

FACULTY OF CHEMISTRY					
SUBJECT CARD					
Name of subject in Polish	Inżynieria nanomaszyn				
Name of subject in English	Engineering of Nanomachines				
Main field of study (if applicable):	Chemical and Process Engineering				
Specialization (if applicable):	Chemical nanoengineering				
Profile:	academic				
Level and form of studies:	2st level full-time				
Kind of subject:	obligatory				
Subject code	ICC025004				
Group of courses	NO				
	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				30
Form of crediting	Crediting with grade				Presentation
For group of courses mark (X) final course					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1				1
*PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES					
1. <i>Elemental mathematics: Analysis I and II, algebra</i>					
2. <i>Elemental physics: Physics I and II</i>					
3. <i>Elemental chemistry: General chemistry, organic chemistry</i>					
4. <i>The English language</i>					
SUBJECT OBJECTIVES					
C1 Application of thermodynamics and organic chemistry to nanoengineering.					
C2 Understanding structure and dynamics of molecules elements of molecular motors.					
C3 Gives ability to select Artificial Molecular Machines for particular application.					
SUBJECT EDUCATIONAL EFFECTS					
Relating to knowledge:					
<i>A person who passed the subject</i>					
<i>PEK_W01 – knows fundamentals of structure and thermodynamics of molecules</i>					
<i>PEK_W02 – knows fundamentals of the description of artificial molecular machines</i>					
<i>PEK_W03– knows fundamentals of the functioning molecular machines</i>					
Relating to skills:					
<i>A person who passed the subject</i>					
<i>PEK_U01 – can solve elementary structural and thermodynamics problems related to Artificial Molecular Machines</i>					
<i>PEK_U02– can select MM according to required application.</i>					
<i>PEK_U03– can find a design for particular molecular level job</i>					
Relating to social competences:					
<i>A person who passed the subject</i>					

PEK_K01 – possesses ability of combining information from disparate fields of science (mathematics, physics, chemistry, mechanics) to arrive at coherent conclusions

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec 1	<i>Elements of molecular structures related to Molecular Machines (MM)</i>	2
Lec 2	<i>Laws of thermodynamics. Entropy, free energy and free enthalpy.</i>	2
Lec 3	<i>Potential energy surfaces, External potential and MM interactions</i>	2
Lec 4	<i>Thermal fluctuations. Ratchet and Brownian machines.</i>	2
Lec 5	<i>Rotaxanes. Molecular shuttles.</i>	2
Lec 6	<i>Molecular switches.</i>	2
Lec 7	<i>The power sources for artificial molecular-level machines.</i>	2
Lec 8	<i>Applications of MM</i>	1
Total hours		15

Form of classes: seminars		Number of hours
S1	<i>Mechanically interlocked molecules. Mechanical bonds versus covalent bond</i>	2
S2	<i>Molecular pump</i>	2
S3	<i>From molecular shuttle to switches</i>	2
S4	<i>Unidirectional transport</i>	2
S5	<i>Motors and car race</i>	2
S6	<i>Nano-molecular machines powered by light</i>	2
S7	<i>Nano-molecular machines powered by chemistry</i>	2
S8	<i>Surface nanomachines</i>	1
Total hours		15

TEACHING TOOLS USED

N1	<i>Lecture: multimedial presentation</i>
N3	<i>Seminar: a set of problems, presented to the students for individual elaboration and discussed during the seminar</i>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation F – forming (during semester), C – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
<i>F1</i>	<i>PEK_U01, PEK_U02, PEK_U03</i>	<i>Presentation</i>
<i>F2</i>	<i>PEK_W01, PEK_W02, PEK_W03</i>	<i>Exam</i>

$$P = 0,5(F1+F2)$$

Condition of passing: P=50% or more

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Peter Atkins, Julio De Paula, "Atkins' Physical Chemistry", Eighth edition, Oxford University Press, Oxford 2006
- [2] Collection of scientific journal papers

SECONDARY LITERATURE:

- [1] NIST WebBook - Chemistry

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Prof. Szczepan Roszak, Szczepan.roszak@pwr.edu.pl