials, exponential functions, logarithms.	8
T-W-3	Differential calculus: definition of a derivative and differentiation methods.	4
T-W-4	Application of differential calculus to functions: approximate calculations, maxima/minima, monotonicity of a function.	4
T-W-5	Integral calculus: definite and indefinite integrals, relation with differentiation, tables of integrals, integration methods.	8
T-W-6	Ordinary differential equations of the first order: separable ODE, linear ODE.	4

Student workload - forms of activity		*Number of hours*
A-A-1	Training participation.	30
A-A-2	Individual work: exercise solving and test preparation.	24
A-A-3	Consultation.	4
A-A-4	Final test.	2
A-W-1	Participation in the lectures	30
A-W-2	Individual study of lecture notes and given literature.	52
A-W-3	Consultations.	10
A-W-4	Preparation for the exam	25
A-W-5	The exam.	2

Teaching methods / tools

M-1	Lecture. Presentation of theory and sample exercises.
M-2	Training. Exercise solving, problem discussion.

Evaluation methods (F - progressive, P - final)

Evaluation methods (F - progressive, P - final)		
S-1	P	Written exam.
S-2	P	Exercise tests.
S-3	F	Lecture: based on discussions. Training: based on solved exercises.

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B01_W01 Knows the basic definitions, theorem and calculation methods.	MSE_1A_W01	P6S_WG P6S_WK	P6S_WG	C-1	T-W-2 T-W-4 T-W-3 T-W-5	M-1	S-1 S-3
Skills							
MSE_1A_B01_U01 Is able to apply the methods taught in the course and found in the litarature to various problems.	MSE_1A_U02	P6S_UW		C-1	T-A-1 T-W-2 T-W-4 T-W-3 T-W-5	M-1 M-2	S-1 S-2 S-3
Social competences							
MSE_1A_B01_K01 Is aware of the need of further study and systematic work.	MSE_1A_K02	P6S_KK	P6S_WK	C-2	T-A-1 T-W-2 T-W-4 T-W-3 T-W-5	M-1 M-2	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B01_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of mathematics
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B01_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to solve mathematical problems.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B01_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Tom M. Apostol, Calculus Vol. I, Juohn Wiley & Sons, https://www.doraci.com.br/downloads/matematica/Apostol_Calculus_vol-1.pdf

2. Paul Dawkins, Calculus I, https://notendur.hi.is/adl2/CalcI_Complete.pdf

3. Michael Trott, The Mathematica GuideBook for Symbolics, https://link.springer.com/book/10.1007/0-387-28815-5

Supplementary reading

1. Jeffrey Lockshin, Calculus: theory, examples, exercises, https://pokrovka11.files.wordpress.com/2012/10/calculus.pdf

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Mathematics 2**		
Code	MSE_1A_S_B01b		
Field of specialisation			
Administering faculty	Studium Matematyki		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	2	30	2,0	0,41	K	credits
lecture	W	2	30	2,0	0,59	K	examination

Leading teacher	Iglewska-Nowak Ilona (Ilona.Iglewska-Nowak@zut.edu.pl)
Other teachers	Iglewska-Nowak Ilona (Ilona.Iglewska-Nowak@zut.edu.pl)

Prerequisites

W-1	Mathematics I.

Module/course unit objectives

C-1	The target is that the students have knowledge and abilities to use mathematical methods to describing physical and chemical processes, as well as kowledge about basic mathematical tools necessary for further studies.
C-2	Awareness of the need of fair and systematic work.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Exercise solving and problem discussion regarding topics from the lecture.	26
T-A-2	Tests.	4
T-W-1	Ordinary differential equations of the first order: Bernoulli equation. Second order linear ODE with constant coefficients.	4
T-W-2	Differentiation of functions of many variables.	2
T-W-3	Partial differential equations of the first and second order with constant coefficients.	6
T-W-4	Linear algebra: operations on vectors and matrices, solving linear equation systems.	8
T-W-5	Dimensional analysis.	2
T-W-6	Error function.	2
T-W-7	Probability, standard distributions, variance, standard deviation, regression, correlation.	6

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	Individual work: exercise solving and test preparation.	24
A-A-3	Consultation.	4
A-A-4	Final test.	2
A-W-1	Lecture participation	30
A-W-2	Individual study of lecture notes and given literature.	14
A-W-3	Consultations.	7
A-W-4	Preparation for the exam	8
A-W-5	The exam.	2

Teaching methods / tools

M-1	Lecture. Presentation of theory and sample exercises.
M-2	Training. Exercise solving, problem discussion.

Evaluation methods (F - progressive, P - final)		
S-1	P	Written exam.
S-2	P	Exercise tests.
S-3	F	Lecture: based on discussions. Training: based on solved exercises.

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B01b_W01 Knows the basic definitions, theorem and calculation methods.	MSE_1A_W01	P6S_WG P6S_WK	P6S_WG	C-1	T-W-4	M-1	S-1 S-3
Skills							
MSE_1A_B01b_U01 Is able to apply the methods taught in the course and found in the litarature to various problems.	MSE_1A_U02	P6S_UW		C-1	T-A-1 T-W-4	M-1 M-2	S-1 S-2 S-3
Social competences							
MSE_1A_B01b_K01 Is aware of the need of further study and systematic work.	MSE_1A_K02	P6S_KK	P6S_WK	C-2	T-A-1 T-W-4	M-1 M-2	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B01b_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of mathematics.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B01b_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to solve mathematical problems.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B01b_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Tom M. Apostol, Calculus Vol. I, Juohn Wiley & Sons, https://www.doraci.com.br/downloads/matematica/Apostol_Calculus_vol-1.pdf

2. Jeffrey R. Chasnov, Differential Equations for Engineers, https://www.math.ust.hk/~machas/differential-equations-for-engineers.pdf

3. Volker Simon, Bernhard Weigand, and Hassan Gomaa, Dimensional Analysis for Engineers, file:///C:/Users/sm/Downloads/2017_Book_DimensionalAnalysisForEngineer.pdf

4. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, http://www.um.edu.ar/math/montgomery.pdf

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Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Physics of Materials**		
Code	MSE_1A_S_B02		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	12,0	*ECTS (forms)*	12,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	45	4,0	0,30	K	credits
laboratory course	L	1	30	3,0	0,30	K	credits
lecture	W	1	45	5,0	0,40	K	examination

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Lubkowski Krzysztof (Krzysztof.Lubkowski@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Szymczyk Anna (Anna.Szymczyk@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites	
W-1	Knowledge of the basic course in mathematics and physics at the elementary level

Module/course unit objectives	
C-1	The students will gain knowledge in the area of fundamental phiscics and skills to explore fundamental properties of materials

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Heat (determination of Debye temperature and specific heat capacity; application of Fourier's law in determination of heat conduction; use of Stefan's law and Wien's law in the calculation of heat radiation)	5
T-A-2	Thermodynamics (calculations related to I and II laws of thermodynamics; efficiency of an engine; determination of coefficients of performance for heat pumps and refrigerators)	4
T-A-3	Temperature (expressing temperature in different scales, calculation of thermal expansion of solids and liquids)	5
T-A-4	Determination of structure factor	2
T-A-5	Computer modelling of x-ray diffraction patter in Powdercell software	2
T-A-6	Calculation of band gap basing on experimental data, discussion	4
T-A-7	Defects in solid materials – case stydy based on carbon materials – Raman data analysis	5
T-A-8	Physical meaning of quantum numbers - analysis	5
T-A-9	Analysis of atomic spectrum and role of X-ray diffraction	5
T-A-10	Analysis of molecular specrum	5
T-A-11	summary and test	3
T-L-1	X-rays diffraction in characterization of materials	5
T-L-2	Determination of Miller indices of reflexions of copper and iron	5
T-L-3	Determination of crystallographic structure type and lattice constant by X-ray diffraction	5
T-L-4	Study of hallotron characteristics	3
T-L-5	Determination of the Earth's magnetic field	3
T-L-6	Measurements of the dependence of magnetic permeability of ferromagnets on temperature	4
T-L-7	Denbsity of solide state laboratory work	5
T-W-1	Temperature (temperature and thermal equilibrium, temperature scales, thermal expansion of solids and liquids, Debye model of solids, Debye temperature, diffusion)	5

Course content divided into various forms of instruction		*Number of hours*
T-W-2	Heat (internal energy, heat capacity and specific heat, phase transitions, thermal conduction, thermal convection, thermal radiation, phonos, heat transport in metals and isolators, calorimetry)	5
T-W-3	Thermodynamics (laws of thermodynamics, thermodynamics functions, heat engines, refrigerators and heat pumps)	4
T-W-4	Difference between amorphous, semi-crystalline and crystalline solids, packing in crystalline solids	3
T-W-5	Transport properties: microscopic model of electrical conductivity, Fermi Energy, Bloch model of electrons, Semiconductors	4
T-W-6	Electronic structure, fluorescence: atom model, band structure semiconductors, electron orbitals, electron transitions, fluorescence and spectrometer	3
T-W-7	Optical band gap, electron doping, spectrophotometry	4
T-W-8	Condensed matter structure: Symmetry; crystallographic structure types; Bragg’s equation; diffraction	2
T-W-9	X-ray radiation; Powder X-ray diffractometer – working principles	2
T-W-10	Electric field and electrical conductivity: Electric charges and fields; Conductors, semiconductors, insulators.	2
T-W-11	Direct current and resistance: Electrical current lows; Resistivity and resistance and dependence and its dependence on temperature	1
T-W-12	Hall effect and magnetoresistance: Magnetic field and its sources; Electromagnetic phenomena, Hall effect, magnetoresistance; methods to measure the magnetic properties	2
T-W-13	Atomic nucleus, isotopes; - The phenomenon of nuclear precession in a magnetic field, Larmor precession; - Quantum and classical description of nuclear magnetic resonance; - Chemical shift, spin echo and relaxation times; - Characteristics of electromagnet; Experimental basics of NMR spectroscopy	2
T-W-14	Magnetic susceptibility: Magnetic quantities and units, Curie–Weiss law, Ferro- and antiferro-magnetism	2
T-W-15	Participation in the zero-term exam	4

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	45
A-A-2	preparing for tests	45
A-A-3	Preparation for recitations	30
A-L-1	participation in laboratory exercises	30
A-L-2	preparation for laboratory exercises	15
A-L-3	preparation of reports	15
A-L-4	Preparing for tests	30
A-W-1	participation in lectures	45
A-W-2	Individual literature studies	45
A-W-3	preparing for the exam	60
A-W-4	Final exam	1

Teaching methods / tools	
M-1	lectures with presentation
M-2	subject discussion during lectures, auditorium excercises and laboratories
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	written completion of exercises and laboratories
S-3	F	laboratory reports
S-4	F	student activity during auditory excercise and laboratories

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B02_W01 basic physics knowledge useful to a materials science and engineer	MSE_1A_W02	P6S_WG	P6S_WG	C-1	T-W-1 T-W-8 T-W-2 T-W-9 T-W-3 T-W-10 T-W-4 T-W-11 T-W-5 T-W-12 T-W-6 T-W-13 T-W-7 T-W-14	M-1	S-1
Skills							

MSE_1A_B02_U01 skills to explore the fundamental properties of materials	MSE_1A_U03	P6S_UW	P6S_UW	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-A-6 T-A-7 T-A-8 T-A-9 T-A-10 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7	M-2 M-3	S-2 S-3 S-4
Social competences							
MSE_1A_B02_K01 Is aware of the need of further study and systematic work.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-A-6 T-A-7 T-A-8 T-A-9 T-A-10 T-A-11 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11 T-W-12 T-W-13 T-W-14 T-W-15	M-1 M-2	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B02_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B02_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B02_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Peter E. J. Flewitt, Robert K. Wild, Physical Methods for Materials Characterisation, CRC Press, 2017, ISBN 9781482245233

2. Prathap Haridoss, Physics of Materials: Essential Concepts of Solid-State Physics, Wiley, 2015, ISBN: 9788126557875

3. Yves Quere, Physics of Materials, CRC PRESS, 1998, ISBN 9789056991197

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Chemistry**		
Code	MSE_1A_S_B03		
Field of specialisation			
Administering faculty	Department of Inorganic and Analytical Chemistry		
ECTS	11,0	*ECTS (forms)*	11,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	2	30	2,0	0,25	K	credits
laboratory course	L	2	75	7,0	0,50	K	credits
lecture	W	2	30	2,0	0,25	K	examination

Leading teacher	Tomaszewicz Elżbieta (Elzbieta.Tomaszewicz@zut.edu.pl)
Other teachers	Błońska-Tabero Anna (Anna.Blonska-Tabero@zut.edu.pl), Bosacka Monika (Monika.Bosacka@zut.edu.pl), Dąbrowska Grażyna (Grazyna.Dabrowska@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Idzik Tomasz (Tomasz.Idzik@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kołodziej Beata (Beata.Kolodziej@zut.edu.pl), Pelka Rafal (Rafal.Pelka@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Piz Mateusz (Mateusz.Piz@zut.edu.pl), Rozwadowski Zbigniew (Zbigniew.Rozwadowski@zut.edu.pl), Sośnicki Jacek (Jacek.Sosnicki@zut.edu.pl), Struk Łukasz (Lukasz.Struk@zut.edu.pl), Szady-Chełmieniecka Anna (Anna.Szady@zut.edu.pl)

Prerequisites	
W-1	The basic knowledge of fundamental and inorganic chemistry as wel as basic safety rules

Module/course unit objectives	
C-1	Knowledge and understanding the basic concepts and laws of inorganic and organic chemistry: type of chemical bonds, chemical reactions, classifications and characterisation of inorganic and organic compounds as well as their structure
C-2	Knowledge of relationships between physico-chemical properties of the various classes of compounds and their structure

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Equilibria in heterogeneous systems	2
T-A-2	Buffers: the control of pH	2
T-A-3	Acid-base equilibria in salt solutions	2
T-A-4	Equilibria in aqueous solutions of precipitates	2
T-A-5	Coordination compounds and their nomenclature. Equilibrium constant in aqueous solutions of complexes.	2
T-A-6	Exercises in recognizing functional groups, naming organic compounds and writing their structural formulas	5
T-A-7	Solving simple problems in organic chemistry	5
T-A-8	Average molecular weight of polymers – definition, basic equation	3
T-A-9	Degree of polymerization, polydispersity – basic calculations	2
T-A-10	Chemical kinetics, equilibrium, catalysis, reaction mechanisms	5
T-L-1	Occupational health and safety in an inorganic chemistry laboratory. Basic laboratory equipment; Regulation and safety rules in organic chemistry laboratory. Basic laboratory equipment. Principles of laboratory report preparation	5
T-L-2	Acid-base titrimetry. Titration of HCl solution. Determination of total hadrness of water.	5
T-L-3	Qualitative analysis of cations of I, II and III groups	10
T-L-4	Qualitative analysis of cations of IV and V groups	5
T-L-5	Qualitative analysis of anions	5

Course content divided into various forms of instruction		*Number of hours*
T-L-6	Qualitative analysis of salts	5
T-L-7	Determination of melting and boiling points. Simple and fractional distillations	5
T-L-8	Preparation and purification of n-butyl acetate by distillation	5
T-L-9	Preparation and purification of aspirin	5
T-L-10	Preparation and purification of p-bromoacetanilide	5
T-L-11	Preparation and purification of dibenzylideneacetone	5
T-L-12	Intrinsic viscosity as a measure of average molecular weigth	5
T-L-13	Rheological behavior of polymers in melt	5
T-L-14	Measurement of the rate of selected chemical reactions	5
T-W-1	Orbital hybridization and molecular structure	4
T-W-2	States of matter - gases, liquids, plasma and solids	2
T-W-3	Physical properties of solutions (Henry's law, colligative properties)	2
T-W-4	Coordination compounds and their nomenclature. Equilibria in solutions of coordination compounds	2
T-W-5	Organic chemistry in life and science (an introduction)	1
T-W-6	Basic rules of organic chemistry	2
T-W-7	Overview of the structures and properties of basic functional groups	7
T-W-8	Intriduction to basic definitions in polymer chmistry	2
T-W-9	Mechanisms of polymerization reactions and polymers classification	3
T-W-10	Inorganic chemistry in industry	3
T-W-11	Chemical kinetics	2

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	study of literature	20
A-A-3	consultations	10
A-L-1	participation in laboratory exercises	75
A-L-2	study of literature	50
A-L-3	preparation of written reports	55
A-L-4	consultations	30
A-W-1	participation in lectures	30
A-W-2	study of literature	20
A-W-3	consultations	10
A-W-4	The exam	1

Teaching methods / tools	
M-1	Lecture
M-2	Discussion
M-3	Labs

Evaluation methods (F - progressive, P - final)		
S-1	P	Written exam (lecture)
S-2	P	Continupus assessment: lab reports and activity (labs)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B03_W01 Students has knowledge and understanding of basic concepts and laws of chemistry: type of reactions, characterisation of organic and inorganic compounds, kinetics, chemical equlibrium, analytical methods	MSE_1A_W02	P6S_WG	P6S_WG	C-1 C-2	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-A-6 T-A-7 T-A-8 T-A-9 T-A-10 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11	M-1 M-2 M-3	S-1

Skills							
MSE_1A_B03_U01 Students are able to plan and conduct experiments, measurements or computer simulations, as well as to interpret the obtained results and draw conclusions	MSE_1A_U03	P6S_UW	P6S_UW	C-2	T-L-1 T-L-8 T-L-2 T-L-9 T-L-3 T-L-10 T-L-4 T-L-11 T-L-5 T-L-12 T-L-6 T-L-13 T-L-7 T-L-14	M-1 M-2 M-3	S-2
Social competences							
MSE_1A_B03_K01 Students are able to cooperate and work in a group also as a team leader and have understanding the need of learning	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-8 T-L-2 T-L-9 T-L-3 T-L-10 T-L-4 T-L-11 T-L-5 T-L-12 T-L-6 T-L-13 T-L-7 T-L-14	M-2 M-3	S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B03_W01	*2,0*	
	3,0	Min. 60% of scoring
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B03_U01	*2,0*	
	3,0	Positive grades of lab reports
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B03_K01	*2,0*	
	3,0	Positive grades of lab reports
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Andrew F. Parsons, Keynotes in Organic Chemistry, Blackwell Science, 2003
2. John McMurry, Organic Chemistry, Brooks/Cole, 2012, 8 ed
3. John McMurry, Organic Chemistry Solutions, Brook/Cole, 2012, 8 ed
4. James W. Zubrick, The Organic Chemistry Survival Manual, John Wiley & Sons, 1988, 2 ed
5. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, Edinburgh, UK, 2001
6. P. W. Atkins, M. J. Clugston, M. J. Frazer, R. A. Y. Jones, Chemistry. Principles and applications, Longman Group UK Limited, New York, 1990
7. J. E. Brady, General Chemistry. Principles and Structure, John Wiley & Sons, New York, 1990
8. W. W. Porterfield, Inorganic Chemistry. An Unified Approach, Academic Press Inc., London, UK, 1993
9. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, Pearson Education Inc., New Jersey, 2004

Supplementary reading

1. David R. Klein, Organic Chemistry as a Second Language. Translating the Basic Concepts, John Wiley & Sons, 2008, 2 ed
2. G. C. Hill, J. S. Holman, Chemistry in Context, Thomas Nelson and Sons Ltd., Wdinburgh, UK, 1989

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Foreign Language 1**		
Code	MSE_1A_S_B04a		
Field of specialisation			
Administering faculty	Studium Języków Obcych		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
foreign language course	LK	1	75	6,0	1,00	K	examination

Leading teacher	Obstawski Andrzej (Andrzej.Obstawski@zut.edu.pl)
Other teachers	Koc Dorota (Dorota.Koc@zut.edu.pl), Sowińska-Dwornik Joanna (Joanna.Sowinska-Dwornik@zut.edu.pl), Stelmaszczyk Marek (Marek.Stelmaszczyk@zut.edu.pl), Waligórska Katarzyna (Katarzyna.Waligorska@zut.edu.pl)

Prerequisites	
W-1	Baccalaureate in a language at the elementary or extended level.

Module/course unit objectives	
C-1	Use the selected foreign language in a variety of everyday situations by skillfully applying the rules of grammar and vocabulary at the B2 language proficiency level.
C-2	Understand and use basic specialized vocabulary consistent with the field of study.
C-3	Develop an awareness of the need for continuous and autonomous learning.

Course content divided into various forms of instruction		*Number of hours*
T-LK-1	Present Simple, Present Continuous, Present Perfect Simple, Past Simple. (Phrasal verbs). Auxiliary verbs (do/ be/ have).	20
T-LK-2	Simple Past/ Past Continuous	20
T-LK-3	Selected specialized vocabulary in an area consistent with the student's major.	35

Student workload - forms of activity		*Number of hours*
A-LK-1	participating in classes	75
A-LK-2	Preparation for classes	75
A-LK-3	consultations	30
A-LK-4	The exam	1

Teaching methods / tools	
M-1	practical classes
M-2	group work
M-3	presentation
M-4	discussion
M-5	work with text
M-6	listening comprehension
M-7	writing formal letters

Evaluation methods (F - progressive, P - final)		
S-1	F	diagnostic test (F)
S-2	F	control test / colloquium (F)
S-3	F	quiz (F)
S-4	F	presentation (F)

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
MSE_1A_A06-1a_U01 has the ability to communicate at level B2 with a variety of subjects in verbal and written form and reads with understanding articles and reports concerning the contemporary world	MSE_1A_U13	P6S_UU		C-1	T-LK-1 T-LK-2	M-1 M-2 M-3 M-5 M-6 M-7	S-2
MSE_1A_A06-1a_U02 has the ability to understand texts and use the basic specialized vocabulary of his/her field	MSE_1A_U13	P6S_UU		C-2	T-LK-3	M-1 M-3 M-5	S-2 S-3 S-4
Social competences							
MSE_1A_A06-1a_K01 understands the importance of language competence in future professional activities	MSE_1A_K01	P6S_KK	P6S_WK	C-3	T-LK-1 T-LK-2 T-LK-3	M-1 M-2 M-4	S-2 S-3 S-4

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
MSE_1A_A06-1a_U01	*2,0*	
	3,0	The student is able to communicate at a basic level with various subjects in verbal and written form.
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A06-1a_U02	*2,0*	
	3,0	The student understands the basic specialist vocabulary in their field and uses them to a limited extent.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A06-1a_K01	*2,0*	
	3,0	The student recognizes the importance of language competences in future professional work.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. A..Clare, JJ Wilson, TOTAL ENGLISH, Pearson Longman, 2006
2. S..Cunningham, P. Moor, NEW CUTTING EDGE, Pearson Longman, 2007

Supplementary reading

1. S. T. Knowles, M. Mann, USE OF ENGLISH, Macmillan, 2003
2. S. T. Knowles, M. Mann, LISTENING AND SPEAKING, Macmillan, 2003
3. S. T. Knowles, M. Mann, READING, Macmillan, 2003
4. S. T. Knowles, M. Mann, WRITING, Macmillan, 2003
5. XYZ, Teksty popularno-naukowe z dziedziny studiowanego kierunku, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Foreign Language 2**		
Code	MSE_1A_S_B04b		
Field of specialisation			
Administering faculty	Studium Języków Obcych		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
foreign language course	LK	2	75	4,0	1,00	K	credits

Leading teacher	Obstawski Andrzej (Andrzej.Obstawski@zut.edu.pl)
Other teachers	Koc Dorota (Dorota.Koc@zut.edu.pl), Sowińska-Dwornik Joanna (Joanna.Sowinska-Dwornik@zut.edu.pl), Stelmaszczyk Marek (Marek.Stelmaszczyk@zut.edu.pl), Waligórska Katarzyna (Katarzyna.Waligorska@zut.edu.pl)

Prerequisites

W-1	passes exam on Foreign language I

Module/course unit objectives

C-1	Use the selected foreign language in a variety of everyday situations by skillfully applying the rules of grammar and vocabulary at the B2 language proficiency level.
C-2	Understand and use basic specialized vocabulary consistent with the field of study.
C-3	Develop an awareness of the need for continuous and autonomous learning.

Course content divided into various forms of instruction		*Number of hours*
T-LK-1	Lifestyle depending on where you live. Forms of the future tense (going to; will; Present Continuous to express the future; modal verbs expressing the future). Grading of adjectives .	10
T-LK-2	The role of the individual in economic processes. The first conditional period and time sentences. Modal verbs (must; have to; mustn't; should; shouldn't). Structure - question tags.	10
T-LK-3	Self-realization and creativity. Passions, leisure time. The Present Perfect Simple and Continuous. Verb forms - infinitive / gerund. Countable / uncountable nouns.	10
T-LK-4	Learning about foreign countries, their cultures, geographical phenomena during holiday travel. Past Perfect Simple in contrast to Past Simple. Different structures using the verb 'like'. Prepositions.	10
T-LK-5	Education. The need for lifelong learning. Modal verbs indicating possibility (can; could; to be able; to manage). Past tense structures- used to/ would.	10
T-LK-6	Selected specialized vocabulary in an area consistent with the student's major.	25

Student workload - forms of activity		*Number of hours*
A-LK-1	participation in class	75
A-LK-2	consultations	10
A-LK-3	study of literature and vocabulary	35

Teaching methods / tools

M-1	practical classes
M-2	group work
M-3	presentation
M-4	discussion
M-5	work with text
M-6	listening comprehension
M-7	writing formal letters

Evaluation methods (F - progressive, P - final)

Evaluation methods (F - progressive, P - final)		
S-1	F	diagnostic test (F)
S-2	F	control test / colloquium (F)
S-3	F	quiz (F)
S-4	F	presentation (F)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
MSE_1A_A06-2a_U01 has the ability to communicate at level B2 with a variety of subjects in verbal and written form and reads with understanding articles and repor	MSE_1A_U13	P6S_UU		C-1	T-LK-1 T-LK-4 T-LK-2 T-LK-5 T-LK-3	M-1 M-2 M-3 M-5 M-6 M-7	S-2
MSE_1A_A06-2a_U02 has the ability to understand texts and use the basic specialized vocabulary of his/her field	MSE_1A_U13	P6S_UU		C-2	T-LK-6	M-1 M-3 M-5	S-2 S-3 S-4
Social competences							
MSE_1A_A06-2a_K01 understands the importance of language competence in future professional activities	MSE_1A_K01	P6S_KK	P6S_WK	C-3	T-LK-1 T-LK-4 T-LK-2 T-LK-5 T-LK-3 T-LK-6	M-1 M-2 M-4	S-2 S-3 S-4

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
MSE_1A_A06-2a_U01	*2,0*	
	3,0	The student is able to communicate at a basic level with various subjects in verbal and written form.
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_A06-2a_U02	*2,0*	
	3,0	The student understands the basic specialist vocabulary in their field and uses them to a limited extent.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A06-2a_K01	*2,0*	
	3,0	The student recognizes the importance of language competences in future professional work.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. A..Clare, JJ Wilson, TOTAL ENGLISH, Pearson Longman, 2006

2. S..Cunningham, P. Moor, NEW CUTTING EDGE, Pearson Longman, 2007

Supplementary reading

1. S. T. Knowles, M. Mann, USE OF ENGLISH, Macmillan, 2003

2. S. T. Knowles, M. Mann, LISTENING AND SPEAKING, Macmillan, 2003

3. S. T. Knowles, M. Mann, READING, Macmillan, 2003

4. S. T. Knowles, M. Mann, WRITING, Macmillan, 2003

5. XYZ, Teksty popularno-naukowe z dziedziny studiowanego kierunku., 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Basics of Scientific Information**		
Code	MSE_1A_S_B05		
Field of specialisation			
Administering faculty	Biblioteka Główna		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	2	0,0	1,00	K	credits

Leading teacher	Gryta Anna (Anna.Gryta@zut.edu.pl)
Other teachers	Gryta Anna (Anna.Gryta@zut.edu.pl), Jankowska Elżbieta (Elzbieta.Jankowska@zut.edu.pl)

Prerequisites

W-1	knowledge of computer and www services

Module/course unit objectives

C-1	Students become familiar with databases, information services and library catalogs in which they can search materials for their thesis. They get acquainted with techniques and ways of formulating queries and searching database resources. They will learn how to access full texts of journals if they are available in Open Access or in the resources of ZUT. They will also learn that they can use licensed databases via VPN also from computers outside the ZUT network. He/she will be able to make a list of used literature independently or with the use of available programs. They will learn about the ethical aspects of scientific work and the basics of copyright law.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	1. The information and library system of ZUT 2. Sources of scientific information - bibliographic and abstract databases - full-text services for books and journals - Polish and foreign, branch-related, multidisciplinary - patent information 3. Access to licensed databases outside ZUT network: - passwords and access codes - VPN - virtual private network 4. Interlibrary loans 5. Resources of Szczecin libraries, ZBC - West Pomeranian Digital Library "Pomerania" 6. Appendix bibliography, bibliographic footnotes 7. Programs for creating appendix bibliographies 8. Practical searching of information in databases 9. 9. Publication database of ZUT research workers 10. Plagiarism, copyright (the basics)	2

Student workload - forms of activity		*Number of hours*
A-W-1	participation in classes	2

Teaching methods / tools

M-1	lecture

Evaluation methods (F - progressive, P - final)

S-1	P	Credit based on attendance

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							

MSE_1A_A13_W01 Student knows databases, information services and library catalogs in which he/she can search materials for the thesis. He or she knows techniques and ways of formulating inquiries and searching database resources. He/she knows that full texts of electronic journals can be available within Open Access or in licensed resources of ZUT. The student knows that he/she can use licensed databases also from computers outside the ZUT network via VPN. He or she knows the rules of preparing lists of used literature. Is aware of the ethical aspects of scientific work - knows the basics of copyright.	MSE_1A_W10	P6S_WK	P6S_WG	C-1	T-W-1	M-1	S-1
Skills							
MSE_1A_A13_U01 The student is able to select appropriate databases, information services and library catalogs in which to search for materials for the thesis. He/she knows to apply techniques and methods of formulating queries and searching resources of databases. He/she knows how to access full texts of electronic journals that may be available within Open Access or in licensed resources of ZUT. He/she is able to access licensed databases via VPN also from computers outside the ZUT network. He/she is able to make a list of used literature independently or with the use of appropriate software.	MSE_1A_U13	P6S_UU		C-1	T-W-1	M-1	S-1
Social competences							
MSE_1A_A13_K01 Able to navigate the information environment of scientific databases. Develops skills of scientific communication. Is aware of the ethical aspects of scientific work - knows the basics of copyright law.	MSE_1A_K01	P6S_KK	P6S_WK	C-1	T-W-1	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_A13_W01	*2,0*	
	3,0	not applicable
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_A13_U01	*2,0*	
	3,0	not applicable
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_A13_K01	*2,0*	
	3,0	not applicable
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. PN-ISO 690 : 2012. Informacja i dokumentacja – Wytyczne opracowania przypisów bibliograficznych i powołań na zasoby informacji, 2012

2. Mazur-Kulesza K., Wierzbicka-Próchniak D., ABC tworzenia przypisów i bibliografii załącznikowej, SBP Zarząd Okręgu w Opolu, Opole, 2012, http://libra.ibuk.pl/book/42212

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Ethics for Engineers**		
Code	MSE_1A_S_B06		
Field of specialisation			
Administering faculty	Department of Chemical and Process Engineering		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	15	1,0	1,00	K	credits

Leading teacher	Story Anna (Anna.Story@zut.edu.pl)
Other teachers	Story Anna (Anna.Story@zut.edu.pl)

Prerequisites

W-1	No prerequisites

Module/course unit objectives

C-1	The course is aimed at increase understanding of the meaning of ethics in the engineering profession. Student will become familiar with relevant moral theories, categories of ethical decision-making, professional codes of ethics and various case studies - situations which engineers may encounter in their professional life. Students will be able to making ethical decision within engineering.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Introduction to Ethics and Engineering Ethics – basic concepts, ethical theories, moral dilemmas	3
T-W-2	Code of Ethics for Engineers	2
T-W-3	Research Ethics and Integrity for Engineers – falsification of data, fabrication of data, plagiarism, unethical treatment of human-animal research subjects, hiding conflicts of interest, ghostwriting, guest authorship	1
T-W-4	Professional Ethics and Integrity for Engineers – fraud, corruption, mismanagement, poor product design, deliberate design faults	2
T-W-5	Engineering Ethics and Sustainability – selected topics in engineering ethics related to sustainability, including adaptive design, green technologies, economic issues, care for the environment	1
T-W-6	Facing the potential ethical dilemmas – case study of different situations which engineers may encounter in their future profession	5
T-W-7	Written test	1

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in class	15
A-W-2	Individual literature studies and presentation preparation	8
A-W-3	Preparing for tests	5
A-W-4	One-on-One Consultations	2

Teaching methods / tools

M-1	Activating methods – lecture illustrated by multimedia presentation and didactic discussion

Evaluation methods (F - progressive, P - final)

S-1	P	Written final exam based on the lecture contents
S-2	P	Student presentation on the individual case study

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods

Knowledge							
MSE_1A_B06_W01 Student possesses a general knowledge of the research and professional ethics and integrity for engineers.	MSE_1A_W10	P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7	M-1	S-1
Skills							
MSE_1A_B06_U01 Student possesses an ability to make informed ethical decisions when confronted with engineering problems in different types of work. Student is able to assess the consequences and threats resulting from non-compliance with the rules of professional ethics in the engineer's activity.	MSE_1A_U06	P6S_UW	P6S_UW	C-1	T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1	S-2
Social competences							
MSE_1A_B06_K01 Student understands his/her duties and responsibilities as professionals. Student has an improved awareness and ability of pointing of potential ethical issues within an engineering context.	MSE_1A_K04	P6S_KR		C-1	T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B06_W01	*2,0*	Unacceptable understanding of course material
	3,0	Serious deficiencies in understanding the core subject material
	3,5	Some deficiencies in understanding the subject material
	4,0	Some deficiencies in understanding the core subject material
	4,5	Some mild deficiencies in Mastery of subject material
	5,0	Complete Mastery of subject material
Skills		
MSE_1A_B06_U01	*2,0*	Unacceptable understanding of course material
	3,0	Serious deficiencies in understanding the core subject material
	3,5	Some deficiencies in understanding the subject material
	4,0	Some deficiencies in understanding the core subject material
	4,5	Some mild deficiencies in Mastery of subject material
	5,0	Complete Mastery of subject material
Other social competences		
MSE_1A_B06_K01	*2,0*	Unacceptable understanding of course material
	3,0	Serious deficiencies in understanding the core subject material
	3,5	Some deficiencies in understanding the subject material
	4,0	Some deficiencies in understanding the core subject material
	4,5	Some mild deficiencies in Mastery of subject material
	5,0	Complete Mastery of subject material

Required reading

1. Naagarazan, R. S., A textbook on professional ethics and human values, New Age International, New Delhi, 2006

2. C.E. Harris Jr., M.S. Pritchard, M.J. Rabins, Engineering Ethics: Concepts and Cases, 4th Edition, Cengage Learning, Wadsworth, 2009, ISBN: 978-0-495-50279-1

3. C.B. Fleddermann, Engineering Ethics, 4th Edition, Prentice Hall, Upper Saddle River, New Jersey, 2012, ISBN: 978-0-13-214521-3

Supplementary reading

1. S.K. Starrett, A.L. Lara, C. Bertha, Engineering Ethics: Real World Case Studies, American Society of Civil Engineers, 2017, ISBN: 978-0-7844-1467-5

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Technology, Law and the Working Environment**		
Code	MSE_1A_S_B07		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	15	1,0	1,00	Z	credits

Leading teacher	Tryba Beata (Beata.Tryba@zut.edu.pl)
Other teachers	Tryba Beata (Beata.Tryba@zut.edu.pl)

Prerequisites

W-1	The basic knowledge on the chemical technology

Module/course unit objectives

C-1	The aim of this course is focused on the general orientation about existed regulations in a working environment related to the technology, safety and man; the student will be aware responsibility for the work and some legal consequences in the case of incompatibility of the work in the industrial systems; students will be aware of the possible occurence of the risks at the different working environment and will know how to asses the risk during working with the toxic or dangerous substances.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Impact of the Environmental Law and EU Regulations on the development of technology	1
T-W-2	Vienna Convention	1
T-W-3	Geneva Convention and protocols	2
T-W-4	Risks and mechanisms of accidents in the industrial installations	2
T-W-5	European Union directives on industrial safety	2
T-W-6	The Occupational Safety and Health Act	1
T-W-7	Occupational Health and Safety Management Systems	1
T-W-8	Employment law in a working environment	1
T-W-9	The Toxic Substances Control Act	1
T-W-10	Nuclear safety	1
T-W-11	REACH regulation	1
T-W-12	Nanotechnology in law regulations	1

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in the lectures	15
A-W-2	Studies of the literature connected with the classes	10
A-W-3	preparation for exam	3
A-W-4	Concultations with the lecturer	2

Teaching methods / tools

M-1	Lecture with multimedial presentations

Evaluation methods (F - progressive, P - final)

S-1	F	Written exam (in the form of test)

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Faculty of Chemical Technology and Engineering

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B07_W01 has knowledge about law and regulations at the working environment	MSE_1A_W09 MSE_1A_W10	P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-9 T-W-10	M-1	S-1
Skills							
MSE_1A_B07_U01 knows and understand regulations and OHS rules applicable in industry and can apply it; can predict and asses the danger in the working place	MSE_1A_U06	P6S_UW	P6S_UW	C-1	T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-10	M-1	S-1
Social competences							
MSE_1A_B07_K01 Is aware of responsibility for the taken decisions during work and their effect on the surrounded environment	MSE_1A_K05	P6S_KR	P6S_WK	C-1	T-W-1 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-11 T-W-12	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B07_W01	*2,0*	
	3,0	Min 50% of score from a final test
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B07_U01	*2,0*	
	3,0	Min 50% of score from a final test
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B07_K01	*2,0*	
	3,0	Min 50% of score from a final test
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Ved Nanda, George (Rock) Pring, International Environmental Law and Policy for the 21st Century, Martinus Nijhoff Publishers, Boston, 2013

2. Nicholas A. Ashford, Charles C. Caldart, Technology, Law, and the Working Environment, Island Press, Island, 1996

3. Steven Vaughan, EU Chemicals Regulation, New Governance, Hybridity and REACH, University College London, UK, 2015

Supplementary reading

1. J. C. Miller, R. Serrato, J. M. Represas-Cardenas, G. Kundahl, The Handbook of Nanotechnology. Business, Policy, and Intellectual Property Law, John Wiley & Sons, Inc., USA, 2005

2. G. Hunt, M. Mehta, Nanotechnology. Risk, Ethics and Law, 2000

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Quality Management and Business Economics**		
Code	MSE_1A_S_B08		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	15	1,0	1,00	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)

Prerequisites

W-1	none

Module/course unit objectives

C-1	The aim of the course is to develop in students a systematic approach to quality management systems in products design and decisionmaking, and the ability to recognise, use and interpret economic information from both the organisation and the wider environment.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Quality Managements Systems (QMS) in developemnt of products (as example, ISO 13485:2016)	3
T-W-2	Design, Verification and Validation of Products	2
T-W-3	Pre-market evaluation (sales plan and forecast, market launch plan)	2
T-W-4	Regulatory approval (certificates, declarations of conformity, etc.)	2
T-W-5	Risk Analysis in Products Development	2
T-W-6	Business economics and risks	4

Student workload - forms of activity		*Number of hours*
A-W-1	participation in lectures	15
A-W-2	individual study of literature	10
A-W-3	consultations	5

Teaching methods / tools

M-1	Lecture with discussion.

Evaluation methods (F - progressive, P - final)

S-1	P	Final test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B08_W01 knows the principles of product design management systems and business economic information from both the organisation and the wider environment perspective	MSE_1A_W08	P6S_WG		C-1		M-1	S-1
Skills							
MSE_1A_B08_U01 is able to appy regulatory and economic aspects in product design	MSE_1A_U06	P6S_UW	P6S_UW	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1	S-1

Social competences							
MSE_1A_B08_K01 is ready to undertake economic-driven decissions in organization	MSE_1A_K03	P6S_KO	P6S_WK	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B08_W01	*2,0*	
	3,0	Min 50% of score from a final test
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B08_U01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B08_K01	*2,0*	
	3,0	positive grade of the final test and exam (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Adam Smith, The Wealth of Nations, 2010

1. selfmade materials, 2020

2. Charles Kinderberger, Manias, Panics, and Crashes, 2014

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Biology for Engineers**		
Code	MSE_1A_S_B09		
Field of specialisation			
Administering faculty	Department of Chemical and Process Engineering		
ECTS	3,0	*ECTS (forms)*	3,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	2	30	1,0	0,30	K	credits
laboratory course	L	2	30	1,0	0,30	K	credits
lecture	W	2	30	1,0	0,40	K	examination

Leading teacher	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl)
Other teachers	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites

W-1	Finished course of Intrduction to Biology

Module/course unit objectives

C-1	To introduce students to modem biology with an emphasis on evolution of biology as a multi-disciplinary field, to make them aware of application of engineering principles in biology, and engineering robust solutions inspired by biological examples.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Mendel’ Law testing	10
T-A-2	Hardy-Weinberg Law testing	6
T-A-3	Chromosome Mapping	4
T-A-4	Case studies from literature	10
T-L-1	Function of proteins and eznymes	4
T-L-2	Function of carbohydrates	4
T-L-3	Function o lipids.	4
T-L-4	DNA isolation from plant cells. DNA electrophoresis	4
T-L-5	Introduction to Microbial culture methods: biosafety & aseptic technique	4
T-L-6	Introduction to Microbial culture methods: sampling and plating cultures	4
T-L-7	Introduction to Microbial culture methods: methods of gram staining	6
T-W-1	Engineering aspects of some Nobel Prizes in Physiology and Medicine & Chemistry.	1
T-W-2	Molecules of Life (proteins, lipids, carbohydrates, nucleic acids)	8
T-W-3	Catabolic metabolic processes	3
T-W-4	Anabolic metabolic processes (biosynthesis)	3
T-W-5	Photorespiration, photosynthesis (artificial photosynthesis).	2
T-W-6	Cell cycle, aging, apoptosis. Stem cells.	2
T-W-7	Gene Structure and Expression: How Genes Work? Gene regulation.	4
T-W-8	Cancer biology - Control and regulation.	2
T-W-9	Physiology of nervous systems of higher organisms	2
T-W-10	Engineering designs inspired by examples in biology	3

Student workload - forms of activity	*Number of hours*

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Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-L-1	Participation in laboratory classes	30
A-W-1	participation in lectures	30

Teaching methods / tools	
M-1	lectures with presentation
M-2	disscussion during lectures and seminar
M-3	laboratory classes
M-4	recitation classes
M-5	Private study , tutorial, learning materials

Evaluation methods (F - progressive, P - final)		
S-1	F	multiple choice test
S-2	F	evaluation of reports (labortory and recitation)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B09_W01 knows and understand the importance of biochemical cycling in the biosphere, know adaptive features, adaptation and understand the importance of different types of selection and evolution for the organisms, understand that organisms become more complex as they grow, nderstand that cell division is important for the development of organisms and the continuity of life	MSE_1A_W02	P6S_WG	P6S_WG	C-1	T-A-1 T-W-1 T-A-2 T-W-2 T-A-3 T-W-3 T-A-4 T-W-4 T-L-1 T-W-5 T-L-2 T-W-6 T-L-3 T-W-7 T-L-4 T-W-8 T-L-5 T-W-9 T-L-6 T-W-10	M-1 M-2 M-3 M-5	S-1 S-2
Skills							
MSE_1A_B09_U01 Select and collate information from a number of sources and present it in a clear, logical form; solve problems in situations that may involve a wide range of variables; process data from a number of sources to identify patterns or trends in modern biology, generate a hypothesis to explain facts, or find facts to support a hypothesis.	MSE_1A_U10 MSE_1A_U11	P6S_UK P6S_UO P6S_UW		C-1	T-A-1 T-L-2 T-A-2 T-L-3 T-A-3 T-L-4 T-A-4 T-L-5 T-L-1 T-L-6	M-1 M-2 M-3 M-4 M-5	S-1 S-2
Social competences							
MSE_1A_B09_K01 Students is able to perform all task on time and cooperate and work in group.	MSE_1A_K03	P6S_KO	P6S_WK	C-1	T-A-1 T-L-2 T-A-2 T-L-3 T-A-3 T-L-4 T-A-4 T-L-5 T-L-1 T-L-6	M-2 M-3 M-4	S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B09_W01	*2,0*	
	3,0	use appropriate scientific and technical vocabulary in a range of contexts, apply a limited range of scientific facts and concepts to give basic explanations of familiar phenomena, to solve straightforward problems and make simple prediction, (erned of 51% points on a test)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B09_U01	*2,0*	
	3,0	Student is able to prepare written reports from laboratory and present literture study on given subject, analyse data to identify a pattern or trend, select, describe and evaluate techniques for a limited range of scientific operations and laboratory procedure
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_B09_K01	*2,0*	
	3,0	Student is able to worksconstructively as a team member and finsish all task during the course with the help of the colleagues and teacher.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Michael T. Madigan,, Kelly S. Bender Daniel H. Buckley,, W. Matthew Sattley, & 1 more, Brock Biology of Microorganisms, Pearson, 2018, 15

2. Matt Ridley, Genome: The Autobiography of a Species in 23 Chapters Hardcover, HarperCollins, 1999

3. Robert A. Weinberg, Robert A Weinberg, The Biology of Cancer, W. W. Norton & Company, 2013, 2

4. Murray P. Pendarvis, John L. Crawley, Exploring Biology in the Laboratory V, Morton Publishing Company, 2018

5. Chandel Navdeep, Navigating Metabolism, Cold Spring Harbor Laboratory, 2016

Supplementary reading

1. Joey Hajda, Lisa B. Hajda, Friendly Biology Student Workbook, CreateSpace Independent Publishing Platform, 2017

2. Richard Dawkins, The Extended Phenotype: The Long Reach of the Gene, Oxford University Press, 2016, 2

3. Biology and Genetic Journal, 2011, International Journal of Biometeorology, Disease Models & Mechanisms, Annual Review of Physiology,Biology of Reproduction, The Journal of Experimental Biology

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Graphical Engineering**		
Code	MSE_1A_S_C01		
Field of specialisation			
Administering faculty	Department of Inorganic Chemical Technology and Environment Engineering		
ECTS	3,0	*ECTS (forms)*	3,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	2	45	2,0	0,50	K	credits
lecture	W	2	15	1,0	0,50	K	credits

Leading teacher	Pelka Rafal (Rafal.Pelka@zut.edu.pl)
Other teachers	Kiełbasa Karolina (Karolina.Kielbasa@zut.edu.pl), Pelka Rafal (Rafal.Pelka@zut.edu.pl), Zapłata Jacek (Jacek.Zaplata@zut.edu.pl)

Prerequisites	
W-1	Basics of mathematics and drawing at the high school level
W-2	Basic computer skills, basics of IT

Module/course unit objectives	
C-1	Familiarize students with the principles of technical drawing.
C-2	Familiarize students with the AutoCAD program.
C-3	Forming students' skills in reading technical drawings, machine diagrams, installations, devices.
C-4	Forming students' skills in making technical drawings.
C-5	Shaping the students' ability to use AutoCAD to perform technical drawings.

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Rectangular projection (European or American method)	3
T-L-2	Axonometric projection	3
T-L-3	Cross sections	3
T-L-4	Dimensioning of simple details	3
T-L-5	Drawing objects	3
T-L-6	Drawing in the AutoCAD program (28h); Test: preparation of a technical drawing using the AutoCAD program (2h);	30
T-W-1	Basics of technical drawing: drawing formats, scales, types of lines and their application	2
T-W-2	Rectangular and axonometric projection (European and American method), cross sections	2
T-W-3	Dimensioning, drawing norms	2
T-W-4	Assembly drawings, diagrams of technical systems, machines and devices	2
T-W-5	AutoCAD: basics, commands, drawing in a CAD program	6
T-W-6	Written test	1

Student workload - forms of activity		*Number of hours*
A-L-1	Attending laboratory classes	45
A-L-2	Lilterature study on the topics discussed within course	5
A-L-3	Preparation for the test	4
A-L-4	Consultations	6
A-W-1	Obligatory participation in lectures	15

Student workload - forms of activity		*Number of hours*
A-W-2	Literature study on the topics discussed within the frame of the lectures	8
A-W-3	Preparing for tests	5
A-W-4	Consultations	2

Teaching methods / tools	
M-1	Lecture illustrated by Power Point presentation
M-2	Practical exercises: manual drawing
M-3	Programmed methods: drawing with the use of a computer

Evaluation methods (F - progressive, P - final)		
S-1	P	Lecture: written test
S-2	F	Practical exercises: positive grade from each drawing made
S-3	F	Programmed methods: positive grade from drawing made using computer
S-4	P	Exercises: average grade resulting from practical exercises and programmed methods

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_B07_W01 Student knows the appropriate methods, techniques and tools used to design, model and simulate and perform tasks in the field of engineering graphics	MSE_1A_W05	P6S_WG P6S_WK		C-1 C-2	T-L-1 T-W-1 T-L-2 T-W-2 T-L-3 T-W-3 T-L-4 T-W-4 T-L-5 T-W-5 T-L-6	M-1 M-2 M-3	S-1 S-2 S-3 S-4
Skills							
MSE_1A_B07_U02 Student has ability and skills to read and perform technical drawings both manually and using AutoCAD program	MSE_1A_U04 MSE_1A_U05 MSE_1A_U11 MSE_1A_U13	P6S_UK P6S_UU P6S_UW	P6S_UW	C-3 C-4 C-5	T-L-1 T-W-1 T-L-2 T-W-2 T-L-3 T-W-3 T-L-4 T-W-4 T-L-5 T-W-5	M-1 M-2	S-1 S-2 S-3 S-4
Social competences							
MSE_1A_B07_K01 Student understands the need for continuous vocational education and training in the field of graphical engineering	MSE_1A_K01 MSE_1A_K02 MSE_1A_K03 MSE_1A_K04 MSE_1A_K05	P6S_KK P6S_KO P6S_KR	P6S_WK	C-1 C-2	T-L-1 T-W-1 T-L-2 T-W-2 T-L-3 T-W-3 T-L-4 T-W-4 T-L-5 T-W-5 T-L-6 T-W-6	M-1 M-2	S-4

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_B07_W01	*2,0*	
	3,0	Student has basic knowledge about the appropriate methods, techniques and tools used to perform task in the field of engineering graphics
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_B07_U02	*2,0*	
	3,0	Student performs a simple technical drawing using the Autocad program
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_B07_K01	*2,0*	
	3,0	Student understands at the basic level the need for continuous education and training in the field of graphical engineering
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

Required reading
1. CADFolks, AutoCAD 2017 For Beginners, 2016
2. Cheryl R. Shrock,Steve Heather, Beginning AutoCAD 2017: Exercise Workbook, 2016
3. George Omura,Brian C. Benton, Mastering AutoCAD 2018 and AutoCAD LT 2018, 2017
4. W. Abbott, Technical drawing, Blackie & Son Limited, London, 1976, Fourth edition
5. R.S.RHODES, L.B.COOK, Basic Engineering Drawing, Pitman Publishing, London, 1978

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to MatSci**		
Code	MSE_1A_S_C01a		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	2,0	*ECTS (forms)*	2,0
Form of course credit	examination	*Language*	english
Electives	2	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	30	2,0	1,00	K	examination

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)

Prerequisites

W-1	Knowledge of the basic course in mathematics, physics and chemistry at the elementary level

Module/course unit objectives

C-1	The purpose of the course is to enriche the students' knowledge in main principle of materials science and engineering.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Historical Perspective, Materials Science and Engineering, Classification of Materials, Advanced Materials, Modern Materials' Needs	2
T-W-2	Atomic Structure and Interatomic Bonding	2
T-W-3	The Structure of Crystalline Solids	2
T-W-4	Imperfections in Solids	2
T-W-5	Diffusion in solids	2
T-W-6	Metallic crystal structures: Close-packed crystal structures; Polymorphism and allotropy; Polycrystalline materials; Anisotropy	3
T-W-7	Imperfections in solids: Vacancies and self-interstitials; Dislocations—linear defects; Interfacial defects	2
T-W-8	Interpretation of phase diagrams in metallic material; Binary eutectic systems; Development of microstructure in isomorphous alloys; Development of microstructure in eutectic alloys; Equilibrium diagrams having intermediate phases or compounds; Eutectoid and peritectic reactions; Congruent phase transformations	3
T-W-9	Properties and applications of metals	2
T-W-10	Introduction to polymers - classification, chemical structure, polymerization mechanisms	2
T-W-11	Structure-property relationships in polymeric materials: overview of characterization methods of polymer structure	2
T-W-12	Introduction to polymer processing	2
T-W-13	Introduction to polymer composites and nanocomposites	2
T-W-14	Selected examples of commodity polymers, engineering and high-peformance	2

Student workload - forms of activity		*Number of hours*
A-W-1	participation in lectures	30
A-W-2	self-study of literature	20
A-W-3	Consultations	8
A-W-4	preparation for exam	2
A-W-5	Final exam	1

Teaching methods / tools

M-1	lectures with presentation

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	student activity during lectures

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C01a_W01 knowledge main principles of materials science and engineering.	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-8 T-W-2 T-W-9 T-W-3 T-W-10 T-W-4 T-W-11 T-W-5 T-W-12 T-W-6 T-W-13 T-W-7 T-W-14	M-1	S-1 S-2
Skills							
MSE_1A_C01a_U01 Select and collate information from a number of sources and present it in a clear, logical form; solve problems in situations that may involve a wide range of variables	MSE_1A_U10 MSE_1A_U11	P6S_UK P6S_UO P6S_UW		C-1	T-W-1 T-W-8 T-W-2 T-W-9 T-W-3 T-W-10 T-W-4 T-W-11 T-W-5 T-W-12 T-W-6 T-W-13 T-W-7 T-W-14	M-1	S-2
Social competences							
MSE_1A_C01a_K01 Is aware of the need of further study and systematic work.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-W-1 T-W-8 T-W-2 T-W-9 T-W-3 T-W-10 T-W-4 T-W-11 T-W-5 T-W-12 T-W-6 T-W-13 T-W-7 T-W-14	M-1	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C01a_W01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C01a_U01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C01a_K01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Donald R. Askeland, Pradeep P. Fulay , Essentials of Materials Science & Engineering 2nd Edition, CL Engineering, 2008, ISBN-13: 978-0495244462

2. William D. Callister Jr., Materials Science and Engineering: An Introduction, Wiley, 1999, ISBN-13: 978-0471320135

3. Tariq A. Khraishi, Marwan S. Al-Haik, Experiments in Materials Science and Engineering, Cognella, 2010, ISBN-13: 978-1609278687

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to MatEng**		
Code	MSE_1A_S_C01b		
Field of specialisation			
Administering faculty	Department of Materials Technology		
ECTS	2,0	*ECTS (forms)*	2,0
Form of course credit	examination	*Language*	english
Electives	2	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	2	30	2,0	1,00	K	examination

Leading teacher	Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl)
Other teachers	Garbiak Małgorzata (Malgorzata.Garbiak@zut.edu.pl), Kwiatkowska Magdalena (Magdalena.Kwiatkowska@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl), Piegat Agnieszka

Prerequisites

W-1	The subject "Introduction to Materials Science and Engineering" aims to introduce the student to the basic knowledge on different types of materials: metals, ceramics and polymers. The subject will acquaint the student with the basic infomation on the structure and properties of different types of engineering materials.

Module/course unit objectives

C-1	The subject aims in acquanting the student with the knowledge on engineering materials: term, historical background, vocabulary, thematic scope.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Introduction: Historical Perspective, Materials Science and Engineering, Classification of Materials, Advanced Materials, Modern Materials' Needs	2
T-W-2	Atomic Structure and Interatomic Bonding	2
T-W-3	The Structure of Crystalline Solids	2
T-W-4	Imperfections in Solids	2
T-W-5	Diffusion in solids	2
T-W-6	Properties and application of ceramics	2
T-W-7	Introduction to metal materials; phase diagrams, properties and application of metals	3
T-W-8	Structures of polymers - classification, chemical structure, fabrication and processing of engineering materials (injection moulding, extrusion, pressing, etc)	5
T-W-9	Introduction to composite materials: definition of composite, types of composite materials. Role of matrix and reinforcement in composites	2
T-W-10	Types of bonding at the interface – mechanical, physical and chemical bonding. Optimum interface bond strength	2
T-W-11	Reinforcements – glass fibers, carbon/graphite fibers, aramid and other organic fibers, boron, silicon carbide fibers.	3
T-W-12	Matrix materials – polymers, metals, ceramic	3

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures.	30
A-W-2	Getting acquainted with literature (articles, books, patents)	20
A-W-3	Consultations	8
A-W-4	Final exam	2

Teaching methods / tools

M-1	Informative lecture

Evaluation methods (F - progressive, P - final)

Evaluation methods (F - progressive, P - final)		
S-1	P	Writing exam
S-2	F	Questions and Replies (discussion during lectures)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C01b_W01 knowledge in main principle of materials science and engineering.	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1 S-2
Skills							
MSE_1A_C01b_U01 Select and collate information from a number of sources and present it in a clear, logical form; solve problems in situations that may involve a wide range of variables	MSE_1A_U10 MSE_1A_U11	P6S_UK P6S_UO P6S_UW		C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1 S-2
Social competences							
MSE_1A_C01b_K01 Is aware of the need of further study and systematic work.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C01b_W01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C01b_U01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C01b_K01	*2,0*	
	3,0	positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. William D. Callister, Fundamentals of materials science and engineering : SI version, John Wiley & Sons, Hoboken, NJ, USA, 2013

2. Traugott Fischer, Materials science for engineering students, Elsevier : Academic Press, Amsterdam, Netherlands, 2009

3. William D. Callister; David G. Rethwisch, Materials Science and Engineering, John Wiley & Sons, 2014

Supplementary reading

1. Gonzalez-Vinas Wenceslao, Introduction to Materials Science, Princeton University Press, USA, 2004

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Structure of Solids**		
Code	MSE_1A_S_C02		
Field of specialisation			
Administering faculty	Department of Inorganic and Analytical Chemistry		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	3	45	4,0	0,75	K	credits
lecture	W	3	15	1,0	0,25	K	credits

Leading teacher	Tabero Piotr (Piotr.Tabero@zut.edu.pl)
Other teachers	Bosacka Monika (Monika.Bosacka@zut.edu.pl), Filipek Elżbieta (Elzbieta.Filipek@zut.edu.pl), Piz Mateusz (Mateusz.Piz@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Tabero Piotr (Piotr.Tabero@zut.edu.pl)

Prerequisites	
W-1	Fundamentals of mathematics, physics and chemistry

Module/course unit objectives	
C-1	Consolidation of basic concepts concerning the structure of solids.
C-2	Familiarize students with methods of generation and properties of X-rays.
C-3	Expanding knowledge about the measuring techniques using diffraction phenomenon and their practical applications.
C-4	Teaching students how to use stuctural data gained from diffraction measurements, available structural databases and literature.

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Identification of chemical compounds, metals, alloys and their mixtures.	5
T-L-2	XRD quantitative phase analysis of various mixtures.	5
T-L-3	Construction of phase diagrams from XRD data.	5
T-L-4	X-ray high-temperature measurements. Determination of coefficients of thermal expansion. Anisotropy of thermal expansion. Investigations of polymorphic phase transitions.	5
T-L-5	Structure solution from owder pattern. Rietveld refinement.	5
T-L-6	Application of XRD method to verify Hume-Rothery rule and Vegard's law for solid solutions.	5
T-L-7	Indexation of powder dfiffraction patterns. Lattice parameter determination. Measurement of density. Rentgenographic density.	5
T-L-8	Determination of grain size, internal stress and lattice distortions.	5
T-L-9	Aplication of the SAXS method.	5
T-W-1	Basic definitions in crystallography. Physical properties of solids. Structure of "ideal" solid.	3
T-W-2	Crystal systems and Bravais lattices. Symmetry in crystals. Point groups and space groups. International Tables for Crystallography.	3
T-W-3	Coordination polyhedra. Simple structures of elements and compounds: SC, BCC, FCC and HCP lattices. Types of phase diagrams.	2
T-W-4	Defects in crystal structure. Solid solutions.	2
T-W-5	Generation and properties of X-rays. Interaction of X-rays with matter. X-rays diffraction on solids.	2
T-W-6	Bragg's Law. Investigation of size of crystalites. Indexing of powder diffraction patterns. Determination of the unit cell parameters.	3

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in laboratories.	45
A-L-2	Self-study of literature	45

Student workload - forms of activity		*Number of hours*
A-L-3	Preparing for laboratory exercises	20
A-L-4	Consultations	10
A-W-1	Participation in lectures	15
A-W-2	Consultations	2
A-W-3	Self-study of the literature	12
A-W-4	Final written test	2

Teaching methods / tools	
M-1	Informative lectures with multimedia instruments, explanation
M-2	Work with computers and dedicated software

Evaluation methods (F - progressive, P - final)		
S-1	P	Final written test.
S-2	P	written reports

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C02_W01 Student knows fundamental concepts in crystallography and knows measuring techniques using diffraction phenomenon	MSE_1A_W02 MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1 C-2 C-3	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1	S-1
Skills							
MSE_1A_C02_U01 Students is able to select appropriate diffraction measuring technique to investigate given property of material and interpret obtained results of investigation	MSE_1A_U03	P6S_UW	P6S_UW	C-1 C-2 C-3	T-L-1 T-L-6 T-L-2 T-L-7 T-L-3 T-L-8 T-L-4 T-L-9 T-L-5	M-1	S-1
Social competences							
MSE_1A_C02_K01 Student knows safety procedures for x-ray equipment and understands importance of permanent learning to improve personal competencies	MSE_1A_K04	P6S_KR		C-1 C-2 C-3	T-L-1 T-L-6 T-L-2 T-L-7 T-L-3 T-L-8 T-L-4 T-L-9 T-L-5	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C02_W01	*2,0*	
	3,0	Student will be able to present basic concepts of crystallography and describe basic measuring methods applying X-ray diffraction.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C02_U01	*2,0*	
	3,0	Student will be able to select approprate XRD measuring technique to solve simple problem concerning analysis of crystalline solid
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C02_K01	*2,0*	
	3,0	Student knows and understands safety procedures for x-ray equipment
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. C. Giacovazzo, H. Z. Monaco, D. Biterbo, F. Scordari, G. Gilli, G. Zanotti, M. Catti,, Fundamentals of Crystallography, IUCR, Oxford University Press, Oxford, 2000

Required reading
2. D. B. Williams, C. B. Carter, Transmission Electron Microscopy, Plenum Press, New York and London, 1996
3. O. Engler, V. Randle, Introduction to Texture Analysis. Macrotexture, Microtexture and Orientation Mapping,, CRC Press, Taylor & Francis Group, London, New York, 2010
4. Cullity B.D., Elements of X-ray Diffraction, Addison-Wesley Publishing Company, Inc., London, 1978
5. P. Luger, Modern X-ray Analysis on Single Crystals, Walter de Gruyter and Co., Berlin, 1980
6. Glusker, J. P.; Lewis, M.; Rossi, M., "Crystal Structure Analysis for Chemists and Biologists, VCH, New York, 1994
7. W.I.F. David, K. Shankland, L.B. McCusker and Ch. Baerlocher, Edt., Structure determination form powder diffraction data. IUCr Monographs on crystallography, Oxford Science Publications, Oxford, 2002
8. A. Gaunier, X-ray Diffraction in Crystals, Imperfect Crystals, and Amorphous Bodies, Courier Corporation, New York, 1994
9. A. AUTHIER, G. CHAPUIS, EDS, A LITTLE DICTIONARY OF CRYSTALLOGRAPHY, INTERNATIONAL UNION OF CRYSTALLOGRAPHY, 2017, 2ND EDITION
10. P. P. Ewald, Ed., Fifty Years of X-ray Diffraction, Reprinted in pdf format for the IUCr XVIII Congress, Glasgow, Scotland, Copyright © 1962, 1999 International Union of Crystallography, https://www.iucr.org

Supplementary reading
1. International Union of Crystallography: https://www.iucr.org
2. http://www.xtal.iqfr.csic.es/Cristalografia/parte_01_1-en.html

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Materials Synthesis and Products Analysis**		
Code	MSE_1A_S_C03		
Field of specialisation			
Administering faculty	Department of Organic and Physical Chemistry		
ECTS	7,0	*ECTS (forms)*	7,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	3	30	2,0	0,25	K	credits
laboratory course	L	3	30	3,0	0,50	K	credits
lecture	W	3	30	2,0	0,25	K	examination

Leading teacher	Sośnicki Jacek (Jacek.Sosnicki@zut.edu.pl)
Other teachers	Idzik Tomasz (Tomasz.Idzik@zut.edu.pl), Lendzion-Bieluń Zofia (Zofia.Lendzion-Bielun@zut.edu.pl), Nowicka-Scheibe Joanna (Joanna.Nowicka-Scheibe@zut.edu.pl), Rozwadowski Zbigniew (Zbigniew.Rozwadowski@zut.edu.pl), Sośnicki Jacek (Jacek.Sosnicki@zut.edu.pl), Struk Łukasz (Lukasz.Struk@zut.edu.pl), Szady-Chełmieniecka Anna (Anna.Szady@zut.edu.pl), Wróblewska Elwira (Elwira.Wroblewska@zut.edu.pl)

Prerequisites	
W-1	Basic knowledge of organic chemistry.

Module/course unit objectives	
C-1	The student knows how to carry out a basic literature search based on databases and scientific literature.
C-2	The student is able to conduct the synthesis of the simple organic compound/material and knows standard methods for their analysis and can prepare the report.
C-3	The student is aware of the importance of the knowledge acquired within the subject for developement of science and for improvement of the quality of life.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Exercises in planning synthesis of the simple and complex organic molecules through functional group transformations with the use of databases.	15
T-A-2	Exercises in determining the structure of organic compounds by IR, NMR, MS methods.	15
T-L-1	Regulations and safety rules in the laboratory of organic synthesis.	2
T-L-2	Practical aspects of purification and structural analysis (by IR, MS, NMR) of organic compounds. (Sample preparation, selection of purification method and measurement conditions, etc.)	5
T-L-3	Building a carbon skeleton by using organometallic compounds. Eg. Application of Sonogashira reaction in the preparation of alkyne. Purification of the product with a properly selected method. Structure analysis by spectroscopic methods (IR, MS, NMR).	18
T-L-4	Elemental analysis, determination of C, N and S in organic materials, microwave mineralization and determination of elemental composition by ICP-OES method.	5
T-W-1	Databases and scientific journals as a platform to start organic material synthesis.	1
T-W-2	Principles of planning the synthesis of simple and complex organic molecules.	1
T-W-3	Functional group transformations – an introduction to the synthesis of complex organic compounds and organic materials (e.g. based on coupling, condensation, addition, substitution and elimination reactions)	6
T-W-4	The synthesis of functionalized arenes, heteroarenes as well as other carbo- and heterocyclic compounds.	4
T-W-5	The synthesis of functionalized monomers based on organometallic chemistry.	3
T-W-6	Isolation and separation techniques of organic compounds and organic materials.	2
T-W-7	Overview of IR, MS and NMR as fundamental methods for analysis of organic compounds.	8
T-W-8	Analysis of the elemental composition of organic materials (elemental analyzers C, N, S, ICP and XRF methods)	5

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	Self-improvement by solving additional problems.	26
A-A-3	Face to face discussion.	4
A-L-1	Participation in the laboratory classes.	30
A-L-2	Self-study of recomended literature.	26
A-L-3	Face to face discussion.	4
A-L-4	Theoretical preparation to the laboratory classes.	20
A-L-5	Preparation of written reports.	10
A-W-1	Participation in the lectures.	30
A-W-2	Self study of recomended literature.	26
A-W-3	Consultations.	4
A-W-4	The exam	1

Teaching methods / tools	
M-1	Lecture with discussion.
M-2	Classes with discussion.
M-3	Laboratory exercises.

Evaluation methods (F - progressive, P - final)		
S-1	F	Continuous assessment: laboratory reports and activity.
S-2	P	Exam.
S-3	P	Final test.

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C03_W01 The studen has basic knowledge on the structure, reactivity of simple organic compounds, knows basic methods for purification and instrumental methods for analyses of organic compounds.	MSE_1A_W02 MSE_1A_W03 MSE_1A_W05 MSE_1A_W06	P6S_WG P6S_WK	P6S_WG	C-2 C-3	T-A-2 T-W-4 T-L-2 T-W-5 T-L-3 T-W-6 T-L-4 T-W-7 T-W-3 T-W-8	M-1 M-2 M-3	S-1 S-2 S-3
Skills							
MSE_1A_C03_U01 The studen is able to plan and perform basic synthetic transformations on the basis of informations taken from databases and scientific literature.	MSE_1A_U01 MSE_1A_U05 MSE_1A_U06 MSE_1A_U09 MSE_1A_U12	P6S_UO P6S_UW	P6S_UW	C-1 C-3	T-A-1 T-W-2 T-L-1 T-W-3 T-L-2 T-W-4 T-L-3 T-W-5 T-W-1	M-1 M-2	S-3
MSE_1A_C03_U02 The studen is able to prepare the basic laboratory report.	MSE_1A_U03	P6S_UW	P6S_UW	C-2	T-L-1 T-L-3 T-L-2 T-L-4	M-3	S-1
Social competences							
MSE_1A_C03_K01 The student is aware of the importance of organic chemistry in life and science.	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-3	T-L-1 T-W-5 T-W-1 T-W-6 T-W-3 T-W-7 T-W-4 T-W-8	M-1 M-2 M-3	S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C03_W01	*2,0*	
	3,0	Positive grade of the final test and exam (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C03_U01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C03_U02	*2,0*	
	3,0	Positive evaluation of the laboratoty report..
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C03_K01	*2,0*	
	3,0	Positive grade of the final test and exam (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. John McMurry, Organic Chemistry, Brooks/cole, 2012, 8e

2. J. J. Li, C. Limberakis, D. A. Pflum, Modern Organic Synthesis in the laboratory. A collection of standard experimental procedures, OXFORD University Press, 2007

3. Clayden, Greeves, Warren, Wothers, Organic Chemistry, Oxford, 2004

4. K. Peter C. Vollhardt, Organic Chemistry Structure and Function, W. H. Freeman, 2014

Supplementary reading

1. Jacques Mortier, Arene Chemistry, Wiley, 2016

2. W. CARRUTHERS, IAIN COLDHAM, MODERN METHODS OF ORGANIC SYNTHESIS, Cambridge University Press, 2004

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Materials Processing**		
Code	MSE_1A_S_C04		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	3	15	1,5	0,25	K	credits
laboratory course	L	3	15	1,5	0,25	K	credits
lecture	W	3	30	3,0	0,50	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl), Przepiórski Jacek (Jacek.Przepiorski@zut.edu.pl), Wróblewska Agnieszka

Prerequisites	
W-1	Basics of chemistry and physics

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the field of processing of various engineering materials

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Calculations of heat transfer and rheological parameters underlying the processing of materials	5
T-A-2	Mesoporous silica materials characterization methods - journal club	5
T-A-3	Exercises on casting	2
T-A-4	Exercises on welding	3
T-L-1	Principles of processing of thermoplastic materials (extrusion and thermoforming) (3h) Injection moulding of polymeric materials (2h)	5
T-L-2	Electrospinning of polymer nanofibres	5
T-L-3	Synthesis (fabrication) of MCM-41 material	5
T-W-1	Principles of polymer melt rheology	3
T-W-2	Introduction to polymer processing (extrusion, injection moulding, thermoforming, casting)	4
T-W-3	Processing of rubbers	1
T-W-4	Fibres and non-wovens technologies	2
T-W-5	Ceramic materials – applications and synthesis routes	3
T-W-6	Ceramic materials – applications and synthesis routes	2
T-W-7	Production of mesoporous silica materials	5
T-W-8	Forming operations of metallic materials (hot working, cold working, forging, rolling, extrusion, drawing)	2
T-W-9	Casting (sand casting, die casting, investment casting, lost-foam casting, continuous casting)	2
T-W-10	Powder Metallurgy	2
T-W-11	Welding	2
T-W-12	Heat treatment and thermo-chemical treatment	2

Student workload - forms of activity		*Number of hours*
A-A-1	participation in recitations	15

Student workload - forms of activity		*Number of hours*
A-A-2	self-study of the literature	20
A-A-3	preparation of reports	10
A-L-1	participation in laboratory exercises	15
A-L-2	self-study of literature	20
A-L-3	preparation of written reports	10
A-W-1	participation in lectures	30
A-W-2	self-study of literature	30
A-W-3	consultations	10
A-W-4	preparing for the exam	20

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory exercises
M-3	Classes with discussion

Evaluation methods (F - progressive, P - final)		
S-1	F	Continuous assessment: laboratory reports and activity
S-2	P	Final test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C04_W01 The student has the knowledge of common aspect of processing methods of engineering materials	MSE_1A_W02 MSE_1A_W07	P6S_WG	P6S_WG	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11 T-W-12	M-1 M-2 M-3	S-1 S-2
Skills							
MSE_1A_C04_U01 The student has skills of selection of appropriate methods for target engineering materials processing	MSE_1A_U08	P6S_UK	P6S_UW	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11 T-W-12	M-1 M-2 M-3	S-1 S-2
Social competences							
MSE_1A_C04_K01 The student understands the importance of processing of engineering materials for practical applications	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11 T-W-12	M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C04_W01	*2,0*	
	3,0	The student knows the fundamentals aspects of processing of engineering materials
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C04_U01	*2,0*	
	3,0	The student can identify a suitable processing method for a given engineering material
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C04_K01	*2,0*	
	3,0	Student understands the importance of processing aspects of engineering materials
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Chang Dae Han, RHEOLOGY AND PROCESSING OF POLYMERIC MATERIALS, Oxford University Press, 2007

2. Montgomery T. Shaw William J. MacKnight, Introduction to Polymer Viscoelasticity, Wiley Interscience, 2005

3. G. Krauss, Steels: Processing, Structure, and Performance, ASM International, Materials Park, 2005

4. M. Ashby, K. Johnson, Materials and Design, The Art and Science of Material Selection in Product Design, Third Edition, Elsevier, 2014

Supplementary reading

1. Gert Strobl, The Physics of Polymers Concepts for Understanding Their Structures and Behavior, Springer, 2007

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Surface Science and Interfacial Phenomena**		
Code	MSE_1A_S_C05		
Field of specialisation			
Administering faculty	Department of Inorganic Chemical Technology and Environment Engineering		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	3	15	1,0	0,25	K	credits
laboratory course	L	3	30	2,0	0,50	K	credits
lecture	W	3	15	2,0	0,25	K	credits

Leading teacher	Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), Janus Ewa (Ewa.Janus@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites	
W-1	none

Module/course unit objectives	
C-1	Student knows the structure of surfaces and interfaces.
C-2	Student knows fundamental laws applicable to the processes performed on interfaces
C-3	Student knows the basic experimental methods applied to evaluate the properties of interfaces and is able to perform respective experiments.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Physics of Surfaces - calculations	2
T-A-2	Adsorption at Interfaces - calculations	3
T-A-3	Calculations using the laws of electrochemistry.	2
T-A-4	Predicting the products of an electrochemical reaction	3
T-A-5	Simulation of Reactions at Liquid Surfaces	5
T-L-1	Monolayers observed by electron spectroscopy	3
T-L-2	Adsorption/desorption phanomena as a tool for surface evaluation	4
T-L-3	Determination of solid surface wetting by liquids using goniometer and contact angle measurement	3
T-L-4	Surfactant structure and concentration effect on the surface and interfacial (liquid/liquid) tension – measurements by the tensiometric method	4
T-L-5	Measurements of electrode potentials and electromotive force in galvanic and concentration cells.	3
T-L-6	The phenomenon of polarization in Daniella's cell.	3
T-L-7	Passivity of metals	4
T-L-8	Determination of surface morphology of metals, metallic and ceramic alloys and composites with electron microscopy	3
T-L-9	Elemental contrast and energy dispersive spectroscopy as a tools for elemental mapping	3
T-W-1	The Physics of Surfaces	2
T-W-2	Structure, surface morphology of metals, metallic and ceramic alloys and composites	1
T-W-3	Adsorption at Interfaces	2
T-W-4	Properties of Monolayers	1
T-W-5	Electrostatic Phenomena	2

Course content divided into various forms of instruction		*Number of hours*
T-W-6	Fundamentals and laws of electrochemistry	1
T-W-7	The electrode potential. galvanic (contact) cells.	1
T-W-8	The phenomenon of polarization. The phenomenon of electrolysis.	1
T-W-9	Surface corrosion resistance of metallic and ceramic materials	1
T-W-10	Surfactant and their effect on the interfaces	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-A-2	self-study	15
A-L-1	Participation in laboratory exercises	30
A-L-2	analysis of data	30
A-W-1	Participation in lectures	15
A-W-2	self-study of the literature	30
A-W-3	preparing for tests	15

Teaching methods / tools	
M-1	informative lecture
M-2	method of cases
M-3	Laboratory exercises
M-4	case studies

Evaluation methods (F - progressive, P - final)		
S-1	F	laboratory reports
S-2	F	Passing

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C05_W01 knows issues concerning the surface and interphase phnomena, their structure, synthesis and properties	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1 C-2	T-W-1 T-W-6 T-W-2 T-W-7 T-W-3 T-W-8 T-W-4 T-W-9 T-W-5 T-W-10	M-1	S-2
Skills							
MSE_1A_C05_U01 is able to use knowledge to solve problems conserning surface science and interphacial phenomena	MSE_1A_U01	P6S_UW	P6S_UW	C-3	T-A-1 T-L-3 T-A-2 T-L-4 T-A-3 T-L-5 T-A-4 T-L-6 T-A-5 T-L-7 T-L-1 T-L-8 T-L-2 T-L-9	M-2 M-3 M-4	S-1 S-2
Social competences							
MSE_1A_C05_K01 is able to critically assess the knowledge and content of literature	MSE_1A_K01	P6S_KK	P6S_WK	C-3	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8 T-L-9	M-2	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C05_W01	*2,0*	
	3,0	Knows a basic informations about surface science and interfacial phenomena
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C05_U01	*2,0*	
	3,0	is able to simple solve problems concerning surface and interfacial phenomena
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C05_K01	*2,0*	
	3,0	is able to analyse basing information about surface science and based on this draw simple conclusions regarding laboratory experiments
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. G.A. Somorjai, Introduction to surface chemistry and catalysis, Wiley, 1994

Supplementary reading

1. Luigi Pasqua, Update on Silica-based Mesoporous Materials for Biomedical Applications, smithersrapra.com, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Thermodynamic of Materials**		
Code	MSE_1A_S_C06		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	3	15	1,0	0,25	K	credits
laboratory course	L	3	30	2,0	0,50	K	credits
lecture	W	3	15	2,0	0,25	K	credits

Leading teacher	Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl)
Other teachers	Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl), Pelka Rafal (Rafal.Pelka@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Witkiewicz Konrad (Konrad.Witkiewicz@zut.edu.pl)

Prerequisites	
W-1	Fundamentals of mathematics and physics.

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the field of fundamental laws and relations for gaseous, liquid and solid-type materials

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Conversions of thermodynamic SI units.	2
T-A-2	Thermodynamic calculation for gaseous, liquid and solid state-type materials. Thermodynamic calculations in relation to thermodynamics laws	8
T-A-3	Thermodynamics of nanomaterials; size effect.	1
T-A-4	Electrochemical equilibria and surface thermodynamics	2
T-A-5	Thermodynamic calculations for chemical reactions.	2
T-L-1	Measurement of specific heat capacity by the DSC method.	5
T-L-2	Study of nanocrystalline metals by chemical potential programmed reaction method.	5
T-L-3	Measurement of the Curie temperature.	5
T-L-4	Measurement of enthalpy of selected chemical reactions by the DSC method.	5
T-L-5	Measurement of combustion heat of solids.	5
T-L-6	Determination of crystallization phase diagram.	5
T-W-1	Fundamental definitions of thermodynamics and physical chemistry parameters	2
T-W-2	The zeroth, the first, the second and the third law of thermodynamics. Definitions and technical aspects.	5
T-W-3	The perfect, semi-perfect and real gases. Laws for gases. Equations of state and thermodynamic properties of fluids. Work and heat. Heat capacity	2
T-W-4	Phase equilibria (vapor-liquid equilibria, liquid-liquid equilibria, solid-liquid and solid-solid equilibria). Thermodynamics of mixtures. Chemical reactions. Electrochemical equilibria.	3
T-W-5	Conversion of fuel materials to mechanical energy, heat machines/engines (structures and work), thermodynamic cycles (Carnot,Otto, Diesel, Sabathe)	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-A-2	Additional student work	15
A-L-1	Participation in the laboratory exercises	30

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Student workload - forms of activity		*Number of hours*
A-L-2	Instructions reading, literature review	20
A-L-3	Preparing lab reports	10
A-W-1	Participation in lectures	15
A-W-2	Additional student work. Literature review.	45

Teaching methods / tools	
M-1	Lecture
M-2	Auditorium exercises
M-3	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	F	Reports
S-2	P	Exam

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C06_W01 The student has the knowledge of common thermodynamic laws and relations for gaseous, liquid and solid state materials	MSE_1A_W02 MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1	S-2
Skills							
MSE_1A_C06_U01 The student has skills of calculation of common thermodynamic parameters for gaseous, liquid and solid state materials	MSE_1A_U02 MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6	M-2 M-3	S-1 S-2
Social competences							
MSE_1A_C06_K01 The student understands the importance of known thermodynamic parameters for gaseous, liquid and solid state materials	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C06_W01	*2,0*	
	3,0	The student knows the fundamentals laws for gaseous, liquid and solid state materials
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C06_U01	*2,0*	
	3,0	The student can calculate the fundamentals thermodynamic parameters for gaseous, liquid and solid state materials
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C06_K01	*2,0*	
	3,0	Students knows the fundamentals importance of thermodynamic laws
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. John Rankin, Themical thermodynamics : theory and applications,, RC Press/Taylor & Francis, Boca Raton, 2020

Required reading
2. G.Price, Thermodynamics of chemical processes,, Oxford University Press, Oxford, 2019
3. T. Matsushita, K. Mukai,, Chemical thermodynamics in materials science : from basic to practical applications,, Springer, Singapore, 2018
4. M. Pavelka, V. Klika, M. Grmela, Multiscale thermo-dynamics : introduction to Generic, Gruyter, Berlin, 2018
5. W. Ciesielczyk, Basic calculations of engineering thermodynamics,, Wydawnictwo PK, Kraków, 2015
6. A. Bejan, Advanced engineering thermodynamics,, John Wiley & Sons, Hoboken, 2006
7. M. Moran, H. Shapiro, Fundamentals of engineering thermodynamics, John Wiley & Sons, Chichester, 2006
8. M. Koretsky, Engineering and chemical thermodynamics, Wiley, Hoboken, 2012

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Computational Methods in MatSci: Data Science and Analysis**		
Code	MSE_1A_S_C08a		
Field of specialisation			
Administering faculty	Department of Chemical and Process Engineering		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives	3	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	4	45	3,0	0,50	K	credits
lecture	W	4	30	2,0	0,50	K	credits

Leading teacher	Rakoczy Rafał (Rafal.Rakoczy@zut.edu.pl)
Other teachers	Kiełbasa Karolina (Karolina.Kielbasa@zut.edu.pl), Rakoczy Rafał (Rafal.Rakoczy@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites

W-1	No prerequisites

Module/course unit objectives

C-1	Gaining knowledge about analysis of large scientific datasets using a variety of software and analytical tools
C-2	Student is able to use software to characterize data taking into account e. g. statistics

Course content divided into various forms of instruction		*Number of hours*
T-L-1	A discovery oriented analysis of scientific datasets - 1st part	5
T-L-2	A discovery oriented analysis of scientific datasets - 2nd part	5
T-L-3	Exploring data technologies	5
T-L-4	Python environment for modelling – exercises	5
T-L-5	Modelling of ideal gases based on kinetic gas theory	10
T-L-6	Application of Statistica in technical calculation	10
T-L-7	Application of Matlab in technical calculation	5
T-W-1	Fundamental of digital data science and analysis	5
T-W-2	Data processing and visualisation	5
T-W-3	Python programming language for modelling purposes	5
T-W-4	Modelling phenomena on basis of kinetic gas theory	5
T-W-5	Statistical analysis of data science	5
T-W-6	Design of experiments (DOE)	5

Student workload - forms of activity		*Number of hours*
A-L-1	Attendind classes	45
A-L-2	Individual consultations	6
A-L-3	Preparing for tests	9
A-L-4	self-study of literature	30
A-W-1	Attending classes	30
A-W-2	Individual consultations	6
A-W-3	Preparing for tests	24

Teaching methods / tools

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory

Evaluation methods (F - progressive, P - final)		
S-1	P	passing test
S-2	F	activity evaluation

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C08a_W01 Knows the principles of analysis of large scientific datasets using a variety of software and analytical tools	MSE_1A_W01 MSE_1A_W05	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3	M-1	S-1
Skills							
MSE_1A_C08a_U01 Student is able to use software to characterize data taking into account e. g. statistics	MSE_1A_U05	P6S_UW	P6S_UW	C-2	T-L-1 T-L-4 T-L-2 T-L-5 T-L-3 T-L-6	M-2	S-2
Social competences							
MSE_1A_C08a_K01 Student is able to discuss programming problem in the team.	MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2	T-L-1 T-W-1 T-L-2 T-W-2 T-L-3 T-W-3 T-L-4 T-W-4 T-L-5 T-W-5 T-L-6 T-W-6 T-L-7	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C08a_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C08a_U01	*2,0*	
	3,0	Student solves selected issues at a basic level(score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C08a_K01	*2,0*	
	3,0	Student solves selected issues at a basic level(score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. John M. Zelle, Python Programming: An Introduction to Computer Science, 2002

Supplementary reading

1. A.M. Starfield, K.A. Smith, and A.L. Bleloch, How to Model It: Problem Solving for the Computer Age, 1994

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Computational Methods in MatSci: Simulation and Modeling**		
Code	MSE_1A_S_C08b		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives	3	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	4	45	3,0	0,50	K	credits
lecture	W	4	30	2,0	0,50	K	credits

Leading teacher	Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)
Other teachers	Kiełbasa Karolina (Karolina.Kielbasa@zut.edu.pl), Rakoczy Rafał (Rafal.Rakoczy@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites	
W-1	No prerequisites

Module/course unit objectives	
C-1	Student is able to describe assumptions of Langmuir isotherm
C-2	Student is able to describe elementary steps in gas-solid reaction
C-3	Student is able to model in Python fundamental physical-chemical phenomena

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Application of Matlab in technical calculation	10
T-L-2	Application of Statistics in technical calculation	5
T-L-3	Python environment for modelling – exercises	5
T-L-4	Modelling of gas adsorption on solids	5
T-L-5	Modelling of gas solid reaction	5
T-L-6	When is modeling usuful? - practice 1st part	5
T-L-7	When is modeling usuful? - practice 2st part	5
T-L-8	Computer-aided design in material science	5
T-W-1	Applications using solvers of differential equation, interpolation, smoothing	5
T-W-2	Various methods, optimization, solution of complex equation	5
T-W-3	Statistical analysis of data science	5
T-W-4	Design of experiments (DOE)	5
T-W-5	Modelling of gas adsorption on solids	5
T-W-6	Modelling of gas solid reaction	5

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in laboratory exercises	45
A-L-2	Solving programming problems	40
A-L-3	Consultations	5
A-W-1	participation in lectures	30
A-W-2	consultations	6
A-W-3	Literature studies	14
A-W-4	Problem solving	10

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory

Evaluation methods (F - progressive, P - final)		
S-1	P	Zaliczenie
S-2	F	Ocena aktywności

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C08b_W01 Student knows assumption of Langmuir ishothrm	MSE_1A_W01	P6S_WG P6S_WK	P6S_WG	C-1	T-W-5	M-1	S-1
MSE_1A_C08b_W02 Student knows elementary steps in gas-solid reaction	MSE_1A_W01	P6S_WG P6S_WK	P6S_WG	C-2		M-1	S-1
Skills							
MSE_1A_C08b_U01 Student is able to model in python programming language the gas adsorption over the surface of solids	MSE_1A_U02	P6S_UW		C-3	T-L-3 T-L-4 T-L-5	M-2	S-1
Social competences							
MSE_1A_C08b_K01 Student is able to discuss programming problem in the team.	MSE_1A_K03	P6S_KO	P6S_WK	C-3	T-L-3 T-L-4 T-L-5	M-2	S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C08b_W01	*2,0*	
	3,0	Student is able to describe assumptions of Langmuir isotherm
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_C08b_W02	*2,0*	
	3,0	Student describes selected issues at a basic level(exam score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C08b_U01	*2,0*	
	3,0	Student is able to write a program in Python language modelling adsorption phenomenon
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C08b_K01	*2,0*	
	3,0	Student is able to explain the programming solution to the other members of the group
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. John M. Zelle, Python Programming: An Introduction to Computer Science, 2002

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Experimental Methods: Nanomaterials Emphasis**		
Code	MSE_1A_S_C09a		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	4	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	4	45	3,0	0,50	K	credits
lecture	W	4	15	1,0	0,50	K	credits

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Kochmański Paweł (Pawel.Kochmanski@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl)

Prerequisites	
W-1	Knowledge of the basic course in mathematics, physics and chemistry at the elementary level

Module/course unit objectives	
C-1	The purpose of the corse is to enrich the students' knowledgeand skills in experimental nanomaterials including the main groups of enginering materials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Influence of different nanofillers on rheological properties of monomer dispersions.	5
T-L-2	Mechanical properties of nanocomposites (tensile properties as a function of temperature).	5
T-L-3	Mechanical properties of nanocomposites (bending and compression tests).	5
T-L-4	Synthesis of carbon nanotubes in the presence of three different metallic catalysts	5
T-L-5	Purification process of obtained carbon material	5
T-L-6	Microscopic observation of purified carbon nanotubes. Elemental analysis of the samples via EDS	5
T-L-7	Mechanical properties testing of nanomaterials	15
T-W-1	Nanocarbons: Graphene, fullerenes, carbon nanotubes, carbon fibres, nanodiamonds	3
T-W-2	Functionalized/modified nanocarbons	2
T-W-3	Carbon in Polymers	3
T-W-4	Nanoparticle Dispersions	2
T-W-5	Evaluation of mechanical properties of nanomaterials	5

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	45
A-L-2	preparation for laboratory exercises	20
A-L-3	preparation of reports	15
A-L-4	preparing for tests	5
A-L-5	Consultations	5
A-W-1	Participation in lectures	15
A-W-2	Individual literature studies	5
A-W-3	preparing for tests	10

Teaching methods / tools	
M-1	lectures with presentation
M-2	subject discussion during lectures and laboratories
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written completion of lectures and laboratories
S-2	F	laboratory reports
S-3	F	student activity during laboratories

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C09a_W01 basic knowledge in experimental nanomaterials including the main groups of enginering materials	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-3 T-W-2 T-W-4	M-1 M-3	S-1
Skills							
MSE_1A_C09a_U01 skills in synthesis and characterization of nanomaterials including the main groups of enginering materials	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-1 T-L-3 T-L-2	M-2 M-3	S-2 S-3
Social competences							
MSE_1A_C09a_K01 The student understands the importance of fabrication and application of engineering nanomaterials	MSE_1A_K02	P6S_KK	P6S_WK	C-1		M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C09a_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C09a_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C09a_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Daniel Schodek Paulo Ferreira Michael Ashby, Nanomaterials, Nanotechnologies and Design, Butterworth-Heinemann, 2009, ISBN: 9780750681490

2. Dieter Vollath, Nanoparticles - Nanocomposites – Nanomaterials: An Introduction for Beginners, Wiley-VCH, 2013, ISBN: 978-3527334605

3. Wei-Hong Zhong, Bin Li, Russell G. Maguire, Vivian T. Dang, Jo Anne Shatkin, Gwen M. Gross, Michael C. Richey, Nanoscience and Nanomaterials - Synthesis, Manufacturing and Industry Impacts, DEStech Publications, 2012, ISBN-13 : 978-1605950136

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Experimental Methods: Biomaterials Emphasis**		
Code	MSE_1A_S_C09b		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	4	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	4	45	3,0	0,50	K	credits
lecture	W	4	15	1,0	0,50	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Kochmański Paweł (Pawel.Kochmanski@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl)

Prerequisites

W-1	Knowledge of the basic course in mathematics, physics and chemistry at the elementary level

Module/course unit objectives

C-1	The purpose of the corse is to enrich the students' knowledgeand skills in experimental biomaterials including the main groups of enginering materials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Viscosity Measurement Using a Brookfield Viscometer	5
T-L-2	Refractive index of selected materials and its changes during crystallization	5
T-L-3	Mechanical properties of biomaterials (tensile properties as a function of temperature)	5
T-L-4	Acid and alkaline hydrolysis of biocellulose.	5
T-L-5	Functionalization of biocellulose by metal oxide nanoparticles.	5
T-L-6	Morphology characterisation of synthesized samples.	5
T-L-7	Mechanical properties testing of biomaterials	15
T-W-1	Nanoceramics: Nanocrystalline Functional Oxide Materials, Compound Crystals	3
T-W-2	Organic Nanomaterials	2
T-W-3	Evaluation of mechanical properties of biomaterials	5
T-W-4	Nanocomposites as Implant Materials	3
T-W-5	Nanofiber Biomaterials	2

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in lectures	45
A-L-2	individual literature studies	35
A-L-3	consultations	10
A-W-1	Participation in lectures	15
A-W-2	Individual literature studies	5
A-W-3	preparing for tests	10

Teaching methods / tools

M-1	lectures with presentation
M-2	subject discussion during lectures and laboratories

Teaching methods / tools	
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written completion of lectures and laboratories
S-2	F	laboratory reports
S-3	F	student activity during laboratories

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C09b_W01 basic knowledge in experimental bioomaterials including various groups of enginering materials	MSE_1A_W02 MSE_1A_W07	P6S_WG	P6S_WG	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3	M-1 M-2	S-1 S-2
Skills							
MSE_1A_C09b_U01 skills in synthesis and characterization of biomaterials including various groups of enginering materials	MSE_1A_U03 MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-1 T-L-2 T-L-3	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_C09b_K01 The student understands the importance of fabrication and application of engineering biomaterials	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-W-2 T-L-2 T-W-3 T-L-3 T-W-4 T-W-1 T-W-5	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C09b_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C09b_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C09b_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Yiu-Wing Mai and Zhong-Zhen Yu, Polymer nanocomposites, Woodhead Publishing Inc., 2006

2. Robert Vajtai Ed., Springer Handbook of Nanomaterials, Springer, 2013

3. Mahmood Aliofkhazraei, Handbook of Nanoparticles, Springer, 2016

4. Kantesh Balani, BIOSURFACES A Materials Science and Engineering Perspective, Wiley, 2015

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Functional Properties of Materials**		
Code	MSE_1A_S_C10		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	4	30	2,0	0,30	K	credits
laboratory course	L	4	30	2,0	0,30	K	credits
lecture	W	4	30	2,0	0,40	K	examination

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Kusiak-Nejman Ewelina (Ewelina.Kusiak@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Wilpiszewska Katarzyna (Katarzyna.Wilpiszewska@zut.edu.pl)

Prerequisites

W-1	Knowledge of the basic course in mathematics, physics and chemistry at the elementary level

Module/course unit objectives

C-1	The aim of the course is to gain the students' knowledge and skills in the understanding of properties of materials in terms of their functionality. The students will have competences of team work in the lab.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Current state of the art of Functional Materials - student's presentations	10
T-A-2	Band theory of semiconductors: Calculations of band gap energy	4
T-A-3	Calculations of the photocatalytic activity and quantum efficiency	4
T-A-4	Calculations of reaction rates and kinetics	1
T-A-5	Evaluation of polymer degradation and depolymerization	3
T-A-6	thermal degradation techniques for stability testing	3
T-A-7	Modelling of thermal degradation	3
T-A-8	participation in passing test	2
T-L-1	Adsorption and photocatalytic removal of air and water pollutants	5
T-L-2	Photoactive building materials for air purification	5
T-L-3	Plasticizing of biopolymers	5
T-L-4	Water soluble polymers for technical application	5
T-L-5	Synthesis of porous molecular structures with different porous distribution.	5
T-L-6	Adsorption properties of porous molecular structures with different porous distribution.	5
T-W-1	Fundamental Properties of Functional Materials: General Concepts	4
T-W-2	Processing technologies for Functional Materials	4
T-W-3	Future Trends in Functional Materials	1
T-W-4	Semiconductor-based materials and devices: Fundamentals and preparation	2
T-W-5	Properties and application of semiconductor materials and devices	2
T-W-6	Fundamentals of the photocatalytic activity: Mechanisms, concepts, general application	2
T-W-7	Photoactive materials: Preparation, properties and application	3
T-W-8	Biodegradable polymers and biopolymers – properties, isolation or preparation, application	3

Course content divided into various forms of instruction		*Number of hours*
T-W-9	Depolymerization, degradation and destruction; degradation types and properties changes, biodegradability testing methods	3
T-W-10	Additives affecting polymer stability (UV light, thermal, mechanical, processing) and functionality (rheology modifiers, surface active additives, adhesion promoters), stability testing, Polymers with improved resistance	3
T-W-11	Participation in the zero-term exam	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	preparing for tests	13
A-A-3	Self-study of the literature	15
A-A-4	Consultations	2
A-L-1	participation in laboratory exercises	30
A-L-2	preparation to laboratory exercises	10
A-L-3	preparation of reports	10
A-L-4	participating in tests	10
A-W-1	participation in lectures	30
A-W-2	Individual literature studies	13
A-W-3	preparation for the exam	15
A-W-4	The exam	1
A-W-5	Consultations	2

Teaching methods / tools	
M-1	lectures with presentation
M-2	subject discussion during lectures, auditorium excercises and laboratories
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	written completion of exercises and laboratories
S-3	F	laboratory reports
S-4	F	student activity during auditory excercise

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C10_W01 knowledge of the understanding of properties of materials in terms of their functionality.	MSE_1A_W06	P6S_WG		C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11	M-1	S-1
Skills							
MSE_1A_C10_U01 the ability to characterize the properties of materials in terms of their functionality.	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-A-6 T-A-7 T-A-8 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6	M-2 M-3	S-1 S-3
Social competences							
MSE_1A_C10_K01 Students is able to perform all task on time and cooperate and work in group.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-A-5 T-A-6 T-A-7 T-A-8 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11	M-1 M-2	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C10_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C10_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C10_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Donald R. Askeland, Wendelin J. Wright, The Science and Engineering of Materials , Cengage Learning, 2017, ISBN-13: 978-1305076761

2. Traugott Fischer, Materials Science for Engineering Students, Academic Press, 2008, ISBN-13: 978-0123735874

3. Susan Trolier-McKinstry, Robert E. Newnham, Materials Engineering: Bonding, Structure, and Structure-Property Relationships, Cambridge University Press, 2017, ISBN-13: 978-1107103788

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Phase Transformations & Microstructure of Materials**		
Code	MSE_1A_S_C11		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	4	15	1,0	0,30	K	credits
laboratory course	L	4	30	2,0	0,30	K	credits
lecture	W	4	30	2,0	0,40	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Kiełbasa Karolina (Karolina.Kielbasa@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl),

Prerequisites	
W-1	Fundamentals of mathematics, physics and chemistry

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the area of phase transformations and microstructure of engineering materials

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Determination of diffusion coefficients and activation energy	5
T-A-2	Isothermal and non-isothermal crystallization process of polymers – analysis and interpretation of DSC thermograms	3
T-A-3	The glass transition temperature – analysis and interpretation of DSC thermograms	2
T-A-4	Study of temperature phase transitions in TiO2– analysis and interpretation of XRD diffractograms and Raman spectra	5
T-L-1	Measurement and prediction of phase transformation kinetics	5
T-L-2	Ferrous alloys: steels, Cast Irons	5
T-L-3	Nonferrous alloys: Copper, Aluminum, Titanium, Magnesium and Its Alloys	5
T-L-4	Heat treatment of alloys	5
T-L-5	Crystallization from the melt of semicrystalline polymers	5
T-L-6	Glass transition temperature of different polymers - DSC and DMA	5
T-W-1	Dislocations and Strengthening Mechanisms; Characteristics of Dislocations; Slip Systems; Slip in Single Crystals; Plastic Deformation of Polycrystalline Materials; Deformation by Twinning; Strengthening by Grain Size Reduction; Solid-Solution Strengthening; Strain Hardening; Recovery Recrystallization; Grain Growth	4
T-W-2	Development of microstructure in iron–carbon alloys	2
T-W-3	Microstructural and Property Changes in Iron–Carbon Alloys (Pearlite; Bainite; Spheroidite; Martensite; Time temperature transformation diagrams)	4
T-W-4	Modeling of mass transfer process in phase transformation	3
T-W-5	Modeling of heat transfer process in phase transformation	3
T-W-6	Nucleation theory, including solid-state nucleation (homogeneous and heterogeneous)	3
T-W-7	Crystallites growth and morphology of polymeric materials	3
T-W-8	Molecular orientation during drawing and shearing	2
T-W-9	Flow-Induced Crystallization in Stiff-Chain Aromatic Polymers	3

Course content divided into various forms of instruction		*Number of hours*
T-W-10	Thermal phase transitions in polymers	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-A-2	preparing of written reports	10
A-A-3	self-study of the literature	5
A-L-1	parcitpation in laboratory exercises	30
A-L-2	individual study of literature	10
A-L-3	consultations	5
A-L-4	preparing written reports	15
A-W-1	parcitpation in lectures	30
A-W-2	Individual literature studies	8
A-W-3	Consultations	3
A-W-4	preparing for tests	20

Teaching methods / tools	
M-1	lectures with presentation
M-2	subject discussion during lectures and laboratories
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written completion of lectures and laboratories
S-2	F	laboratory reports
S-3	F	student activity during laboratories and discussion

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C11_W01 The student has the knowledge of common aspect of phase transformations and microstructure in engineering materials	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-6 T-W-2 T-W-7 T-W-3 T-W-8	M-1 M-2	S-1 S-2
Skills							
MSE_1A_C11_U01 The student has the knowledge of common aspect of phase transformations and microstructure characterization of engineering materials	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-A-1 T-L-1 T-A-2 T-L-2 T-A-3 T-L-3 T-A-4 T-L-4	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_C11_K01 The student is aware of the importance of phase transformations and microstructure in engineering materials	MSE_1A_K04	P6S_KR		C-1	T-A-1 T-L-1 T-A-2 T-L-2 T-A-3 T-L-3 T-A-4 T-L-4	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C11_W01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C11_U01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_C11_K01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. W. D. Callister, D. G. Rethwisch, Materials Science and Engineering An introduction, Wiley, 2014

2. M. DeGraef and M. E. McHenry, Structure of Materials: An Introduction to Crystallography, Diffraction, and Symmetry, Cambridge University Press, NY, 2007

3. W. Massa, Crystal Structure Determination, Springer, New York, NY, 2004

4. M. Ashby, K. Johnson, Materials and Design, The Art and Science of Material Selection in Product Design, Third Edition, Elsevier, 2014

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Chemical and Biochemical Engineering**		
Code	MSE_1A_S_C12		
Field of specialisation			
Administering faculty	Department of Chemical and Process Engineering		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	4	15	1,0	0,25	K	credits
project course	P	4	30	2,0	0,50	K	credits
lecture	W	4	15	1,0	0,25	K	credits

Leading teacher	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl)
Other teachers	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl), Rakoczy Rafał (Rafal.Rakoczy@zut.edu.pl)

Prerequisites

W-1	Basic knowledge of biology and chemistry, finshed course of mathematics

Module/course unit objectives

C-1	The objective of the course is to educate specialists in production-scale industrial processing of any substance. They are (bio)chemical and (bio)process engineers well-trained in chemical and biochemical process equipment as well as the processes themselves, especially large-scale ones. They are able to design, automate, and control them regardless of how complex the installation is.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Fermentation kinetics and model processes	5
T-A-2	Modeling and simulation of boreactor process dynamics	5
T-A-3	Predicting Reactor biomass concentration	5
T-P-1	Preparation of own project (Examples of topics related to Bioprocess Engineering: bioenergy, biofactories, probiotics, biofertilizers, biopesticides, blood products; fermented food and drink,production of vaccines and antibodies, natural products).	30
T-W-1	What is chemical and biochemical engineering? Biotechnology and Bioprocess engineering	2
T-W-2	Media formulation/sterilization in bioprocess engineering	2
T-W-3	Industrial strain development. Cell growth kinetics. Effect of culture conditions.	2
T-W-4	Bioreactor design & scaleup (e.g. airlift reactor, stirred and air-driven etc.)	3
T-W-5	Fermentation technologies	3
T-W-6	Large-scale production of enzymes. Medical and Industrial Utilization of Enzymes.	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-A-2	preparing of written raports	8
A-A-3	self-study of literature	5
A-A-4	Consultations	2
A-P-1	preparation of own project on given subject	30
A-P-2	consultations	10
A-P-3	Self-study of the literature	20
A-W-1	participation in lectures	15
A-W-2	self-study of literature	8

Student workload - forms of activity		*Number of hours*
A-W-3	individual consultations	2
A-W-4	preparation for test	5

Teaching methods / tools	
M-1	lectures
M-2	disscusion during lectures and seminar
M-3	Private study

Evaluation methods (F - progressive, P - final)		
S-1	F	lectures with presentation
S-2	F	seminar
S-3	F	private study

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C12_W01 The student: displays comprehensive knowledge of bioreactor design, can analyze kinetics of bioreactor processes, design or select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria	MSE_1A_W02	P6S_WG	P6S_WG	C-1	T-A-1 T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1 M-2 M-3	S-1 S-2 S-3
Skills							
MSE_1A_C12_U01 students are able critically analyze biochemical engineering journal articles; analyze and interpret experimental biochemical data;	MSE_1A_U05	P6S_UW	P6S_UW	C-1	T-A-1 T-W-3 T-A-2 T-W-4 T-W-1 T-W-5 T-W-2 T-W-6	M-1 M-2 M-3	S-1 S-2 S-3
Social competences							
MSE_1A_C12_K01 Student can acquire an appreciation for the role of biochemical engineering in both industry and academia.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-2 T-W-2 T-A-3 T-W-3 T-P-1 T-W-4 T-W-1 T-W-5	M-1 M-2 M-3	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C12_W01	*2,0*	
	3,0	51% of test points, 30% of project points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C12_U01	*2,0*	
	3,0	Have a fundamental understanding of chemostats and their applications, and be able to perform the corresponding calculations.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C12_K01	*2,0*	
	3,0	Student is able to finish all task during course with the help of the colleaguss and a teacher.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Shigeo Katoh, Jun-ichi Horiuchi, Fumitake Yoshida, Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists, 2nd, Completely Revised and Enlarged Edition, Wiley, 2015, 2

2. Ghasem D. Najafpour, Biochemical Engineering and Biotechnology,, Elsevier Science, 2011, 2

3. Michael L. Shuler, Fikret Kargi, Matthew DeLisa, Bioprocess Engineering: Basic Concepts (Prentice Hall International Series in the Physical and Chemical Engineering Sciences), Prentice Hall, 2007, 3

Supplementary reading
1. Francoise Simon, Glen Giovannetti, Managing Biotechnology: From Science to Market in the Digital Age, John Wiley & Sons, 2017
2. A. H. Scragg (Editor), Bioreactors in Biotechnology: A Practical Approach, E. Horwood,, 1991, 1
3. Chemical Engeenering Journals, 2019, Frontiers in Chemical Engineering, Chemical Engineering Journal, Journal of Chemical Engineering, Journal of Chemical Engineering & Process Technology , International Journal of Chemical Engineering and others

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Smart and Nanomaterials**		
Code	MSE_1A_S_C13		
Field of specialisation			
Administering faculty	Department of Materials Technology		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	4	15	1,0	0,25	K	credits
laboratory course	L	4	30	4,0	0,50	K	credits
lecture	W	4	15	1,0	0,25	K	examination

Leading teacher	Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), Figiel Paweł (Pawel.Figiel@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Wenelska Karolina (Karolina.Wilgosz@zut.edu.pl)

Prerequisites

W-1	The lecture aims in getting acquainted the student into the knowledge into nanomaterials. Basic knowledge of physics and chemistry is required

Module/course unit objectives

C-1	The subject aims in providing to students general information about nanomaterials, their structure, and properties. Students will be acquainted with liquid crystals and high temperature materials - intriduction during lectures, and will get more practical skills during laboratories and auditorium classes.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Optical properties of 1D material (e.g. singlewalled carbon nanotubes) - UV-Vis spectrum analysis	2
T-A-2	Vibronic properties of 2D materials (CNTs, graphene, TMD) - Raman response interpretation	3
T-A-3	3D types high temperature materials (carbides, nitides, borides etc.) – XRD analysis	3
T-A-4	Analysis on the oxidation mechanisms of 3D types high temperature materials	2
T-A-5	Chemical structure of mesophases of liquid crystals – FTIR spectrum analysis	2
T-A-6	Different techniques of liquid crystals analysis. Application of liquid crystals – case studies	3
T-L-1	Study on high temperature materials (TGA/DSC study)	5
T-L-2	Morphological studies on high temperature materials (SEM, AFM)	5
T-L-3	Determination of the temperature of phase transitions of liquid crystals using the thermal polarizing microscope.	5
T-L-4	Determination of the temperature of phase transitions and their energy effects of liquid crystals using differential scanning calorimetry.	5
T-L-5	Measurements of UVVis spectra of singlewalled carbon nanotubes (1D material)	5
T-L-6	Study on 1D & 2D materials by means of Raman spectroscopy	5
T-W-1	Layered materials - from 3D to 2D materials: structure, electronic and optical properties	3
T-W-2	One-dimensional materials: structure, electronic, optical , vibronic response	2
T-W-3	High temperature materials – classification, structure, properties.	2
T-W-4	3D types high temperature materials (carbides, nitides, borides etc.)	3
T-W-5	Liquid crystals – classification according molecular order, thermotropic LC, lyotropic LC and their properties	2
T-W-6	Liquid crystalline polymers – classification, chemical structure and properties.	3

Student workload - forms of activity	*Number of hours*

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-A-2	Preparation for recitations	13
A-A-3	Taking part in exam.	2
A-L-1	Participation in laboratory classes	30
A-L-2	Preparation for laboratory exercises	60
A-L-3	Taking part in exam.	2
A-L-4	Preparation of reports	28
A-W-1	Participation in lectures.	15
A-W-2	Getting acquainted with literature (articles, books, patents)	12
A-W-3	Participation in consultations	2
A-W-4	Accession to the exam	1

Teaching methods / tools	
M-1	Informative lecture (presentation prepared in PowerPoint)
M-2	Group discussion

Evaluation methods (F - progressive, P - final)		
S-1	P	Written exam
S-2	F	Brain storm during lectures, laboratories etc. - Questions and Replies
S-3	F	Report preparation (at auditorium classes and laboratories)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C13_W01 Student describes selected issues concerning smart and nanomaterials	MSE_1A_W03 MSE_1A_W04	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1	S-1
Skills							
MSE_1A_C13_U01 Student characterizes smart and nanomaterials	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-A-1 T-L-1 T-A-2 T-L-2 T-A-3 T-L-3 T-A-4 T-L-4 T-A-5 T-L-5 T-A-6 T-L-6	M-2	S-2 S-3
Social competences							
MSE_1A_C13_K01 The student understands the importance of fabrication and application of smart and nanomaterials	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-L-4 T-A-2 T-L-5 T-A-3 T-L-6 T-A-4 T-W-1 T-A-5 T-W-2 T-A-6 T-W-3 T-L-1 T-W-4 T-L-2 T-W-5 T-L-3 T-W-6	M-1	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C13_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C13_U01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_C13_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Yury Gogotsi (editor), Nanomaterials Handbook, CRC Press/Taylor & Francis Group, cop. 2017., 2017
2. Kalia Susheel (editor), Organic-inorganic hybrid nanomaterials, Springer-Verlag, Berlin, 2015
3. Nikos Tagmatarchis (editor), Advances in carbon nanomaterials : science and applications, Pan Stanford Publishing, Singapore, 2012
4. Malkiat S. Johal, Understanding nanomaterials, CRC Press/Taylor & Francis Grou, 2011

Supplementary reading

1. Rich Falcon (editor), Smart Nanomaterials: Synthesis, Properties and Applications, NY RESEARCH PRESS, NY USA, 2017
2. Guozhong Cao, Ying W, Nanostructures and nanomaterials : synthesis, properties and applications, World Scientific, New Jersey, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Materials Characterization and Analytical Techniques**		
Code	MSE_1A_S_C14		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	30	3,0	0,50	K	credits
lecture	W	5	30	2,0	0,50	K	credits

Leading teacher	Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)
Other teachers	Lendzion-Bieluń Zofia (Zofia.Lendzion-Bielun@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Przepiórski Jacek (Jacek.Przepiorski@zut.edu.pl), Sośnicki Jacek (Jacek.Sosnicki@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl)

Prerequisites

W-1	no prerequirements

Module/course unit objectives

C-1	Learning of principles of most important analytical techniques

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Analysis of surface composition by X-ray Photoelectron Spectroscopy	5
T-L-2	Transmission electron microsopy and microanalysis - sample preparation, observations and data analysis	5
T-L-3	Raman spectroscopy as a powerful technique in carbon nanotubes investigations: mesurements, data presentation and interpretation	5
T-L-4	Temperature-programmed chemisorption of gases on the surface of metals, analysis of the bonding strength, identify the surface acidity	5
T-L-5	High-resolution solution-state NMR as a versatile technique providing qualitative and quantitative information on the chemical structure of a polymeric material	5
T-L-6	Cold field emission scanning electron microscopy with microanalysis	5
T-W-1	Surface analysis by X-ray Photoelectron Spectroscopy and Auger Electron Spectrroscopy	5
T-W-2	Transmission electron microscopy and microanalysis	4
T-W-3	Scanning electron microscopy and microanalysis	4
T-W-4	Scanning tunnelling microscopy, atomic force microscopy, electron field microscopy, ion field microscopy	3
T-W-5	Thermal analysis of materials: microcalorymetry and thermogravimetry	6
T-W-6	Raman spectroscopy - fundamentals and materials analysis	3
T-W-7	Temperature programmed techniques (TPR, TPO, TPD,) in the characteristics of mater	5

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory	30
A-L-2	Consultations	4
A-L-3	Preparation of raports; data evaluation	28
A-L-4	self-study of the literature	28
A-W-1	participation in lectures	30
A-W-2	Consultations	2

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Student workload - forms of activity		*Number of hours*
A-W-3	literature study	15
A-W-4	problem solving	13

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory

Evaluation methods (F - progressive, P - final)		
S-1	F	Test
S-2	P	Passing

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C14_W01 Student properly describes microscopy techniques	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-2 T-W-3 T-W-4	M-1	S-1 S-2
MSE_1A_C14_W02 Student describes applications and working principles of temperature programmed techniques	MSE_1A_W05	P6S_WG P6S_WK		C-1	T-W-5 T-W-7	M-1	S-1 S-2
Skills							
MSE_1A_C14_U01 Student is able to work alone with scanning electron microscopy in most basic tasks	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-6	M-2	S-2
Social competences							
MSE_1A_C14_K01 Student is able to analyse experimental data	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-4 T-L-2 T-L-5 T-L-3 T-L-6	M-2	S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C14_W01	*2,0*	
	3,0	Student is able in basic lavel to describe microscopy techniques
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_C14_W02	*2,0*	
	3,0	Student is able to explain working principles of TGA and TPD techniques
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C14_U01	*2,0*	
	3,0	Student is able to introduce the sample into the microscope and obtain sharp picture at low magnifications
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C14_K01	*2,0*	
	3,0	Student is able to deliver most fundamental information on the basis of raw data obtained during experiments
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Daniel C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, New York, 2010

2. AR Clarke; CN EBERHARDT, Microscopy Techniques for Materials Science, CRC, 2002

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Polymer Synthesis, Recycling & Safety**		
Code	MSE_1A_S_C15		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	45	4,0	0,70	K	credits
lecture	W	5	15	1,0	0,30	K	examination

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Dzięcioł Małgorzata (Malgorzata.Dzieciol@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Wilpiszewska Katarzyna (Katarzyna.Wilpiszewska@zut.edu.pl), Wróblewska Agnieszka

Prerequisites

W-1	Fundamentals of chemistry and physics

Module/course unit objectives

C-1	To gain the knowledge, skills and competences in the field of polymer synthesis, recycling and safety in environmental and human aspects

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Radical polymerization of styrene in suspension	5
T-L-2	Condensation polymers from renewable resources	5
T-L-3	Hydrogels from photocurable monomers	5
T-L-4	Preparation of waste plastics for recycling. Separation of polymer materials based on their physicochemical properties.	4
T-L-5	Modification of plastic recyclates	4
T-L-6	Glycolysis of polymer materials (PET, polyurethane etc.)	4
T-L-7	Energy recycling of polymer materials	3
T-L-8	Migration of substances from polymeric food packaging materials	5
T-L-9	Polymerization of PVAC using emulsion technque	5
T-L-10	Obtaining limonene from plant raw material	5
T-W-1	Introduction to polymers science: nomenclature, types of polymerization and depolymerization reactions.	1
T-W-2	Chain and step-growth polymerization: monomers, methods, introduction to kinetic aspects.	4
T-W-3	Copolymerization (reactivity ratios, their effect on copolymer composition, Q-e scheme)	2
T-W-4	Ionic polymerization (anionic, cationic, catalyst, living polymers), coordination polymerization (autoinhibition, Ziegler-Natta catalysts, catalysts generations, mechanism)	3
T-W-5	Bio-alternatives (biobased polymers): bio-polyolefins, bio-PET, rec-PET, PEF etc.).	2
T-W-6	Introduction to polymer recycling; methods of plastic recycling; devices used in plastic recycling	3

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	45
A-L-2	individual study of literature	30
A-L-3	consultations	15

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Student workload - forms of activity		*Number of hours*
A-L-4	preparation of written reports	30
A-W-1	participation in lectures	15
A-W-2	individual study of a literature	10
A-W-3	consultations	2
A-W-4	preparation for exam	3

Teaching methods / tools	
M-1	Lecture with presentation
M-2	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	F	Continuous assessment: laboratory reports and activity
S-2	F	Exam
S-3	F	Final test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C15_W01 The student has the knowledge of common aspect of synthesis, recycling and safety of polymeric materials	MSE_1A_W02 MSE_1A_W07	P6S_WG	P6S_WG	C-1	T-W-1 T-W-4 T-W-2 T-W-5 T-W-3 T-W-6	M-1 M-2	S-1 S-2 S-3
Skills							
MSE_1A_C15_U01 The student has skills in synthesis, recycling and safety of polymeric materials	MSE_1A_U03 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1	T-L-1 T-L-6 T-L-2 T-L-7 T-L-3 T-L-8 T-L-4 T-L-9 T-L-5 T-L-10	M-1 M-2	S-1 S-2 S-3
Social competences							
MSE_1A_C15_K01 The student has skills in synthesis, recycling and safety of polymeric materials	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-9 T-L-2 T-L-10 T-L-3 T-W-1 T-L-4 T-W-2 T-L-5 T-W-3 T-L-6 T-W-4 T-L-7 T-W-5 T-L-8 T-W-6	M-1 M-2	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C15_W01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C15_U01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C15_K01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading
1. Sebastian Koltzenburg, Michael Maskos, Oskar Nuyken, Berlin, Polymer chemistry, Springer-Verlag, Heidelberg, 2017

Required reading
2. A. Dieter Schlüter, Craig J. Hawker, and Junji Sakamoto, Synthesis of polymers : new structures and methods, Wiley-VCH Verlag, Weinheim, 2012
3. A. Ravve, Principles of polymer chemistry, Plenum Press, New York, 1995
4. La Mantia F., Handbook of Plastic Recycling: Sience, Technology and Applications, John Wiley and Sons, Chichester, 1998
5. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill Companies, Inc., Lutherville, Maryland, 2000, doi:10.1036/0070267146

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Biomaterials: Implants and Devices**		
Code	MSE_1A_S_C16a		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	credits	*Language*	english
Electives	5	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	45	4,0	0,50	K	credits
lecture	W	5	30	2,0	0,50	K	credits

Leading teacher	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl)
Other teachers	Biedunkiewicz Anna (Anna.Biedunkiewicz@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), Ossowicz-Rupniewska Paula (Paula.Ossowicz@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Wróblewska Agnieszka

Prerequisites

W-1	Knowledge of the basic course in physics and chemistry at the elementary level

Module/course unit objectives

C-1	To make student to understand the basic principles in biomaterials design and characterization for implants and medical devices

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation patches containing terpene compounds	5
T-L-2	Determination of factors influencing the permeability of drugs through biological membranes	5
T-L-3	Controlled release of proteins: Material preparation	4
T-L-4	Controlled release of proteins: Material characterization	4
T-L-5	Controlled release of proteins: Assessment of release	2
T-L-6	Metal-organic frameworks derived from biomass and waste polymers	7
T-L-7	Characterization of the produced metal-organic frameworks by XRD	4
T-L-8	Characterization of the produced metal-organic frameworks by nitrogen sorption/desorption technique	4
T-L-9	Testing the resistance of metallic materials in the environment of Ringer's solution.	3
T-L-10	Assessment of the formation of apatite-like structures on the surface of selected biomaterials.	3
T-L-11	Assessment of bioactive properties by the results of the Kokubo test	4
T-W-1	Introduction to biomaterials & biocompatibility	1
T-W-2	Biocompatibility and the host response to materials	4
T-W-3	Introduction to controlled drug delivery	1
T-W-4	Diffusion controlled drug delivery	2
T-W-5	Chemically controlled drug delivery	2
T-W-6	Mesoporous silica materials for controlled delivery of drugs	6
T-W-7	Transdermal Therapy Systems (TTS) and therapeutic nail polishes and patches	4
T-W-8	Molecular mechanisms of polymer and nanomaterials degradation	3
T-W-9	Carbon fibers and nanoparticles as versatile materials for medical applications	2
T-W-10	Materials for use in the Body: Metals (Ti and its alloys, Co-Cr alloys, stainless steels, TiNi alloys, Au, Ag, Pt, etc.), Ceramics (aluminum oxide, calcium phosphates including hydroxyapatite, carbon), Composites (carbon-carbon, wire or fiber reinforced bone cement, etc.).	2
T-W-11	Manufacturing of implants (stainless steels , CoCr alloys , Ti and its alloys, etc.).	2

Course content divided into various forms of instruction		*Number of hours*
T-W-12	Advantages, disadvantages and examples ceramics, metals, composites used for the fabrication of biomedical materials.	1

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	45
A-L-2	preparing for laboratory exercises	30
A-L-3	preparation of reports	20
A-L-4	Preparing for tests	20
A-L-5	Consultations	5
A-W-1	participation in lectures	30
A-W-2	Individual literature studies	13
A-W-3	Preparing for tests	15
A-W-4	Cosultations	2

Teaching methods / tools	
M-1	lectures with presentation
M-2	laboratory
M-3	subject discussion during laboratories
M-4	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written passing test
S-2	F	laboratory reports
S-3	F	student activity

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C16a_W01 basic knowledge in the area of synthesis, characterization and application of biomaterials	MSE_1A_W02 MSE_1A_W03 MSE_1A_W04	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-5 T-W-2 T-W-6 T-W-3 T-W-7 T-W-4 T-W-8	M-1	S-1
Skills							
MSE_1A_C16a_U01 ability in the basic scope to synthesize, characterization and application of selected biomaterials in the area of implants and other devices	MSE_1A_U03 MSE_1A_U07 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1	T-L-1 T-L-5 T-L-2 T-L-6 T-L-3 T-L-7 T-L-4 T-L-8	M-2 M-3 M-4	S-1 S-2 S-3
Social competences							
MSE_1A_C16a_K01 competences in synthesis, characterization and application of selected biomaterials in the area of implants and medical devices	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-W-2 T-L-2 T-W-3 T-L-3 T-W-4 T-L-4 T-W-5 T-L-5 T-W-6 T-L-6 T-W-7 T-L-7 T-W-8 T-L-8 T-W-9 T-L-9 T-W-10 T-L-10 T-W-11 T-L-11 T-W-12 T-W-1	M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C16a_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C16a_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C16a_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani , Introduction to Biomaterials: Basic Theory with Engineering Applications, Cambridge University, 2013, ISBN-13: 978-0521116909

2. Joon Park, R. S. Lakes , Biomaterials: An Introduction, Springer, 2007, ISBN-13: 978-0387378794

3. William R Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang , Michael J. Yaszemski , Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2020, ISBN-13: 978-0128161371

4. James Sangster, Octanol-Water Partition Coefficients: Fundamentals and Physical Chemistry, WILEY, 1997, 1

5. Yihong Qiu, Yisheng Chen, Geoff G.Z. Zhang, Lirong Liu, William Porter, Developing Solid Oral Dosage Forms: Pharmaceutical Theory and Practice, Academic Press, 2016, 1

6. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, An Introduction to Materials in Medicine, Academic Press (Elsevier), USA, 2013, 3, ISBN: 978-0-12-374626-9

7. J. Y. Wong, J. D. Bronzino, D.R. Peterson,, Biomaterials Principles and Practices, CRC Press, 2013, ISBN 9781439872512

8. R. Hudak, M. Penhaker, J. Majernik, Biomedical engineering—technical applications in medicine, InTech, 2012

9. A. Serra, Advances in Bioengineering, InTechOpen, 2015, ISBN: 978-953-51-2141-1

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Biomaterials: Drug Delivery and Biosensing**		
Code	MSE_1A_S_C16b		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	credits	*Language*	english
Electives	5	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	45	4,0	0,50	K	credits
lecture	W	5	30	2,0	0,50	K	credits

Leading teacher	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl)
Other teachers	Biedunkiewicz Anna (Anna.Biedunkiewicz@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), Ossowicz-Rupniewska Paula (Paula.Ossowicz@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Wróblewska Agnieszka

Prerequisites

W-1	Knowledge of the basic course in physics and chemistry at the elementary level

Module/course unit objectives

C-1	To make student to understand the basic mechanisms of drug delivery and biosensing with the use of various classes of biomaterials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation patches containing terpene compounds	5
T-L-2	Isolation of raw materials for use in medical polymers	5
T-L-3	Microparticles for protein delivery: Material preparation	4
T-L-4	Microparticles for protein delivery: Material characterization	4
T-L-5	Microparticles for protein delivery: Assessment of release	2
T-L-6	Preparation of porous materials from biomass and waste derived sources	7
T-L-7	Characterization of the produced porous materials by XRD	4
T-L-8	Characterization of the produced porous materials by nitrogen sorption/desorption technique.	4
T-L-9	Investigation of surface wettability and evaluation of the influence on the functional properties of implants.	3
T-L-10	Investigation of the phenomenon of implant degradation in aqueous environments.	3
T-L-11	Assessment of bioactive properties by the surfaces after modification	4
T-W-1	Introduction to biomaterials & biocompatibility	1
T-W-2	Biocompatibility and the host response to materials	4
T-W-3	Introduction to controlled drug delivery	1
T-W-4	Targeted drug delivery	2
T-W-5	Nanoparticles for drug delivery	2
T-W-6	Mesoporous silica materials for controlled delivery of drugs	3
T-W-7	Transdermal Therapy Systems (TTS) and therapeutic nail polishes and patches	2
T-W-8	Biomass derived polymers as high value added products for healthcare sector	5
T-W-9	Carbon-based polymer (nano)composites for biosensing applications	5
T-W-10	Materials for orthopedic, dental implants, and endoprostheses. Biocompatibility	1
T-W-11	Osseointegration issues between the bone and the surface of the implanted implant	1

Course content divided into various forms of instruction		*Number of hours*
T-W-12	Microbial biofilm on the surface of implants. The formation of microcolonies. Influence of surface morphology and topography on the induced response of biological objects.	1
T-W-13	Functionalization of the surface of biomedical materials. Influence of ion implantation on the structural and mechanical properties dental ceramics.	1
T-W-14	The effect of Er,Cr:YSGG and Diode Laser Applications on dental implant surfaces contaminated with Acinetobacter Baumannii and Pseudomonas Aeruginosa.	1

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	45
A-L-2	preparation for laboratory exercises	20
A-L-3	preparation of reports	30
A-L-4	Preparing for tests	20
A-L-5	Consultations	5
A-W-1	participation in lectures	30
A-W-2	Individual literature studies	13
A-W-3	Preparing for tests	15
A-W-4	Consultations	2

Teaching methods / tools	
M-1	lectures with presentation
M-2	labolaroty
M-3	subject discussion during laboratories
M-4	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written passing test
S-2	F	laboratory reports
S-3	F	student activity

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C16b_W01 basic knowledge in the area of synthesis, characterization and application of biomaterials	MSE_1A_W02 MSE_1A_W03 MSE_1A_W04	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9	M-1	S-1
Skills							
MSE_1A_C16b_U01 ability in the basic scope to synthesize, characterization and application of selected biomaterials in the area of drug delivery and biosensing	MSE_1A_U03 MSE_1A_U07 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8	M-2 M-3 M-4	S-1 S-2 S-3
Social competences							
MSE_1A_C16b_K01 competences in synthesis, characterization and application of selected biomaterials in the area of drug delivery and biosensing	MSE_1A_K02	P6S_KK	P6S_WK	C-1		M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C16b_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C16b_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C16b_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. William R Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J. Yaszemski, Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2020, ISBN-13: 978-0128161371

2. Joon Park, R. S. Lakes , Biomaterials: An Introduction, Springer, 2007, ISBN-13: 978-0387378794

3. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani, Introduction to Biomaterials: Basic Theory with Engineering Applications, Cambridge University, 2017, ISBN-13: 978-0521116909

4. Thomas Nogrady, Donald F., Weaver Medicinal Chemistry: A Molecular and Biochemical Approach, Oxford University Press, 2005, 3

5. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, An Introduction to Materials in Medicine, Academic Press (Elsevier), USA, 2013, 3, ISBN: 978-0-12-374626-9

6. 3. A. Serra, Advances in Bioengineering, InTechOpen, 2015, ISBN: 978-953-51-2141-1

7. R. Hudak, M. Penhaker, J. Majernik, Biomedical engineering—technical applications in medicine, InTech, 2012

8. J. Y. Wong, J. D. Bronzino, D.R. Peterson,, Biomaterials Principles and Practices, CRC Press ISBN 9781439872512, 2013, ISBN 9781439872512

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Structural Deformation in Materials**		
Code	MSE_1A_S_C17a		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives	6	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	45	3,0	0,50	K	credits
lecture	W	5	30	2,0	0,50	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Kochmański Paweł (Pawel.Kochmanski@zut.edu.pl), Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl), Wenelska Karolina

Prerequisites

W-1	Fundamentals of mathematics and physics. Fundamentals of mechanics.

Module/course unit objectives

C-1	To gain the knowledge, skills and competences in the field of structural deformations of engineering materials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Influence of the structural defects on mechanical profile of polymers	5
T-L-2	Evaluation of temerature effect on creep and stress relaxation	5
T-L-3	Introduction to elastomer fatique testing	5
T-L-4	Determination of deformation parameters of organic binder-based layers	5
T-L-5	Preparation and mechanical characterization of steel reinforced concrete elements	5
T-L-6	Studies on stress level influence on metals microstructure and properties; Evaluation of metals deformability	5
T-L-7	Studies on thermal recovery of metals microstructure and properties	5
T-L-8	Study on microstructure and the properties of silica materials	5
T-L-9	Study on microstructure and the properties of silica materials	5
T-W-1	Stress corrosion and other corrosion types of metallic materials. Corrosion protection methods	6
T-W-2	Reinforcing methods of building materials. Steel reinforced and prestressed concrete materials. Steel reinforcement corrosion phenomenon	2
T-W-3	Deformation abilities, mechanical and barrier features of filled polymer layers	2
T-W-4	Basics of fracture mechanics	2
T-W-5	Creep and relaxation in soft polymers, elastic recovery and permanent set	2
T-W-6	Interface fracture mechanics	2
T-W-7	Fatigue crack growth models and mechanisms	2
T-W-8	Wear of composites and nanocomposites	2
T-W-9	Deformation mechanisms in metals; influence of stress on microstructure and metals properties; recovery mechanisms after stress induced deformation	6
T-W-10	Technologies of mechanical deformation for tailoring mechanical properties of metals	4

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	45

Student workload - forms of activity		*Number of hours*
A-L-2	individual study of literature	25
A-L-3	preparation of written reports	20
A-W-1	participation in lectures	30
A-W-2	individual study of literature	20
A-W-3	consultations	10

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	F	Reports
S-2	P	Exam

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C17a_W01 The student has the knowledge of common aspect of structural deformation in different engineering materials	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-6 T-W-2 T-W-7 T-W-3 T-W-8 T-W-4 T-W-9 T-W-5 T-W-10	M-1 M-2	S-1 S-2
Skills							
MSE_1A_C17a_U01 The student has skills of identification, description and prevention of different materials from structural deformations	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-1 T-L-5 T-L-2 T-L-6 T-L-3 T-L-7 T-L-4	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_C17a_K01 The student understands the importance of structural deformations of engineering materials in practical applications	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-W-3 T-L-2 T-W-4 T-L-3 T-W-5 T-L-4 T-W-6 T-L-5 T-W-7 T-L-6 T-W-8 T-L-7 T-W-9 T-W-1 T-W-10 T-W-2	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C17a_W01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C17a_U01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C17a_K01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

Required reading
1. M. DeGraef and M. E. McHenry, Structure of Materials: An Introduction to Crystallography, Diffraction, and Symmetry, Cambridge University Press, New York, 2007
2. Gibson R.F., Principles of Composite Material Mechanics, 1994

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Fatigue, Fracture and Wear**		
Code	MSE_1A_S_C17b		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives	6	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	45	3,0	0,50	K	credits
lecture	W	5	30	2,0	0,50	K	credits

Leading teacher	Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Figiel Paweł (Pawel.Figiel@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Kochmański Paweł (Pawel.Kochmanski@zut.edu.pl), Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl), Wenelska Karolina (Karolina.Wilgosz@zut.edu.pl)

Prerequisites	
W-1	Fundamentals of mathematics and physics. Fundamentals of mechanics.

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the field of fatigue, fracture and wear aspects of engineering materials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation and characterization of conversion-type inorganic coatings	5
T-L-2	Determination of abrasion, cupping and impact resistance of polymer layers	5
T-L-3	Influence of the structural defects on mechanical profile of polymers composites	5
T-L-4	Fatique resistance of biopolymers	5
T-L-5	Intrerfacial adhesion in polymer composites	5
T-L-6	Evaluation of corrosion properties of materials	5
T-L-7	Evaluation of tribological properties of materials; Analysis of failures in metallic materials	5
T-L-8	Fatigue of polymer-supported nanomaterials thin films	5
T-L-9	Microstructural effects in ceramic materials	5
T-W-1	Steel and alloys corrosion phenomenon. Fatigue corrosion and other corrosion types. Fundamentals of anticorrosion protection	6
T-W-2	PVC and CPVC parameters of thin polymeric films with pigments/fillers	2
T-W-3	Fundamentals of tribology. Lubrication and bearing methods. Mechanisms of tribological wear. Materials and coatings for tribological applications. Methods of tribological wear resistance evaluation.	8
T-W-4	Introduction to fracture mechanics	2
T-W-5	Fatigue of polymer and composite materials: S-N and hystheresis methods	2
T-W-6	Fatigue crack growth models and mechanisms	2
T-W-7	Interface fracture mechanics	2
T-W-8	Wear of polymers	2
T-W-9	Failure mechanisms in metallic materials	4

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in the laboratory exercises	45

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Faculty of Chemical Technology and Engineering

Student workload - forms of activity		*Number of hours*
A-L-2	Instructions reading, literature review	35
A-L-3	Reports preparation	5
A-L-4	Consultations	5
A-W-1	Participation in the lectures	30
A-W-2	Additional student work. Literature review.	28
A-W-3	Consultations	2

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	F	Reports
S-2	P	Exam

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C17b_W01 The student has the knowledge of common aspect of fatigue, fracture and wear of engineering materials	MSE_1A_W02 MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8	M-1	S-2
Skills							
MSE_1A_C17b_U01 The student has skills of identification, description and prevention of fatigue, fracture and wear of engineering materials	MSE_1A_U02 MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8 T-L-9	M-2	S-1 S-2
Social competences							
MSE_1A_C17b_K01 The student understands the importance of fatigue, fracture and wear of engineering materials in practical applications	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8 T-L-9 T-W-1 T-W-2 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C17b_W01	*2,0*	
	3,0	The student knows the fundamentals aspects of fatigue, fracture and wear of engineering materials
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C17b_U01	*2,0*	
	3,0	The student can identify,describe and prevent fatigue, fracture and wear of engineering materials
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C17b_K01	*2,0*	
	3,0	Student understands the importance of fatigue, fracture and wear aspects of engineering materials
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

Required reading
1. Wranglen G., An Introduction to Corrosion and Protection of Metals, Springer Netherlands, 1985
2. Uhling H.H., Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, John Wiley & Sons, Inc., 2008
3. J. Kolesce, Paint and coating testing manual, ASTM, Ann Arbor, 1995

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Micro- and Nanofabrication of Materials**		
Code	MSE_1A_S_C18a		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	8,0	*ECTS (forms)*	8,0
Form of course credit	examination	*Language*	english
Electives	7	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	5	30	2,0	0,25	K	credits
laboratory course	L	5	60	4,0	0,50	K	credits
lecture	W	5	30	2,0	0,25	K	examination

Leading teacher	Zielinska Beata (Beata.Zielinska@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Wenelska Karolina (Karolina.Wilgosz@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata (Beata.Zielinska@zut.edu.pl), Żwir Marek

Prerequisites

W-1	Knowledge of the basic course in physics and chemistry at the elementary level

Module/course unit objectives

C-1	The aim of the course is to develop student's knowledge and skills in the area of different techniques used for materials and nanomaterials synthesis.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Kinetic theory of gases – exercises	9
T-A-2	Model design and slicing for FDM printing	9
T-A-3	Chemical vapor deposition techniques (CVD, plasma enhanced CVD, alcohol CVD, gel CVD, laser assisted CVD) – effect of synthesis parameters on the produced nanostructures properties.	9
T-A-4	Participation in passing test	3
T-L-1	1a. Studies on metallic and ceramic coatings deposited by magnetron sputtering deposition. 1b. Studies on composite thin films deposited by high energetic beams. 1c. Studies on polymer thin films deposited by high energetic beams	15
T-L-2	2a. Thin films obtained by magnetron sputtering. 2b. Thin films characterisation – attenuation effect of overlayer films. 2c. Application of x-ray diffraction for thin film characterization.	15
T-L-3	Influence of process parameters on the surface composition of deposited polymer films	8
T-L-4	Preparation of RTV silicone mold for rapid tooling resin casts (part I – preparation, part II -determination of strength).	4
T-L-5	Chemical vapar deposition as technique of carbon nanotubes synthesis - study of synthesis parameters on physicochemical properties of carbon nanotubes (synthesis and product characterization)	15
T-L-6	SLA manufacturing technology. Design, printing and post-processing	3
T-W-1	1a. Micro- and nanostructure formation in coatings and thin films deposited by physical methods 1b. Influence of high energetic beams on film growth and properties	7
T-W-2	Chemical vapor deposition techniques (CVD, plasma enhanced CVD, alcohol CVD, gel CVD, laser assisted CVD) as methods of nanostructures synthesis.	7
T-W-3	3a. Principles of the kinetic theory of gasses. 3b. Magnetron sputtering. 3c. Ion etching	8
T-W-4	Free-standing polymer films and coatings formation (Langmuir-Blodget, LBL)	4
T-W-5	Polymer microcapsules preparation and encapsulation technologies	2

Course content divided into various forms of instruction		*Number of hours*
T-W-6	Electrospinning of polymeric nanofibres	2

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	preparing for tests	13
A-A-3	Preparing for recitations	15
A-A-4	Consultations	2
A-L-1	participation in laboratory exercises	60
A-L-2	preparing for laboratory exercises	20
A-L-3	preparation of reports	20
A-L-4	preparing for tests	10
A-L-5	Cosultations	10
A-W-1	participation in lectures	30
A-W-2	Individual literature studies	13
A-W-3	Preparing for the exam	15
A-W-4	The exam	1
A-W-5	Consultations	2

Teaching methods / tools	
M-1	lectures with presentation
M-2	subject disscusion during lectures, auditorium excercises and laboratories
M-3	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	written completion of exercises
S-3	F	laboratory reports
S-4	F	student activity during auditory excercise

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C18a_W01 knowledge in the area of different methods of materials synthesis	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1	S-1
Skills							
MSE_1A_C18a_U01 ability to plan and implement synthesis processes of selected materials	MSE_1A_U08	P6S_UK	P6S_UW	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6	M-2 M-3	S-2 S-3 S-4
Social competences							
MSE_1A_C18a_K01 Competences in micro- and nanofabrication of engineering materials	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1 M-2	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C18a_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C18a_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C18a_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Jiwang Yan, Micro and Nano Fabrication Technology (Micro/Nano Technologies), Springer, 2020, ISBN-13: 978-9811300998

2. Kwang-Leong Choy, Chemical Vapour Deposition (CVD) Advances, Technology and Applications, CRC Press, 2019, ISBN 9781466597761

3. Eiichi Kondoh, Micro- and Nanofabrication for Beginners, CRC Press, 2020, ISBN 9789814877091

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Advanced Manufacturing Processes**		
Code	MSE_1A_S_C18b		
Field of specialisation			
Administering faculty	Department of Materials Technology		
ECTS	8,0	*ECTS (forms)*	8,0
Form of course credit	examination	*Language*	english
Electives	7	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	5	30	2,0	0,25	K	credits
laboratory course	L	5	60	4,0	0,50	K	credits
lecture	W	5	30	2,0	0,25	K	examination

Leading teacher	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Moszyński Dariusz (Dariusz.Moszynski@zut.edu.pl), Wenelska Karolina (Karolina.Wilgosz@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata (Beata.Zielinska@zut.edu.pl), Żwir Marek

Prerequisites	
W-1	approval in subjects: Physic of Materials, Intro to MatSci/Intro to MatEng, Structure of Solids, Materials processing, Surface Science and Interfacial Phenomena

Module/course unit objectives	
C-1	to get knowledge about selected advanced manufacturing technologies
C-2	formation of skills in the area of technological processes preparation and carrying out.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Study on influence of synthesis parameters on the physicochemical properties of selected nanostructures produced via vapor deposition techniques: case studies (10h)	10
T-A-2	Kinetic theory of gases – solving problems	10
T-A-3	Proper design of adhesive joints. Case analysis and theoretical prediction of joint’s bearing capacities	10
T-L-1	Influence of process parameters on coating deposition by magnetron sputtering techniques	5
T-L-2	Advanced deposition of polymer thin films by MAPLE method	5
T-L-3	Influence of process parameters on thin film deposition by pulsed laser and pulsed electron beam method	5
T-L-4	Formation of FexN layers under variable nitriding potential during gaseous nitridation of iron	10
T-L-5	Magnetron sputtering for preparation of sandwich structure nanolayers	5
T-L-6	Attenuation effect of thin films in EDS/XPS spectroscopies	5
T-L-7	Modification of particle size obtained via magnetron sputtering via sintering	5
T-L-8	Experimental comparison of adhesive joints strength prepared wit different polymer adhesives (part I – preparation, part II -determination of strength)	5
T-L-9	Degradation of waste polymer into metal-organic framworks (MOFs)	10
T-L-10	SLA manufacturing technology. Design, printing and post-processing	5
T-W-1	Principles of the kinetic theory of gasses	4
T-W-2	Magnetron sputtering in coatings and thin films deposition	2
T-W-3	Lithography and surface etching	2
T-W-4	Vapor deposition techniques for growing nanostructures: chemical vapor deposition (CVD) and physical vapor deposition (PVP) and their modification	7
T-W-5	Thin polymer films formation by LBL and sping coating techniques; thin biological layers formation	3

Course content divided into various forms of instruction		*Number of hours*
T-W-6	High energetic beams used for thin films deposition and their influence on coating structure and properties; process parameters selections; kinetics of coatings growth	7
T-W-7	Rapid protopyping of polymers using photocuring and thermoforming prosessing (FDM, SLA)	3
T-W-8	Electrospinning of polymer nanofibres	2

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	Preparing for recitations	23
A-A-3	Preparing for tests	5
A-A-4	Consultations	2
A-L-1	participation in laboratory exercises	60
A-L-2	preparing for laboratory exercises	30
A-L-3	Preparation of reports	20
A-L-4	Consultations	10
A-W-1	participation in lectures	30
A-W-2	self-study of the literature	17
A-W-3	preparing for the exam	10
A-W-4	The exam	1
A-W-5	Consultations	2

Teaching methods / tools	
M-1	interactive lectures, use of presentation (e.g. Powerpoint), films
M-2	Auditorium Exercises
M-3	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	questions
S-3	F	reports

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C18b_W01 Student describes issues concerning advanced manufacturing processes	MSE_1A_W07	P6S_WG	P6S_WG	C-1	T-W-1 T-W-5 T-W-2 T-W-6 T-W-3 T-W-7 T-W-4 T-W-8	M-1	S-1
Skills							
MSE_1A_C18b_U01 Student has skills in advanced manufacturing processes	MSE_1A_U08	P6S_UK	P6S_UW	C-2	T-A-1 T-L-5 T-A-2 T-L-6 T-A-3 T-L-7 T-L-1 T-L-8 T-L-2 T-L-9 T-L-3 T-L-10 T-L-4	M-2	S-2 S-3
Social competences							
MSE_1A_C18b_K01 Competences in advanced manufacturing of engineering materials	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-L-9 T-A-2 T-L-10 T-A-3 T-W-1 T-L-1 T-W-2 T-L-2 T-W-3 T-L-3 T-W-4 T-L-4 T-W-5 T-L-5 T-W-6 T-L-6 T-W-7 T-L-7 T-W-8 T-L-8	M-1 M-3	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C18b_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C18b_U01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C18b_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Mikell Groover, Introduction to Manufacturing Processes, Wiley, 2011

2. Prof. Dr.-Ing. Friedrich-Wilhelm Bach Dr. Andreas Laarmann Dipl.-Ing. Thomas Wenz, Modern Surface Technology, Springer, 2006

3. Ian GibsonDavid W. RosenBrent Stucker, Additive Manufacturing Technologies, Springer, 2010

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Functional Materials and Devices**		
Code	MSE_1A_S_C19		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	3,0	*ECTS (forms)*	3,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	6	30	1,5	0,50	K	credits
lecture	W	6	30	1,5	0,50	K	credits

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Bartkowiak Artur (Artur-Bartkowiak@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Wenelska Karolina (Karolina.Wilgosz@zut.edu.pl)

Prerequisites	
W-1	Knowledge of the basic course in mathematics, physics and chemistry at the elementary level

Module/course unit objectives	
C-1	The students will have knowlegge and skills in device fabrication composed of functional materials for defined applications for example supercapacitors.

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation of supercapacitors and its measurements (Part I).	5
T-L-2	Electrochemical data colection and analysis (part II)	5
T-L-3	Preparation of polymeric porous structures by porogen removal method	5
T-L-4	Nanoprecipitation of protein nanoparticles for drug delivery and release systems	5
T-L-5	Smart pH-indicators and humidity regulators in food packaging	5
T-L-6	Antimicrobial and antiviral surfaces based on functional coatings of polymer and cellulosic materials	5
T-W-1	Functional materials for supercapacitors.	3
T-W-2	Electrode components in lithium-ion batteries.	3
T-W-3	Electrode materials for electrochemcial water decomposition	3
T-W-4	Functional materials based on polyelectrolytes	2
T-W-5	Functional packaging materials	2
T-W-6	Smart packaging materials	2
T-W-7	Modification of barrier properties of polymer materials	2
T-W-8	Bioactive surfaces and materials	2
T-W-9	participation in passing test	1
T-W-10	Porous structures as scaffolding systems	4
T-W-11	Wet adhesion surfaces	2
T-W-12	Micro- and nanoparticles for drug delivery systems	4

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	30
A-L-2	preparing for laboratory exercises	5
A-L-3	preparation of reports	3
A-L-4	preparing for tests	5

Student workload - forms of activity		*Number of hours*
A-L-5	Consultations	2
A-W-1	participation in lectures	30
A-W-2	Individual literature studies	5
A-W-3	preparing for tests	8
A-W-4	Consultations	2

Teaching methods / tools	
M-1	lectures with presentation
M-2	practical
M-3	subject discussion during lectures and laboratories
M-4	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	written completion of lectures and laboratories
S-2	F	laboratory reports
S-3	F	student activity during lectures and laboratories

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C19_W01 knowlegge of device fabrication composed of functional materials for defined applications	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-7 T-W-2 T-W-8 T-W-3 T-W-9 T-W-4 T-W-10 T-W-5 T-W-11 T-W-6 T-W-12	M-1	S-1
Skills							
MSE_1A_C19_U01 ability to device fabrication composed of functional materials for defined applications.	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-L-1 T-L-4 T-L-2 T-L-5 T-L-3 T-L-6	M-2 M-3 M-4	S-1 S-2 S-3
Social competences							
MSE_1A_C19_K01 understanding of the importance of functional materials and devices in practical applications	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-W-4 T-L-2 T-W-5 T-L-3 T-W-6 T-L-4 T-W-7 T-L-5 T-W-8 T-L-6 T-W-9 T-W-1 T-W-10 T-W-2 T-W-11 T-W-3 T-W-12	M-1 M-2 M-3	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C19_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C19_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_C19_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Deborah D. L. Chung, Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic Applications, World Scientific Publishing Company, 2010, ISBN-13: 978-9814287159

2. A. K. Arof, S. A. Hashim Ali, Functional Materials and Devices, Trans Tech Publications, 2006, ISBN-13: 978-0878494040

3. Donald R. Askeland, Wendelin J. Wright , Essentials of Materials Science and Engineering, Cengage Learning, 2018, ISBN-13: 978-1337385497

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Adhesives and Coatings**		
Code	MSE_1A_S_C20		
Field of specialisation			
Administering faculty	Department of Organic Chemical Technology and Polymer Materials		
ECTS	5,0	*ECTS (forms)*	5,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	6	45	3,0	0,75	K	credits
lecture	W	6	15	2,0	0,25	K	credits

Leading teacher	Czech Zbigniew (psa_czech@wp.pl)
Other teachers	Bartkowiak Artur (Artur-Bartkowiak@zut.edu.pl), Czech Zbigniew (psa_czech@wp.pl), Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl)

Prerequisites

W-1	Fundamentals of chemistry and materials science, presented in previous courses in this field of study.

Module/course unit objectives

C-1	The aim of the course is to get knowledge and skills in the field of technology of adhesives and coatings used in present-day industry.

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation and application of a solvent-borne polyurethane paint.	5
T-L-2	Preparation and application of a waterborne paint	5
T-L-3	Application of a powder coating. Testing of the prepared varnish and paint coatings.	5
T-L-4	Preparation and application of inks and coatings for modification of polymer films.	5
T-L-5	Preparation and application of inks and coatings for modification of cellulosic material coating.	5
T-L-6	Characteristion of coated polymer films and cellulosic materials for modified packaging materials.	5
T-L-7	Crosslinking of solvent-based pressure-sensitive adhesive acrylics using UV-C lamp.	5
T-L-8	Manufacturing of one-sided and double-sided tapes based on solvent-free low viscosity adhesives.	5
T-L-9	UV-initiated polymerization of typical adhesive monomers.	5
T-W-1	Definitions of a varnish, paint, adhesive, binder, film forming substance, pigment, micro- and nanofiller, solvent, diluent.	1
T-W-2	Characterization of the most popular binders, micro- and nanofillers, pigments (decorative, anticorrosive), solvents and coating additives.	4
T-W-3	Preparation and application methods of coating compositions.	2
T-W-4	Historical development of adhesives and sealants, from ancient times to modern technology. Theories and mechanisms of adhesion.	2
T-W-5	Types of commonly used adhesives based on polymers ((hot-melt adhesives, contact adhesives, solvent type adhesives, dispersed adhesives, pressure-sensitive adhesives) and their application.	2
T-W-6	Adhesives for special applications. Pressure-sensitive adhesives technology and their application in many branches of modern industry	2
T-W-7	Physical and chemical testing and analysis of adhesives – methods and procedures.	2

Student workload - forms of activity		*Number of hours*
A-L-1	Participation in laboratory exercises.	45
A-L-2	Self-study of the literature	30
A-L-3	Consultations	15
A-W-1	Participation in lectures	15

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Student workload - forms of activity		*Number of hours*
A-W-2	Self-study of the literature	30
A-W-3	Consultations	15

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	P	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C20_W01 The student has a knowledge about technology of adhesives and self adhesive materials, coatings, and fillers, solvents and film forming polymers as well as modern auxiliary agents for coatings, paints and varnishes.	MSE_1A_W03 MSE_1A_W04	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7	M-1	S-1
Skills							
MSE_1A_C20_U01 The student has skills in the field of modern coatings and adhesives, including preparation, purification, application methods, analysis and practical testing of their properties.	MSE_1A_U01 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8 T-L-9	M-2	S-1
Social competences							
MSE_1A_C20_K01 The student understands the role of modern, environmentally friendly technologies in the field of adhesives, self-adhesive materials and coatings.	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-L-7 T-L-8 T-L-9 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7	M-1 M-2	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C20_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C20_U01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C20_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. J. Koleske, Paint and coating testing manual, ASTM, Philadelphia, 1995
2. J.H. Koo, Polymer nanocomposites, The McGraw-Hill Comp., New York, 2006
3. Z. Wicks, F. Jones, Organic coatings, John Wiley&Sons, Hoboken, 2007
4. A. Pizzi, K.L. Mittal (editors), Handbook of Adhesive Technology, Marcel Dekker Inc., New York - Basel, 2003, 2nd Ed.
5. I. Benedek, Pressure-Sensitive Adhesives and Application, Marcel Dekker Inc., New York - Basel, 2004, 2nd Ed.

Required reading

6. Z. Czech, D. Sowa, Adhesion of Pressure-Sensitive Adhesives, Especially of Solvent-Based PSA, WPUT Szczecin Publishing House, Szczecin, 2016

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Porous Structures and Foams**		
Code	MSE_1A_S_C21		
Field of specialisation			
Administering faculty	Department of Catalytic and Sorbent Materials Engineering		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	6	30	4,0	0,70	K	credits
lecture	W	6	30	2,0	0,30	K	examination

Leading teacher	Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl), Pelka Rafal (Rafal.Pelka@zut.edu.pl), Sreńscek-Nazzal Joanna (Joanna.Srenscek@zut.edu.pl), Żwir Marek (Marek.Zwir@zut.edu.pl)

Prerequisites	
W-1	none

Module/course unit objectives	
C-1	Gaining knowledge about structure, properties and manufacturing of porous materials and foams
C-2	Skills of characterising structure, properties and manufacturing of porous materials and foams

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Surface Area and Porosity Characterization	5
T-L-2	Synthesis of Ordered Mesoporous Silica	5
T-L-3	International standards for determining properties of porous materials. Testing selected properties of various foams according to standards	5
T-L-4	Modelling and design of porous materials (using computer techniques)	5
T-L-5	Measurements of catalytic activity of porous materials	5
T-L-6	Density and pore structure of PUR foam as function of amount and kind of a blowing agent. Synthesis and characterization of PUR foams.	5
T-W-1	Nature’s Porous Materials	1
T-W-2	Theory of Adsorption and Catalysis: Surface Area and Porosity	2
T-W-3	Zeolites and Zeotypes	2
T-W-4	Ordered Mesoporous Silica	2
T-W-5	Carbons	3
T-W-6	Polyurethane microcellular materials and foams	4
T-W-7	Introduction to numerical modelling	2
T-W-8	Modelling of the structure of porous materials	3
T-W-9	Modelling of catalytic properties of porous materials	3
T-W-10	Metals, metal oxides, ceramics, glasses and composites	2
T-W-11	Characterization methods of porous polymeric materials	3
T-W-12	Processing methods and blowing agents for preparation of polymeric foams	3

Student workload - forms of activity		*Number of hours*
A-L-1	Attending Classes	30
A-L-2	Preparing for tests	24
A-L-3	Preparing reports	60

Student workload - forms of activity		*Number of hours*
A-L-4	individual consultations	6
A-W-1	Attending Classes	30
A-W-2	Preparing for the exam	26
A-W-3	Individual consultations	2
A-W-4	The exam	2

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory

Evaluation methods (F - progressive, P - final)		
S-1	P	Exam
S-2	F	written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C21_W01 Student describes selected issues concerning the structure of porous materials, properties and synthesis	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1	T-W-1 T-W-6 T-W-2 T-W-7 T-W-3 T-W-8 T-W-4 T-W-9 T-W-5 T-W-10	M-1	S-1
Skills							
MSE_1A_C21_U01 Student characterizes the structure and determines the basic properties of porous materials	MSE_1A_U07	P6S_UW	P6S_UW	C-2	T-L-1 T-L-5 T-L-3 T-L-6	M-2	S-2
MSE_1A_C21_U02 Student synthetises selected porous materials	MSE_1A_U08	P6S_UK	P6S_UW	C-2	T-L-2 T-L-4	M-2	S-2
Social competences							
MSE_1A_C21_K01 Student understands the importance of porous structures and foams in practical applications	MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2	T-L-1 T-W-4 T-L-2 T-W-5 T-L-3 T-W-6 T-L-4 T-W-7 T-L-5 T-W-8 T-L-6 T-W-9 T-W-1 T-W-10 T-W-2 T-W-11 T-W-3 T-W-12	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C21_W01	*2,0*	
	3,0	Student describes selected issues concerning the structure of porous materials, properties and synthesis at a basic level (exam score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C21_U01	*2,0*	
	3,0	Student characterizes properties of porous materials at a basic level (exam score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_C21_U02	*2,0*	
	3,0	Student synthetises selected porous materials at a basic level (exam score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_C21_K01	*2,0*	
	3,0	Student understands the structure-property relationship in porous materials at a basic level (exam score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading
1. David Atwood, David Atwood, Gerd Meyer, Derek Woollins, Introduction to Porous Materials, A Wiley Series of Advanced Textbooks, 2019
2. Duncan W. Bruce, Dermot O'Hare, Richard I. Walton, Porous Materials, A John Wiley and Sons, Ltd, Publication, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Case Studies in Biomaterials**		
Code	MSE_1A_S_C22a		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	8	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
project course	P	6	15	1,0	0,25	K	credits
seminars	S	6	45	3,0	0,75	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Biedunkiewicz Anna (Anna.Biedunkiewicz@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites	
W-1	Basic knowledge in polymer, metal and ceramic materials synthesis, characterization and structure-properties relationship with the application as biomaterials

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the field of various aspects of biomaterials synthesis, characterization and medical applications
C-2	To carry out a basic literature search based on databases and scientific literature.

Course content divided into various forms of instruction		*Number of hours*
T-P-1	Design of biomaterials for hard and soft tissue repair	5
T-P-2	Design of metal and ceramic biomaterials	5
T-P-3	Nanomaterials for medical applications	5
T-S-1	Operating conditions and mechanisms of dergadation/failure of biomedical materials	3
T-S-2	The most common problems with ensuring the quality of implants and endoprostheses	3
T-S-3	Methods of preventing biomaterials from destructive phenomena	3
T-S-4	The issue of biocompatibility	3
T-S-5	Development directions of nano- and micro-crystalline ceramic, metallic and composite biomaterials. Intelligent structures	3
T-S-6	Production process of TiO2 - cause and effect relationships	6
T-S-7	Analysis and discussion of current biomaterials literature	15
T-S-8	Analysis and discussion of current nanomaterials literature	9

Student workload - forms of activity		*Number of hours*
A-P-1	participation in projects	15
A-P-2	individual study of literature	10
A-P-3	consultations	5
A-S-1	participation in seminars	45
A-S-2	individual study of literature	30
A-S-3	consultations	15

Teaching methods / tools	
M-1	Seminars
M-2	Discussion

Teaching methods / tools	
M-3	Case study
M-4	Projects

Evaluation methods (F - progressive, P - final)		
S-1	F	Assessment based on evaluation of the given presentation and activity during discussions (seminar).
S-2	P	Written project and presentation (project)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C22a_W01 The student has knowledge in the subject of case analysis in the field of biomaterials.	MSE_1A_W10	P6S_WK	P6S_WG	C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2
Skills							
MSE_1A_C22a_U01 Studdent can perform a case study for selected Biomaterials Engineering problems.	MSE_1A_U09 MSE_1A_U12	P6S_UO P6S_UW		C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2
Social competences							
MSE_1A_C22a_K01 Student understands the need for continuous training and development in the field of case studies	MSE_1A_K05	P6S_KR	P6S_WK	C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C22a_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C22a_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C22a_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. J. Y. Wong, J. D. Bronzino, D.R. Peterson, Biomaterials Principles and Practices, CRC Press, 2013

2. R. Hudak, M. Penhaker, J. Majernik, Biomedical engineering—technical applications in medicine, InTech, 2012

3. A. Serra Ed., Advances in Bioengineering, InTechOpen, 2015

4. Aldo R. Boccaccini, Peter X. Ma, Tissue Engineering Using Ceramics and Polymers, Elsevier, 2014

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Case Studies in Medical Devices**		
Code	MSE_1A_S_C22b		
Field of specialisation			
Administering faculty	Department of Materials Technology		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives	8	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
project course	P	6	15	1,0	0,30	K	credits
seminars	S	6	45	3,0	0,70	K	credits

Leading teacher	Biedunkiewicz Anna (Anna.Biedunkiewicz@zut.edu.pl)
Other teachers	Biedunkiewicz Anna (Anna.Biedunkiewicz@zut.edu.pl), Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites

W-1	Basic knowledge in polymer, metal and ceramic materials synthesis, characterization and structure-properties relationship with the application in medical devices

Module/course unit objectives

C-1	To gain the knowledge, skills and competences in the field of various aspects of biomaterials synthesis, characterization in medical devices applications
C-2	To carry out a basic literature search based on databases and scientific literature.

Course content divided into various forms of instruction		*Number of hours*
T-P-1	Design criteria and materials for blood contacting medical devices (heart assist devices)	5
T-P-2	Design criteria for metals and ceramic used in medical devices	5
T-P-3	Nanocomposites in medical devices	5
T-S-1	Issues with biocompatibility of implants and endoprostheses. Impact of implants on life processes.	3
T-S-2	Introduction to the structure of the human body. Problems with ensuring the durability of the quality of ceramic, metallic and composite biomaterials in the environment of body fluids and in contact with human tissue.	3
T-S-3	Improving oseointegration (ceramic bioactive layers). Microporous ceramic capsules for drug carriers. Titanium nanotubes in biomaterials surface engineering.	3
T-S-4	Reconstruction of biological tissues. Design of scaffolding	3
T-S-5	Problems of joining metallic and ceramic biomaterials.	3
T-S-6	Production process of TiO2 - cause and effect relationships	6
T-S-7	Analysis and discussion of current medical device literature	15
T-S-8	Analysis and discussion of current nanocomposites literature	9

Student workload - forms of activity		*Number of hours*
A-P-1	participation in projects	15
A-P-2	individual study of literature	10
A-P-3	consultations	5
A-S-1	participation in seminars	45
A-S-2	study of literature	20
A-S-3	consultations	15
A-S-4	written reports	10

Teaching methods / tools

Teaching methods / tools	
M-1	Seminars
M-2	Discussion
M-3	Case studies
M-4	Projects

Evaluation methods (F - progressive, P - final)		
S-1	F	Assessment based on evaluation of the given presentation and activity during discussions (seminar).
S-2	P	Written project and presentation (project)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C22b_W01 The student has knowledge in the subject of case analysis in the field of medical devices	MSE_1A_W10	P6S_WK	P6S_WG	C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2
Skills							
MSE_1A_C22b_U01 Studdent can perform a case study for selected Medical Devices problems.	MSE_1A_U09 MSE_1A_U12	P6S_UO P6S_UW		C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2
Social competences							
MSE_1A_C22b_K01 Student understands the need for continuous training and development in the field of case studies	MSE_1A_K04	P6S_KR		C-1 C-2	T-P-1 T-P-2 T-P-3 T-S-1 T-S-2 T-S-3 T-S-4 T-S-5 T-S-6 T-S-7 T-S-8	M-1 M-2 M-3 M-4	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C22b_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C22b_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C22b_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading
1. J. Y. Wong, J. D. Bronzino, D.R. Peterson, Biomaterials Principles and Practices, CRC Press, 2013
2. R. Hudak, M. Penhaker, J. Majernik,, Biomedical engineering—technical applications in medicine, InTech, 2012
3. A. Serra Ed., Advances in Bioengineering, InTech Open, 2015

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Composite and Advanced Materials**		
Code	MSE_1A_S_C23		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	examination	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	6	30	4,0	0,50	K	credits
lecture	W	6	30	2,0	0,50	K	examination

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kowalczyk Krzysztof (Krzysztof.Kowalczyk@zut.edu.pl), Kwiatkowska Magdalena (Magdalena.Kwiatkowska@zut.edu.pl), Paszkiewicz Sandra (Sandra.Paszkiewicz@zut.edu.pl), Żwir Marek (Marek.Zwir@zut.edu.pl)

Prerequisites	
W-1	Fundamentals of chemistry of polymers, their synthesis and processing.
W-2	Fundamentals of mechanics of materials.

Module/course unit objectives	
C-1	To gain the knowledge, skills and competences in the field of composite and advanced materials

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Preparation of BMC-type polymer composites	5
T-L-2	Determination of mechanical properties and fracture behavior of fiber reinforced composites	5
T-L-3	Preparation and determination of electroconductivity of nano-soot based functional polymer nanocomposites	5
T-L-4	Preparation of polymer nanocomposites (melt blending, in situ)	5
T-L-5	Processing techniques used to prepare samples for measurements (injection moulding, pressing, casting); Physicochemical properties of polymer nanocomposites containing different types of nanofillers	5
T-L-6	Physical (mechanical, impact test etc.) properties of polymer nanocomposites containing different types of nanofillers	5
T-W-1	Composite materials: general principles and basic concepts	2
T-W-2	Materials for composites: fibres and matrices	4
T-W-3	Design examples: natural and man-made composites	3
T-W-4	Interfaces in composites	2
T-W-5	Fracture physics of composites	2
T-W-6	Composites based on biology	2
T-W-7	Introduction to polymer nanocomposites (historical background, definition, general information)	2
T-W-8	Properties of polymer nanocomposites containing carbon nanofillers (mechanical, electrical, thermal etc.)	5
T-W-9	Polymer nanocomposites containing natural fibers	2
T-W-10	Preparation methods and applications of polymer nanocomposites	4
T-W-11	Destructive and non-destructive methods for (nano)composites properties assessment	2

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	30

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Student workload - forms of activity		*Number of hours*
A-L-2	individual study of literature	40
A-L-3	preparation of written reports	30
A-L-4	consultations	20
A-W-1	participation in lectures	30
A-W-2	individual study of the literature	20
A-W-3	Consultations	10
A-W-4	The exam	1

Teaching methods / tools	
M-1	Lecture
M-2	Laboratory exercises

Evaluation methods (F - progressive, P - final)		
S-1	P	Exam
S-2	F	written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C23_W01 The student has the knowledge of common aspect of composite and advanced engineering materials	MSE_1A_W02 MSE_1A_W06	P6S_WG	P6S_WG	C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11	M-1 M-2	S-1 S-2
Skills							
MSE_1A_C23_U01 The student has the knowledge of common aspect of composite and advanced engineering materials	MSE_1A_U03 MSE_1A_U09	P6S_UW	P6S_UW	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_C23_K01 The student understands the importance of composite and advanced engineering materials in practical applications	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9 T-W-10 T-W-11	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C23_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C23_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C23_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading
1. Agarwal B.D., Broutman L.J., Analysis and Performance of Fiber Composites, Elsevier, 1990
2. Gibson R.F., Principles of Composite Material Mechanics, 1994
3. Chawla K.K ., Composite Materials – Science and Engineering, 1998

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Mechanics of Materials**		
Code	MSE_1A_S_C24		
Field of specialisation			
Administering faculty	Department of Materials Technology		
ECTS	2,0	*ECTS (forms)*	2,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	3	15	1,0	0,50	K	credits
lecture	W	3	15	1,0	0,50	K	credits

Leading teacher	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), Fryska Sebastian (Sebastian.Fryska@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Kiełbasa Karolina (Karolina.Kielbasa@zut.edu.pl), Kochmański Paweł (Pawel.Kochmanski@zut.edu.pl)

Prerequisites	
W-1	Approval in Mathematics, Physics of materials, Intro to MatSci/Intro to MatEng

Module/course unit objectives	
C-1	to get the basic knowledge about mechanics of materials, main mechanical parameters of materials and methods of their evaluation,
C-2	formation of the skills in mechanical properties testing

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Tensile test of metallic materials; Charpy impact strength test	5
T-L-2	Compressive test of metals and ceramic	5
T-L-3	Tensile and flexural properties of engineering polymeric materials.	5
T-W-1	Introduction to mechanics of materials; definition of stresses, strains and displacements; Models used in mechanics of materials, elasticity, plasticity, brittleness	3
T-W-2	Hooke’s low in a uniaxial tensile or compressive stress: stress-strains curves for different materials, determination of principal mechanical parameters of materials	4
T-W-3	Multiaxial stress and strain and their relationship; Mohr’s circle; generalized Hooke's law, moments of intertia	4
T-W-4	Mechanics of materials during shear, bending and torsion; impact toughness	2
T-W-5	Stress concentration; introduction to fatigue strength of materials	2

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	15
A-L-2	preparation for laboratory exercises	6
A-L-3	Preparation of reports	7
A-L-4	Consultations	2
A-W-1	participation in lectures	15
A-W-2	individual studies of the subject	8
A-W-3	preparing for tests	5
A-W-4	Consultations	2

Teaching methods / tools	
M-1	interactive lectures, presentation (e.g. power point)
M-2	group discussion

Teaching methods / tools	
M-3	reports preparation

Evaluation methods (F - progressive, P - final)		
S-1	P	written exam
S-2	F	questions
S-3	F	raports prepration

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C24_W01 Student describes selected issues concerning the mechanics of materials	MSE_1A_W05	P6S_WG P6S_WK		C-1	T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1	S-1
Skills							
MSE_1A_C24_U01 has skills in practical usage of mechanics of materials	MSE_1A_U02	P6S_UW		C-2	T-L-1 T-L-2 T-L-3	M-2 M-3	S-2 S-3
Social competences							
MSE_1A_C24_K01 Students is able to perform all task on time and cooperate and work in group.	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5	M-1 M-3	S-1 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C24_W01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C24_U01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C24_K01	*2,0*	
	3,0	Student describes selected issues at a basic level (score => 50%)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Clarence W. de Silva, Mechanics of Materials, CRC Press, 2014

2. James H. Allen III, Mechanics of Materials For Dummies, Wiley, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Management and Project Planning**		
Code	MSE_1A_S_C24aa		
Field of specialisation			
Administering faculty	RCIiTT		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives	9	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	7	15	1,0	1,00	K	credits

Leading teacher	Żebrowski Paweł (Pawel.Zebrowski@zut.edu.pl)
Other teachers	Żebrowski Paweł (Pawel.Zebrowski@zut.edu.pl)

Prerequisites

W-1	Basics of Mathematics
W-2	Engineering

Module/course unit objectives

C-1	Consolidation of knowledge related to the management in engineering.
C-2	Developing student’s ability to recognize the basic concepts of management in engineering.
C-3	Improving student’s awareness of the need for continuous education and professional development.
C-4	Project management of engineering projects in practice. Get to know and forming teams. Teams management. Workflow. Milestones. Risks and how to aviod them. Project planning and executing

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Team Management: forming teams and team building	5
T-W-2	Workflow. Milestones. Risks and how to aviod them.	5
T-W-3	Project planning and executing. Project management of engineering projects in practice.	5

Student workload - forms of activity		*Number of hours*
A-W-1	Classroom participation.	15
A-W-2	Self-study of the lecture content and literature	10
A-W-3	Consultations	5

Teaching methods / tools

M-1	Lecture

Evaluation methods (F - progressive, P - final)

S-1	F	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C24a_W01 Student has theory-based knowledge within the scope of management in engineering.	MSE_1A_W11	P6S_WK		C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Skills							

MSE_1A_C24a_U01 Student can use the acquired knowledge to solve and evaluate selected problems in the field of management in engineering.	MSE_1A_U12	P6S_UO		C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Social competences							
MSE_1A_C24a_K01 Student is aware of the need for continuous education and professional development in the field of management in engineering.	MSE_1A_K03	P6S_KO	P6S_WK		T-W-1 T-W-2 T-W-3		

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C24a_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of management in engineering.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C24a_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to solve and evaluate selected problems in the field of management in engineering.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C24a_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level in the field of management in engineering.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Paul S Chinowsky, James E Meredith, Strategic Corporate Management for Engineering, Oxford University Press, UK, 2000

2. Garold D. Oberlender, Project Management for Engineering and Construction, McGraw-Hill International Editions, 2011

3. Karl Smith, P.K. Imbrie, Teamwork and Project Management (Basic Engineering Series and Tools), 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Innovation Teams**		
Code	MSE_1A_S_C24b		
Field of specialisation			
Administering faculty	RCIiTT		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives	9	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	7	15	1,0	1,00	K	credits

Leading teacher	Żebrowski Paweł (Pawel.Zebrowski@zut.edu.pl)
Other teachers	Żebrowski Paweł (Pawel.Zebrowski@zut.edu.pl)

Prerequisites

W-1	Student knows the basics of high school mathematics

Module/course unit objectives

C-1	Consolidation of knowledge related to the innovation management.
C-2	Developing student’s ability to recognize the basic concepts of innovation management.
C-3	Improving student’s awareness of the need for continuous education and professional development.
C-4	cquiring knowledge on fundamentals of innovation team formation, work and delivering outcomes

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Product, business process, and organizational innovation. Innovation management. Innovation management tools.	5
T-W-2	Creating multi-functional development teams. Leadership for innovation; Innovation team design and roles.	5
T-W-3	Managing team interactions; Design Thinking to drive innovation; Creating innovation strategy; Measuring innovation success	5

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	15
A-W-2	Self-study of the literature	10
A-W-3	Consultations	5

Teaching methods / tools

M-1	Lecture

Evaluation methods (F - progressive, P - final)

S-1	F	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C24b_W01 Student has theory-based knowledge within the scope of innovation management.	MSE_1A_W11	P6S_WK		C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Skills							

MSE_1A_C24b_U01 Student can use the acquired knowledge to solve and evaluate selected problems in the field of innovation management.	MSE_1A_U11	P6S_UK P6S_UW		C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Social competences							
MSE_1A_C24b_K01 Student is aware of the need for continuous education and professional development in the field of innovation management.	MSE_1A_K03	P6S_KO	P6S_WK	C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C24b_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of innovation management.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C24b_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to solve and evaluate selected problems in the field of innovation management.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C24b_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level in the field of innovation management.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Scott Anthony, Build an Innovation Engine in 90 Days, Harvard Business Review, 2011

2. Roni Reiter-Palmon, Team Creativity and Innovation, 2011

3. Paul S Chinowsky, James E Meredith, Strategic Corporate Management for Engineering, Oxford University Press, 2000

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Bio-inspired Materials & Structures**		
Code	MSE_1A_S_C25		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	5	15	0,5	0,50	K	credits
lecture	W	5	15	0,5	0,50	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Bartkowiak Artur (Artur-Bartkowiak@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites

W-1	basic knowledge of biology and chemistry

Module/course unit objectives

C-1	To familiarize the student with the basic concepts of biomimetics and nature-inspired structures
C-2	Preparing and delivering a presentation on biomimetics and bio-inspired structures

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Self-cleaning and superhydrofobic surfaces: preparation and characterization	9
T-L-2	Immobilisation of active compounds by molecular inclusion and emulsification	3
T-L-3	Bioimmobilisation of enzymes and living cells in hydrogel microcapsules – materials and methods	3
T-W-1	Bioinspiration from nature: definitions and basic phenomena	2
T-W-2	Molecular design of biological and nano-materials	3
T-W-3	Bio-inspired intelligent and morphing structures	3
T-W-4	Functional surfaces in biology	2
T-W-5	Immobilisation of active compounds	2
T-W-6	Bioimmobilisation of enzymes and living cells	3

Student workload - forms of activity		*Number of hours*
A-L-1	participation in laboratory exercises	15
A-W-1	participation in lectures	15

Teaching methods / tools

M-1	lecture with presentation
M-2	laboratory exercises

Evaluation methods (F - progressive, P - final)

S-1	F	continuous evaluation
S-2	P	questions, problem solving

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							

MSE_1A_C25_W01 the student defines the basic concepts related to biomimetics and bio-inspired structures	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1 C-2	T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1 M-2	S-1 S-2
Skills							
MSE_1A_C25_U01 As a result of the conducted classes the student is able to characterize the most important aspects of biomimetics and structures inspired by nature	MSE_1A_U03	P6S_UW	P6S_UW	C-1 C-2	T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1 M-2	S-1 S-2
Social competences							
MSE_1A_C25_K01 the student is able to work in a team, is prepared to use and constantly acquire knowledge in any professional environment related to engineering of biomaterials	MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2	T-L-1 T-L-2 T-L-3 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C25_W01	*2,0*	
	3,0	Positive grade of the final test (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C25_U01	*2,0*	
	3,0	Positive evaluation of the laboratoty report.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C25_K01	*2,0*	
	3,0	Positive grade of the final test and exam (more than 55% correct answers)
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Y. Bar-Cohen, Biomimetics Biologically Inspired Technologies, CRC Taylor&Francis, New York, 2006

2. Wise D.L., Biomaterials and Bioengineering Handbook, Marcel Dekker, New York, 2000

3. Andrew J. Ruys, Biomimetic biomaterials: Structure and Applications, Woodhead Publishing Limited, 2013

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Materials for Healthcare**		
Code	MSE_1A_S_C26		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	4,0	*ECTS (forms)*	4,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	7	15	0,5	0,25	K	credits
laboratory course	L	7	30	1,5	0,25	K	credits
lecture	W	7	30	2,0	0,50	K	credits

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Baranowska Jolanta (Jolanta.Baranowska@zut.edu.pl), Figiel Paweł (Pawel.Figiel@zut.edu.pl), Kochmańska Agnieszka (Agnieszka.Kochmanska@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Zielinska Beata (Beata.Zielinska@zut.edu.pl)

Prerequisites	
W-1	Knowledge of the basic course in physics, chemistry and materials science at the elementary level

Module/course unit objectives	
C-1	The aim of the corse is to develop student's knowledge in the area of materials used in medical diagnosis, water purification from heavy metals and drugs and in overall the students will be skilled to designe materials and its performance to increase life quality.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Characterization of polymeric hydrogels: porosity, density, average molecular weight between crosslinks	2
T-A-2	Polymeric materials for healthcare – case studies: surface modification, tailoring of mechanical properties and degradation profile.	3
T-A-3	Analysis of influence of nanparticles morphology on antimicrobial performance: explanation and discussion	5
T-A-4	Analysis of failure of selected metal medical devices	5
T-L-1	Determination of size and Zeta potential of polymeric micelles.	5
T-L-2	Surface modification of biopolymers. Contact angle determination	5
T-L-3	Photocatalytic removal of drug molecules form wastewater	5
T-L-4	Magnetic separation of heavy metals from wastewater.	5
T-L-5	Antibacterial coatings for healthcare applications Composites for dental application: technology and testing	5
T-L-6	Corrosive and tribocorrosive wear of metallic biomaterials	5
T-W-1	Antimicrobial materials: Au, Cu, TiO2, ZnO – case study	3
T-W-2	Materials in medical diagnostics: overview, needs, perspectives	3
T-W-3	Biosensors and biosensing: concept, classification and case study	3
T-W-4	The human eye: anatomy and pathophysiology	3
T-W-5	Intraocular lenses: from early development to the most implanted medical device	4
T-W-6	Drug delivery in the intraocular space	2
T-W-7	Metals, metal-based composites and coatings used in healthcare;	5
T-W-8	Selected aspects of metal wear in contact with body	4
T-W-9	Participation in passing test	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	15
A-L-1	participation in laboratory exercises	30
A-L-2	preparation of lab reports	5
A-L-3	preparation for laboratory exercises	3
A-L-4	preparing for tests	5
A-L-5	Consultations	2
A-W-1	participation in lectures	30
A-W-2	self-study of the literature	13
A-W-3	preparing for tests	15
A-W-4	Consultations	2

Teaching methods / tools	
M-1	lectures
M-2	case study
M-3	laboratory work
M-4	preparation and presentation of multimedia presentations by the student during the thematic exercises
M-5	self studies

Evaluation methods (F - progressive, P - final)		
S-1	P	Written passing test
S-2	F	Continuous assessment during research conductiong
S-3	P	assessment of lab reports
S-4	F	participation in the discussion during lectures

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C26_W01 knowledge in the area of materials that can be used in healthcare applications	MSE_1A_W04	P6S_WG P6S_WK		C-1	T-W-1 T-W-5 T-W-2 T-W-6 T-W-3 T-W-7 T-W-4 T-W-9	M-1	S-1 S-4
Skills							
MSE_1A_C26_U01 abilities to design materials and evaluate its performance to increase the life quality.	MSE_1A_U07	P6S_UW	P6S_UW	C-1	T-A-1 T-L-2 T-A-2 T-L-3 T-A-3 T-L-4 T-A-4 T-L-5 T-L-1 T-L-6	M-2 M-3 M-4 M-5	S-2 S-3
Social competences							
MSE_1A_C26_K01 The student understands the importance of materials development and application in healthcare	MSE_1A_K02	P6S_KK	P6S_WK	C-1	T-A-1 T-A-2 T-A-3 T-A-4 T-L-1 T-L-2 T-L-3 T-L-4 T-L-5 T-L-6 T-W-1 T-W-2 T-W-3 T-W-4 T-W-5 T-W-6 T-W-7 T-W-8 T-W-9	M-1 M-2 M-3 M-4	S-1 S-2 S-3 S-4

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C26_W01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Skills		
MSE_1A_C26_U01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C26_K01	*2,0*	
	3,0	from 50 to 55% of percentage points
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Vijay K. Varadan, LinFeng Chen, Jining Xie, Nanomedicine Design and Applications of Magnetic Nanomaterials, Nanosensors and Nanosystems, Wiley, 2008, ISBN-13 : 978-0470033517

2. Marina A Dobrovolskaia, Scott E McNeil, Handbook of Immunological Properties of Engineered Nanomaterials, World Scientific Publishing, 2013, ISBN-13 : 978-9814390255

3. Seila Šelimović, Nanopatterning and Nanoscale Devices for Biological Applications (Devices, Circuits, and Systems), CRC Press, 2014, ISBN-13 : 978-1466586314

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Entrepreneurship for Engineers**		
Code	MSE_1A_S_C27a		
Field of specialisation			
Administering faculty	RCIiTT		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives	10	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	7	15	1,0	1,00	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	

Prerequisites	
W-1	Student knows the basics of high school mathematics.

Module/course unit objectives	
C-1	Consolidation of knowledge related to the entrepreneurship for engineers.
C-2	Developing student’s ability to recognize the basic concepts of entrepreneurship for engineers.
C-3	Improving student’s awareness of the need for continuous education and professional development.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Enerpreneurship Basics. Startups formation. Key successes and failures of young companies. Technological companies.	5
T-W-2	Procedures of forming company. Entrepreneurship Economy.	5
T-W-3	Business models. Strategy, mission and vision. Finding partners and building competitive advantages. Intellectual Property Rights.	5

Student workload - forms of activity		*Number of hours*
A-W-1	Classroom participation	15
A-W-2	Preparing for the lecture	8
A-W-3	Self-study of the literature	5
A-W-4	Consultations	2

Teaching methods / tools	
M-1	Lecture

Evaluation methods (F - progressive, P - final)		
S-1	F	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C27a_W01 Student has theory-based knowledge within the scope of entrepreneurship for engineers.	MSE_1A_W11	P6S_WK		C-1 C-2 C-3	T-W-1 T-W-2 T-W-3	M-1	S-1
Skills							
MSE_1A_C27a_U01 Student can use the acquired knowledge to recognize the basic concepts of entrepreneurship for engineers.	MSE_1A_U06	P6S_UW	P6S_UW	C-1 C-2 C-3	T-W-1 T-W-2 T-W-3	M-1	S-1
Social competences							

MSE_1A_C27a_K01 Student is aware of the need for continuous education and professional development in the field of entrepreneurship for engineers.	MSE_1A_K03	P6S_KO	P6S_WK	C-1 C-2 C-3	T-W-1 T-W-2 T-W-3	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C27a_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of entrepreneurship for engineers.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C27a_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of entrepreneurship for engineers.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C27a_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level in the field of entrepreneurship for engineers.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Uchino Kenji, Entrepreneurship for engineers, CRC Press, 2009

2. Alexander Osterwalder, Yves Pigneur, Business Model Generation, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Strategies for Startups**		
Code	MSE_1A_S_C27b		
Field of specialisation			
Administering faculty	RCIiTT		
ECTS	1,0	*ECTS (forms)*	1,0
Form of course credit	credits	*Language*	english
Electives	10	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecture	W	7	15	1,0	1,00	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Żebrowski Paweł (Pawel.Zebrowski@zut.edu.pl)

Prerequisites

W-1	Student knows the basics of high school mathematics.

Module/course unit objectives

C-1	Consolidation of knowledge related to the startups.
C-2	Developing student’s ability to recognize the basic concepts of startups.
C-3	Improving student’s awareness of the need for continuous education and professional development.
C-4	Acquiring knowledge on startup development proces and tools. Strategies to use in consecutive stages of business venture development.

Course content divided into various forms of instruction		*Number of hours*
T-W-1	Marketing strategies for startups. Analysis of the market needs, market trends and market growth projections. Industry analysis - the roles of major industry competitors.	5
T-W-2	Positioning statements. Pricing strategy. Promotion strategy. Distribution and delivery strategy. Marketing programs.	5
T-W-3	Market research techniques; Forming value proposition and business model; Identyfying Minimum Viable Product; Bootstraping techniques; Defining IPR strategy; Strategies for team management	5

Student workload - forms of activity		*Number of hours*
A-W-1	Participation in lectures	15
A-W-2	Self-study of the literature	13
A-W-3	Consultations	2

Teaching methods / tools

M-1	Lecture

Evaluation methods (F - progressive, P - final)

S-1	P	Written test

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_C27b_W01 Student has theory-based knowledge within the scope of startups.	MSE_1A_W11	P6S_WK		C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Skills							

MSE_1A_C27b_U01 Student can use the acquired knowledge to recognize the basic concepts of startups.	MSE_1A_U06	P6S_UW	P6S_UW	C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1
Social competences							
MSE_1A_C27b_K01 Student is aware of the need for continuous education and professional development in the field of startups.	MSE_1A_K03	P6S_KO	P6S_WK	C-1 C-2 C-3 C-4	T-W-1 T-W-2 T-W-3	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_C27b_W01	*2,0*	
	3,0	Student demonstrates basic knowledge of startups.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_C27b_U01	*2,0*	
	3,0	Student is able to use the acquired knowledge at a basic level to recognize the basic concepts of startups.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_C27b_K01	*2,0*	
	3,0	The student understands the need for continuous education and training at a basic level in the field of startups.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Uchino Kenji, Entrepreneurship for engineers, CRC Press, 2009

2. Steve Blank, The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, 2011

3. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 2011

4. Ash Maurya, Running Lean: Iterate from Plan A to a Plan That Works, 2011

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Biomaterials Science Project Research**		
Code	MSE_1A_S_D01a		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	9,0	*ECTS (forms)*	9,0
Form of course credit	credits	*Language*	english
Electives	11	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
laboratory course	L	7	180	9,0	1,00	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata

Prerequisites

W-1	Passing classes from semester I-VI

Module/course unit objectives

C-1	Consolidation of detailed knowledge related to the key issues of materials science and engineering.
C-2	Developing students' skills to acquire and evaluate literature data and formulate reports on this basis.
C-3	Developing students' skills in developing study results in the field of biomaterials science and engineering.
C-4	Developing of students' ability to present selected issues in the field of materials engineering.
C-5	Improving students' ability to use the acquired knowledge for critical analysis and evaluation of the functioning of technical solutions in the field of materials engineering.
C-6	Improving students' awareness of the need for continuous education and professional development.

Course content divided into various forms of instruction		*Number of hours*
T-L-1	Presentation the principles of the preparation of texts and scientific reports, reports on studies, expert opinions. Breakdown of content. Linguistic correctness. Quoting literature. Plagiarisms.	5
T-L-2	Presentation of the rules for the presentation of the progress in the diploma thesis. Principles and culture of discussing.	5
T-L-3	Conducting research, measurements, calculations related to the subject of dissertation.	85
T-L-4	Presentation by students of the progress in the research being the subject of dissertation. Discussion of the results obtained in the individual stages of dissertation.	40
T-L-5	Discussion of materials engineering issues covered by the program content and proposed for the dissertation defense. Examples of practical application of selected solutions.	45

Student workload - forms of activity		*Number of hours*
A-L-1	participation in classes	180
A-L-2	preparing a presentation	40
A-L-3	preparation for discussion on issues covered by program content	40
A-L-4	Consultations	10

Teaching methods / tools

M-1	Seminar
M-2	Didactic discussion

Evaluation methods (F - progressive, P - final)

S-1	F	Credit based on the presented presentations

Evaluation methods (F - progressive, P - final)		
S-2	F	Credit based on the student's continuous activity assessment in class discussions
S-3	P	Final credit based on the average of the positive marks from the presentation and participation in the discussions.

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_D01a_W01 Student has a well-established detailed knowledge related to the key issues of materails engineering.	MSE_1A_W04	P6S_WG P6S_WK		C-1 C-2 C-3 C-4 C-5 C-6		M-1 M-2	S-1 S-2 S-3
Skills							
MSE_1A_D01a_U01 Student has the ability to acquire and critically evaluate data from the literature and formulate reports.	MSE_1A_U09	P6S_UW		C-1 C-2 C-3 C-4 C-5 C-6		M-1 M-2	S-1 S-2 S-3
MSE_1A_D01a_U02 Student is able to develop the results of research in the field of materials engineering.	MSE_1A_U09	P6S_UW		C-1 C-2 C-3 C-4 C-5 C-6		M-1 M-2	S-1 S-2 S-3
MSE_1A_D01a_U03 Student is able to prepare and present the development of research results in the field of materials engineering.	MSE_1A_U12	P6S_UO		C-1 C-2 C-3 C-4 C-5 C-6		M-1 M-2	S-1 S-2 S-3
Social competences							
MSE_1A_D01a_K01 Student is aware of the need for continuous education and professional development.	MSE_1A_K01	P6S_KK	P6S_WK	C-1 C-2 C-3 C-4 C-5 C-6	T-L-1 T-L-2 T-L-3 T-L-4 T-L-5	M-1 M-2	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_D01a_W01	*2,0*	
	3,0	Student is able to explain key operations and processes in the field of materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_D01a_U01	*2,0*	
	3,0	Student is able to acquire and critically evaluate information from literature and prepare a report at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_D01a_U02	*2,0*	
	3,0	Student is able to prepare a simple development of the results of research in the field of materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_D01a_U03	*2,0*	
	3,0	Student can prepare and present an oral presentation on issues in materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	

Other social competences		
MSE_1A_D01a_K01	*2,0*	
	3,0	Student is able to understand key operations and processes in the field of materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading
1. Wise D.L., Biomaterials and Bioengineering Handbook, Marcel Dekker, New York, 2000
2. Ratner B.D., Biomaterials Science, Elsevier, New York, 2004

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Materials Engineering Project Research**		
Code	MSE_1A_S_D01b		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	9,0	*ECTS (forms)*	9,0
Form of course credit	credits	*Language*	english
Electives	11	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
project course	P	7	180	9,0	1,00	K	credits

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Ignaczak Wojciech (Wojciech.Ignaczak@zut.edu.pl), Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata

Prerequisites

W-1	Passing classes from semester I-VI

Module/course unit objectives

C-1	Forming the ability to review and select available publications related to the subject of dissertation and their elaboration in the form of an oral presentation
C-2	Preparation for the development of research results and their reliable interpretation

Course content divided into various forms of instruction		*Number of hours*
T-P-1	Discussion of the subject of engineering dissertation in the area of materials science and engineering	15
T-P-2	Getting to know the exterimental methods applied in the dissertation and checking the correctness of their implementation	40
T-P-3	Getting to know the test stand and checking its operation	30
T-P-4	Conducting preliminary tests	95

Student workload - forms of activity		*Number of hours*
A-P-1	Participation in laboratory classes	180
A-P-2	studying of literature	15
A-P-3	Performing research and analysis of the obtained results	65
A-P-4	consultations	10

Teaching methods / tools

M-1	Continuous work with a student in the laboratory
M-2	Substantive discussions regarding the correctness of the tests carried out and the interpretation of results

Evaluation methods (F - progressive, P - final)

S-1	P	Written report on the implementation of the assumed research and discussion of results
S-2	F	Periodic evaluation of the course of the implementation of the assumed research as part of the engineering diploma thesis
S-3	F	Assessment of independence and activity in conducting research

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods

Knowledge							
MSE_1A_D01b_W01 knowledge in the field of materials science and engineering uses it to control the engineering process and interpretation of results	MSE_1A_W05	P6S_WG P6S_WK		C-1 C-2	T-P-1 T-P-3 T-P-2 T-P-4	M-1 M-2	S-1 S-2 S-3
Skills							
MSE_1A_D01b_U01 Ability to - repare oral presentations on the basis of collected literature on the subject of engineering thesis and deepening his knowledge in the process of self-education - build a research stand, use analytical methods to control operations and unit processes related to the thesis of engineering thesis, develop and interpret the obtained results	MSE_1A_U01 MSE_1A_U03 MSE_1A_U07 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1	T-P-1	M-2	S-1
Social competences							
MSE_1A_D01b_K01 Student is aware of the need for continuous education and professional development.	MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2		M-1 M-2	S-1 S-2 S-3

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_D01b_W01	*2,0*	
	3,0	Student is able to explain key operations and processes in the field of materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_D01b_U01	*2,0*	
	3,0	Student is able to acquire and critically evaluate information from literature and prepare a report at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_D01b_K01	*2,0*	
	3,0	Student is able to understand key operations and processes in the field of materials engineering.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. C. N. R. Rao, Achim Müller, Anthony K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley, 2014, ISBN-13 : 978-3527306862

2. Jin Zhang, Zhong-lin Wang, Jun Liu, Self-Assembled Nanostructures, Springer, 2002, ISBN-13 : 978-0306472992

3. Zhifeng Ren, Yucheng Lan, Qinyong Zhang, Advanced Thermoelectrics, Materials, Contacts, Devices, and Systems, CRC Press, 2017, ISBN 9781498765725

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Dissertation Research in MatSci**		
Code	MSE_1A_S_D02a		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	15,0	*ECTS (forms)*	15,0
Form of course credit	credits	*Language*	english
Electives	12	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
	PD	7	0	15,0	1,00	K	credits

Leading teacher	El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata (Beata.Zielinska@zut.edu.pl)

Prerequisites

W-1	knowledge and skills acquired throughout the course of education

Module/course unit objectives

C-1	Acquire the basic skills in analysis and interpretation of obtained results in the field of materials science
C-2	Acquire the skills in data collection and interpretation

Course content divided into various forms of instruction		*Number of hours*
T-PD-1	Presentation of recommendations regarding the layout of the content of engineering dissertation.	0
T-PD-2	Gathering and analyzing by the student the literature containing the current state of knowledge about the subject of the work.	0
T-PD-3	Formulating the basic point of the dissertation by the student and indicating the issues that should be solved in dissertation.	0
T-PD-4	Depending on the specificity of the work, the student performs a measurement / design or computational part of the work.	0
T-PD-5	The student's analysis of the results of the work received. Student's final conclusions.	0
T-PD-6	The student's performance of the graphic design of the dissertation, a summary of the tables and other annexes to the dissertation.	0
T-PD-7	Editing the dissertation by the student.	0
T-PD-8	Preparation of oral presentation for the defense	0

Student workload - forms of activity		*Number of hours*
A-PD-1	Collecting and analyzing literature that is the subject of dissertation	60
A-PD-2	Performing measurements / design or calculations.	260
A-PD-3	Carrying out the analysis of the received work results.	75
A-PD-4	Writting the dissertation	45
A-PD-5	Preparing for the defense	20

Teaching methods / tools

M-1	Consultations with the thesis supervisor

Evaluation methods (F - progressive, P - final)

S-1	P	Consultations with the thesis supervisor

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
MSE_1A_D02a_W01 Student is able to explain key issues related to manufacturing of various engineering materials and structure-property relationship	MSE_1A_W02	P6S_WG	P6S_WG	C-1 C-2	T-PD-1 T-PD-5 T-PD-2 T-PD-6 T-PD-3 T-PD-7 T-PD-4 T-PD-8	M-1	S-1
Skills							
MSE_1A_D02a_U01 Student can acquire and critically evaluate information from literature, databases and other sources	MSE_1A_U07 MSE_1A_U08	P6S_UK P6S_UW	P6S_UW	C-1 C-2	T-PD-1 T-PD-5 T-PD-2 T-PD-6 T-PD-3 T-PD-7 T-PD-4 T-PD-8	M-1	S-1
Social competences							
MSE_1A_D02a_K01 Student understands the need for continuous education and professional development	MSE_1A_K04 MSE_1A_K05	P6S_KR	P6S_WK	C-1 C-2	T-PD-1 T-PD-5 T-PD-2 T-PD-6 T-PD-3 T-PD-7 T-PD-4 T-PD-8	M-1	S-1

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_D02a_W01	*2,0*	
	3,0	Student is able to explain key components for various materials manufacturing and describe structure-properties relationship at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_D02a_U01	*2,0*	
	3,0	Student can acquire information from the literature at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_D02a_K01	*2,0*	
	3,0	is able to critically assess the knowledge and content received
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Literature dealing with subject of research - papers, monographs, books, patents, 2011

1. Literature dealing with subject of research - papers, monographs, books, patents, 2020

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Dissertation Research in MatEng**		
Code	MSE_1A_S_D02b		
Field of specialisation			
Administering faculty	Department of Nanomaterials Physicochemistry		
ECTS	15,0	*ECTS (forms)*	15,0
Form of course credit	credits	*Language*	english
Electives	12	*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
	PD	7	0	15,0	1,00	K	credits

Leading teacher	Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl)
Other teachers	Chen Xuecheng (Xuecheng.Chen@zut.edu.pl), El Fray Mirosława (Miroslawa.ElFray@zut.edu.pl), Michalkiewicz Beata (Beata.Michalkiewicz@zut.edu.pl), Mijowska Ewa (Ewa.Borowiak-Palen@zut.edu.pl), Piegat Agnieszka (Agnieszka.Piegat@zut.edu.pl), Wróbel Rafał (Rafal.Wrobel@zut.edu.pl), Zielinska Beata

Prerequisites	
W-1	knowledge and skills acquired throughout the course of education

Module/course unit objectives	
C-1	Acquire the basic skills in analysis and interpretation of obtained results in the field of material engineering.
C-2	Acquire the skills in data collection and interpretation
C-3	Acquire the skills in the preparation of dissertation based on the subject literature research and obtained experimental results

Course content divided into various forms of instruction		*Number of hours*
T-PD-1	Conducting laboratory research	0
T-PD-2	Gathering and analyzing by the student the literature containing the current state of knowledge about the subject of the work.	0
T-PD-3	Analysis and interpretation of obtained results	0
T-PD-4	Preparation of oral presentation for the defense	0

Student workload - forms of activity		*Number of hours*
A-PD-1	Participating in laboratory experiments	260
A-PD-2	Analysis and interpretation of obtained results	50
A-PD-3	Writing the dissertation	100
A-PD-4	Preparing for the defense	40

Teaching methods / tools	
M-1	Individual discussion dealing with the form of degree's thesis and progress in editing of thesis
M-2	Individual, discussions dealing with the literature analysis, conduction of studies and results work out

Evaluation methods (F - progressive, P - final)		
S-1	F	Cyclic evaluation of realization of studies and progress in editing of degree's thesis
S-2	F	Evaluation of activity and individuality
S-3	P	Valuation of degree's thesis

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							

MSE_1A_D02b_W01 Student is able to explain key components for manufacturing various engineering materials and structure-property relationship	MSE_1A_W03	P6S_WG P6S_WK	P6S_WG	C-1 C-2 C-3		M-1 M-2	S-1 S-2 S-3
Skills							
MSE_1A_D02b_U01 Basing on subject literature research and results of conducted studies is able to prepare documentation dealing with problems of engineering thesis in English while cooperating with other specialists	MSE_1A_U01	P6S_UW	P6S_UW	C-2 C-3	T-PD-2 T-PD-4 T-PD-3	M-2	S-1
MSE_1A_D02b_U02 Ability to designe and build test station, use analytical methods to control unit operation and processes, work out and interpretate the obtained results, can use statisticall methods to plan experiment	MSE_1A_U07 MSE_1A_U08 MSE_1A_U09	P6S_UK P6S_UW	P6S_UW	C-1 C-2 C-3	T-PD-1 T-PD-4 T-PD-3	M-1 M-2	S-1 S-2 S-3
Social competences							
MSE_1A_D02b_K01 Understands the effect of reliable realization of self-work tasks on the final results of group work, can determine the order of actions importance, is able to share knowledge and discuss	MSE_1A_K01 MSE_1A_K02	P6S_KK	P6S_WK	C-1 C-2 C-3	T-PD-1 T-PD-3 T-PD-2 T-PD-4	M-1 M-2	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_D02b_W01	*2,0*	
	3,0	Student is able to explain key components for various materials manufacturing and describe structure-properties relationship at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_D02b_U01	*2,0*	
	3,0	Student can acquire information from the literature at a basic level.
	3,5	
	4,0	
	4,5	
	5,0	
MSE_1A_D02b_U02	*2,0*	
	3,0	Guided by the tutor, he builds a research stand, uses the indicated analytical methods to control operations and unit processes related to the subject of the engineering diploma thesis
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_D02b_K01	*2,0*	
	3,0	is able to critically assess the knowledge and content received
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. Literature dealing with subject of research - papers, monographs, books, patents, 2020

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Practicum (Internship)**		
Code	MSE_1A_S_P01		
Field of specialisation			
Administering faculty	Department of Polymer and Biomaterials Science		
ECTS	6,0	*ECTS (forms)*	6,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
	PR	6	**180**	6,0	1,00	K	credits

Leading teacher	Żwir Marek (Marek.Zwir@zut.edu.pl)
Other teachers	

Prerequisites	
W-1	Materials science, properties and testing
W-2	Materials engineering
W-3	Materials processing and identification in industry

Module/course unit objectives	
C-1	Acquire knowledge, skills and competencies related to: 1. raw materials and materials used in the processes of materials and other industries 2. the course of materials production and processing, food, energy and other processes in which transformations of materials take place 2. methods of management and organization of production 3. automation and process control methods used in practice 4. practical course of designing products, equipment and technologies, and the procedures for their implementation and optimization 5. use of raw materials, energy and the reduction and management of waste in industrial processes 6. become familiar with the current safety regulations for the used raw materials, materials and apparatus (devices)

Course content divided into various forms of instruction		*Number of hours*
T-PR-1	Acquaintance with technological processes in the industry or in industries using raw materials with the required specific material characteristics, or in institutions that maintain design studios and laboratories that carry out procedures for the supervision, identification and analysis, certification and approval of materials with the required specific characteristics. Acquisition of practical methods of selection, analysis and characterization of raw materials and materials in technological processes, or in the course of research and development work, or the organization and implementation of procedures for control, certification and approval of the quality of raw materials and engineering materials. Preparation to work in the materials engineering and related industries, design offices, scientific and research institutions, institutions of technical supervision, control, standardization and certification.	6

Student workload - forms of activity		*Number of hours*
A-PR-1	Participation in practicum (internship)	178
A-PR-2	Contact with supervisor	2

Teaching methods / tools	
M-1	Professional Practice

Evaluation methods (F - progressive, P - final)		
S-1	F	Evaluation of the class report
S-2	P	Assessment in the form of oral credit by the person responsible for the course

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods

Knowledge							
MSE_1A_P01_W01 He/she knows raw materials and materials used in the processes of materials industry and other industries; he/she understands the course of materials production and processing, food, energy and other processes in which structural transformations of materials take place; he/she knows the ways of production management and organization; he/she knows the automatics used in practice and the ways of controlling processes; he/she understands the course of designing products, devices and technologies, and the procedures of their implementation and optimization; he/she knows the ways of using raw materials, energy and limiting the creation and management of waste in industrial processes; he/she knows the valid safety regulations concerning the raw materials, materials and apparatus used.	MSE_1A_W02 MSE_1A_W04 MSE_1A_W07 MSE_1A_W09 MSE_1A_W11	P6S_WG P6S_WK	P6S_WG	C-1	T-PR-1	M-1	S-1 S-2
Skills							
MSE_1A_P01_U01 Students can effectively use the acquired knowledge of technological processes in the field of material chemistry, material science methods and techniques for testing and characterizing materials.	MSE_1A_U01 MSE_1A_U06 MSE_1A_U07 MSE_1A_U08 MSE_1A_U09	P6S_UK P6S_UW	P6S_UW	C-1	T-PR-1	M-1	S-1 S-2
Social competences							
MSE_1A_P01_K01 The student is able to work in a team, being aware of the influence of own actions on the results of work of the whole team and ability to communicate with team members.	MSE_1A_K02 MSE_1A_K04	P6S_KK P6S_KR	P6S_WK	C-1	T-PR-1	M-1	S-1 S-2

Outcomes	Grade	Evaluation criterion
Knowledge		
MSE_1A_P01_W01	*2,0*	
	3,0	Student sufficiently demonstrated in the documentation of the practice and in the oral colloquium after its completion has knowledge necessary to perform the tasks assigned during the practice in terms of knowledge of materials and raw materials and the ways of their characterization, the course of technological processes and their control, materials management and energy and safety regulations.
	3,5	
	4,0	
	4,5	
	5,0	
Skills		
MSE_1A_P01_U01	*2,0*	
	3,0	The student is able to sufficiently apply the acquired knowledge of technological processes in materials engineering and manufacturing techniques (e.g.: the selection of materials, methods and techniques to control the process and products, etc.).
	3,5	
	4,0	
	4,5	
	5,0	
Other social competences		
MSE_1A_P01_K01	*2,0*	
	3,0	The student is able to work in a team, being aware of the influence of his own actions on the work of the whole team.
	3,5	
	4,0	
	4,5	
	5,0	

Required reading

1. 2011, Brak

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Chemistry**		
Code	MSE_1A_S_U01		
Field of specialisation			
Administering faculty	Department of Inorganic and Analytical Chemistry		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	30	0,0	0,50	K	credits
lecture	W	1	15	0,0	0,50	K	credits

Leading teacher	Rozwadowski Zbigniew (Zbigniew.Rozwadowski@zut.edu.pl)
Other teachers	Bosacka Monika (Monika.Bosacka@zut.edu.pl), Filipek Elżbieta (Elzbieta.Filipek@zut.edu.pl), Kołodziej Beata (Beata.Kolodziej@zut.edu.pl), Rozwadowski Zbigniew (Zbigniew.Rozwadowski@zut.edu.pl), Tomaszewicz Elżbieta

Prerequisites	
W-1	The basic knowledge of fundamental chemistry (inorganic and organic)

Module/course unit objectives	
C-1	Knowledge and understandig the basic concepts and laws of chemistry

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Nomenclature and formulas of inorganic compounds	4
T-A-2	Chemical reactions and chemical equations	4
T-A-3	Oxidation – reduction reactions	4
T-A-4	Calculations based on chemical equations. Yield of reactions	4
T-A-5	Concentrations of solutions	4
T-A-6	The stoichiometry of reactions in a solution	4
T-A-7	The electronic structure of elements and the periodic table	2
T-A-8	The equilibrium law for a chemical reaction	2
T-A-9	Acid – base equilibrium in aqueous solutions. The pH concept. Equilibria involving weak molecular acids and bases	2
T-W-1	Introduction to chemistry. Nomenclature of inorganic compounds. Atoms, molecules and moles	2
T-W-2	Fundamental chemical laws	2
T-W-3	Chemical reactions	2
T-W-4	The periodic table and some properties of the elements	2
T-W-5	Chemical bonding: general concepts	2
T-W-6	Reaction rate, equilibrium, equilibrium constants, catalyts.	1
T-W-7	Electrolytes, pH concepts	1
T-W-8	An introduction to organic chemistry	3

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	Preaparation for classes	30
A-A-3	Individual problem solving	27
A-A-4	Consultations	3
A-W-1	Participation in lectures	15

Student workload - forms of activity		*Number of hours*
A-W-2	Preparation for final test	15
A-W-3	Individual literature studies	28
A-W-4	Consultations	2

Teaching methods / tools	
M-1	Lecture
M-2	Discussion

Evaluation methods (F - progressive, P - final)		
S-1	P	Final test
S-2	P	Continuous assessment: test (exercises)

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
Social competences							

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
Other social competences		

Required reading

1. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Pearson Education Limited, Edinburgh, UK, 2001, ISBN 0582-31080-6

2. P. W. Atkins, M. J. Clugston, M. J. Frazer, R. A. Y. Jones, Chemistry. Principles and applications, Longman Group UK Limited, New York, 1990, ISBN 0582-35590-7

3. J. E. Brady, General Chemistry. Principles and Structure, John Wiley & Sons, New York, 1990, ISBN 0-471-62131-5

4. W. W. Porterfield, Inorganic Chemistry. A Unified Approach, Academic Press Inc., London, 1993, ISBN 0-12-562981-8

5. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, Pearson Education Inc., New Jersey, 2004, ISBN 0-13-120198-0

6. G. C. Hill, J. S. Holman, Chemistry in Context, Thomson Nelson and Sons Ltd, Edinburgh, UK, 1989, ISBN 0-17-438401-7

7. John E. McMurry, Organic Chemistry, New York, 2012, (8th Edition)

8. G. Marc Laudon, Organic Chemistry, Oxford, New York, 2002, (4th edition)

Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Field of study	Materials Science and Engineering		
Mode of study	stationary	*Level*	first cycle
Graduate's qualification	inżynier		
Fields of science	engineering and technology		
Disciplines of science	materials engineering (100%)		
Educational profile	general academic		
Module			
Course unit	**Intro to Biology**		
Code	MSE_1A_S_U02		
Field of specialisation			
Administering faculty	Department of Chemical and Process Engineering		
ECTS	0,0	*ECTS (forms)*	0,0
Form of course credit	credits	*Language*	english
Electives		*Elective group*	

Form of instruction	*Cod*	*Semester*	*Hours*	*ECTS*	*Weight*	*Realization*	*Credit*
lecturing course	A	1	30	0,0	0,50	K	credits
lecture	W	1	15	0,0	0,50	K	credits

Leading teacher	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl)
Other teachers	Markowska-Szczupak Agata (Agata.Markowska@zut.edu.pl), Sobolewski Piotr (psobolewski@zut.edu.pl)

Prerequisites

W-1	knowledge at the basic of natural science, biology or related subjects

Module/course unit objectives

C-1	To introduce students to basic study of structure, function and interactions of living organisms including cell theory, genetics and evolution and ecology.

Course content divided into various forms of instruction		*Number of hours*
T-A-1	Design and panning biological experiments.Statistical Methods in Biology	10
T-A-2	Calculation of concentrations and dilutions cell bology	5
T-A-3	The kinetics of growth	5
T-A-4	Examination of plant biodiversity.	5
T-A-5	Introduction to microbial culture methods: microscopy.	5
T-W-1	History of Biology. Definition. Division of Biological Sciences.	2
T-W-2	An introduction to Classification and taxonomy.	2
T-W-3	Biological Law/ Central dogma of biology	3
T-W-4	Cellular assemblies - From single cell to multi-cellular organisms	3
T-W-5	An introduction to genetics, heredity and evolution.	3
T-W-6	Environmental biosafety, bioresources, biodiversity.	2

Student workload - forms of activity		*Number of hours*
A-A-1	Participation in recitations	30
A-A-2	studing literature	10
A-A-3	preparing of written reports	10
A-A-4	consultations	10
A-W-1	participating in lectures	15
A-W-2	individual consultations	1
A-W-3	prepartion for tests	3

Teaching methods / tools

M-1	power point presentation lectures
M-2	disscusion during the lectures
M-3	recitation class

Teaching methods / tools	
M-4	private study , tutorials, learning materials

Evaluation methods (F - progressive, P - final)		
S-1	F	multiple choice test
S-2	F	evaluation of reports

Designed learning outcomes	Reference to the learning outcomes designed for the fields of study	Reference to Learning Outcomes for qualifications at PQF 6, 7 or 8	Reference to learning outcomes for qualifications at level 6 or 7 that enable acquiring engineering competences	Course objectives	Course content	Teaching methods	Evaluation methods
Knowledge							
Skills							
Social competences							

Outcomes	Grade	Evaluation criterion
Knowledge		
Skills		
Other social competences		

Required reading
1. Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Campbell Biology in Focus, Global Edition, Pearson, 2016
2. Karen Hopkin, Alexander D Johnson, David Morgan, Martin Raff, Keith Roberts,, Essential Cell Biology, W. W. Norton & Company;, 2011, 5
3. Kristi Lew, Taxonomy: The Classification of Biological Organisms (Heredity and Genetics), Enslow Publishing, 2018

Supplementary reading
1. R. Dawkins, The Selfish Gene: 30th Anniversary edition, OUP Oxford, Oxfors, 2006, 1
2. Michael T. Madigan , Kelly S. Bender Daniel H. Buckley, W. Matthew Sattley, Brock Biology of Microorganisms, Pearson, 2019, 14
3. Biology Journals, 2010, Frontiers in Biology, PLoS Biology,Journal of Theoretical Biology,Biological Reviews