

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka 1.2**

Name in English: **Physics 1.2**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **FZP001058**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	120	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	4	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	4.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		1
Lec6		2
Lec7		2
Lec8		2
Lec9		3
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Classes		Number of hours
CI1		2
CI2		2
CI3		2
CI4		2
CI5		2
CI6		2
CI7		2
CI8		2
CI9		2
CI10		2
CI11		2
CI12		2
CI13		2
CI14		2
CI15		2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
 N2.
 N3.
 N4.
 N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W17;	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U22 PEK_K03 - PEK_K07	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics 1.2
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02 PEK_W03	K1MTR_W01	C1.1		N1,N5,N7
PEK_W04, PEK_W05, PEK_W06, PEK_W07, PEK_W08, PEK_W09, PEK_W10, PEK_W11, PEK_W12, PEK_W13, PEK_W14	K1MTR_W02	C1.1, C1.2		N1,N5,N7
PEK_W15, PEK_W16, PEK_W17	K1MTR_W02, K1MTR_W12	C1.3		N1,N5,N7
PEK_U01, PEK_U02, PEK_U03, PEK_U04, PEK_U05, PEK_U06, PEK_U07, PEK_U08, PEK_U09, PEK_U10, PEK_U11, PEK_U12, PEK_U13, PEK_U14, PEK_U15, PEK_U16, PEK_U17, PEK_U18, PEK_U19,	K1MTR_U01, K1MTR_U02, K1MTR_U24	C2.1, C2.2, C2.3		N2,N3,N4,N5,N6,N7
PEK_U20, PEK_U21, PEK_U22	K1MTR_U12, K1MTR_U24	C2.1		N2,N3,N4,N5,N6,N7
PEK_K01 PEK_K08	K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	C3		N1,N7

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka 2.8**

Name in English: **Physics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **FZP003002**

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)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	2.0		2.0		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		3
Lec2		3
Lec3		2
Lec4		2
Lec5		3
Lec6		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED	
N1.	
N2.	
N3.	
N4.	
N5.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W14	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)	
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Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U11, PEK_K01 - PEK_K08	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02 PEK_W03, PEK_W04, PEK_W05, PEK_W06, PEK_W07, PEK_W08	K1MTR_W01, K1MTR_W02, K1MTR_W13, K1MTR_W25	C1		N1, N6, N7
PEK_W01, PEK_W09, PEK_W10, PEK_W11 PEK_W12, PEK_W13, PEK_W14	K1MTR_W02, K1MTR_W07, K1MTR_W14, K1MTR_W25	C2		N1, N6, N7
PEK_U01 - PEK_U11	K1MTR_U01, K1MTR_U24, K1MTR_U25	C3 – C5		N1-N7
PEK_K01 - PEK_K08	K1MTR_K02, K1MTR_K11	C5		N1-N7

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: OCHRONA WŁASNOŚCI**

Name in English:

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **HMH100035BK**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
		Total hours: 2

TEACHING TOOLS USED

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	wg kart opracowanych przez SNH	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W05			
PEK_K01	K1MTR_K09			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: AUTOPREZENTACJA**

Name in English:

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **HMH100035BK**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
		Total hours: 2

TEACHING TOOLS USED

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	wg kart opracowanych przez SNH	
P =		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
<u>SECONDARY LITERATURE</u>

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U25			
PEK_K01	K1MTR_K15			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: FILOZOFICZNO - ETYCZNY**

Name in English:

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **HMH100035BK**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
		Total hours: 2

TEACHING TOOLS USED

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	wg kart opracowanych przez SNH	
P =		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
<u>SECONDARY LITERATURE</u>

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W25			
PEK_K01	K1MTR_K02, K1MTR_K07			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE**

Name in English: **Block of Foreign Languages**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **JZL100400BK**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
Group of courses					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Foreign Languages
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K1MTR_U06	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.
PEK_K1	K1MTR_K01	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Algebra z geometrią analityczną**

Name in English: **Algebra and Analytic Geometry**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MAP001140**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.5	1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		4
Lec2		4
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		3
Lec10		2
Lec11		2
Lec12		3
		Total hours: 30
Form of classes – Classes		Number of hours
CI1		2
CI2		2
CI3		2
CI4		3
CI5		2
CI6		3
CI7		1
		Total hours: 15

TEACHING TOOLS USED	
N1.	
N2.	
N3.	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K02	

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Algebra and Analytic Geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C4		N1, N3, N4
PEK_W02	K1MTR_W01	C2, C4		N1, N3, N4
PEK_W03	K1MTR_W01	C3, C4		N1, N3, N4
PEK_U01	K1MTR_U01	C1, C4		N2, N3, N4
PEK_U02	K1MTR_U01	C2, C4		N2, N3, N4
PEK_U03	K1MTR_U01	C3, C4		N2, N3, N4
PEK_K01-PEK_K02	K1MTR_K01	C1-C4		N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna 1.1 A**

Name in English: **Mathematical Analysis 1A**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MAP001142**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	5	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points for direct teacher-student contact (BK) classes	3.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is recommended that the knowledge of mathematics is equivalent to secondary school certificate at the advanced level.

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		3
Lec5		4
Lec6		3
Lec7		2
Lec8		3
Lec9		2
Lec10		3
Lec11		4
		Total hours: 30
Form of classes – Classes		Number of hours
CI1		2
CI2		4
CI3		5
CI4		2
CI5		4
CI6		3
CI7		4
CI8		4
CI9		2
		Total hours: 30

TEACHING TOOLS USED

N1.
N2.
N3.
N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W3	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U04 PEK_K01-PEK_K02	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Mathematical Analysis 1A AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C4		N1, N3, N4
PEK_W02	K1MTR_W01	C2, C4		N1, N3, N4
PEK_W03	K1MTR_W01	C3, C4		N1, N3, N4
PEK_U01	K1MTR_U01	C1, C4		N2, N3, N4

PEK_U02	K1MTR_U01	C2, C4		N2 ,N3, N4
PEK_U03	K1MTR_U01	C2, C4		N2, N3, N4
PEK_U04	K1MTR_U01	C3, C4		N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna 2.1 A**

Name in English: **Mathematical Analysis 2.1 A**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MAP001156**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	120	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	4	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points for direct teacher-student contact (BK) classes	3.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		3
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		3
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		4
Lec13		2
		Total hours: 30
Form of classes – Classes		Number of hours
CI1		5
CI2		4
CI3		3
CI4		4
CI5		8
CI6		4
CI7		2
		Total hours: 30

TEACHING TOOLS USED	
N1.	
N2.	
N3. tutorials	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01-PEK_W3	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U04	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Mathematical Analysis 2.1 A AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C4		N1, N3, N4
PEK_W02	K1MTR_W01	C2, C4		N1, N3, N4
PEK_W03	K1MTR_W01	C3, C4		N1, N3, N4
PEK_U01	K1MTR_U01	C1, C4		N2, N3, N4
PEK_U02	K1MTR_U01	C2, C4		N2, N3, N4
PEK_U03	K1MTR_U01	C2, C4		N2, N3, N4
PEK_U04	K1MTR_U01	C3, C4		N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**

Name in English: **Ordinary Differential Equations**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MAP003062**

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)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.0	1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		1
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Classes		Number of hours
CI1		1
CI2		2
CI3		2
CI4		2
CI5		2
CI6		2
CI7		2
CI8		2
		Total hours: 15

TEACHING TOOLS USED	
N1.	
N2.	
N3. tutorials	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-U03 PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ordinary Differential Equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C2		N1, N2, N3, N4
PEK_W02	K1MTR_W01	C3		N1, N2, N3, N4
PEK_W03	K1MTR_W01	C4		N1, N2, N3, N4
PEK_U01	K1MTR_U01	C1, C2		N1, N2, N3, N4
PEK_U02	K1MTR_U01	C3		N1, N2, N3, N4
PEK_U03	K1MTR_U01	C4		N1, N2, N3, N4
PEK_K01	K1MTR_K01	C1 - C4		N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**

Name in English: **Chemistry**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD031001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of chemistry at the high school level
2. Knowledge of mathematics at the high school level
3. Knowledge of physics at the high school level

SUBJECT OBJECTIVES

- C1. To familiarize students with the basic general chemistry issues in the field of study, especially, the atom and molecule structure, crystallography.
- C2. To familiarize students with the kinetics of chemical reactions and factors which have influence on the rate and the direction of chemical reaction
- C3. To familiarize students with the chemistry and electrochemistry of metals including the chemical and electrochemical corrosion.
- C4. To familiarize students with the essential elements of organic chemistry, the division of organic compounds and polymer chemistry.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has the knowledge in the field of the basic chemistry, especially, in the subject of crystallography and physicochemical properties of inorganic and organic materials, including the relationship between their properties and structure, from the point of view of the widely understood engineering materials.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts and laws of the chemistry	2
Lec2	The atomic structure, the periodic table	2
Lec3	The molecule structure	2
Lec4	States of matter and their properties	2
Lec5	The elements of crystallography	2
Lec6	Chemical reactions and kinetics	2
Lec7	Chemical equilibrium	2
Lec8	The chemistry of solutions	2
Lec9	Electrochemistry	2
Lec10	Chemistry of metals	2
Lec11	Corrosion of metals	2
Lec12	Chemistry of non-metals	2
Lec13	Introduction to organic chemistry	2
Lec14	Elements of polymer chemistry	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of computer slides
- N2. tutorials
- N3. problem discussion
- N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Discussion Final test
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] I. Barycka, K. Skudlarski, Podstawy chemii, Oficyna Wydawnicza Politechniki Wrocławskiej , 2001.

[2] Praca zbiorowa pod redakcją Jacka Banasia i Wojciecha Stolarskiego, Chemia dla inżynierów, AGH, Kraków 2008.

SECONDARY LITERATURE

[1] L. Pauling, P. Pauling, Chemia, WNT 1997.

[2] F. A. Otton, G. Wilkinson, P.L. Gaus, Chemia nieorganiczna, WNT 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Chemistry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07	C1-C4	Wy1-Wy14	N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy i układy elektroniczne**

Name in English: **Electronic Components and Circuits**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD032001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED	
N1.	
N2. tutorials	
N3.	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic Components and Circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W14, K1MTR_W29	C1-C2		N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy informatyki**

Name in English: **Fundamentals of Computer Science**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD032101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

- N1.
- N2.
- N3. tutorials
- N4.
- N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Computer Science
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
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PEK_W01 (wiedza)	K1MTR_W19	C1		N1 - N4
PEK_U01 (umiejętności)	K1MTR_U19	C2		N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy i układy elektroniczne**

Name in English: **Electronic Components and Circuits**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD033001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
Lab6		3
Lab7		3
Lab8		3
Lab9		3
Lab10		3
		Total hours: 30

TEACHING TOOLS USED		
N1.		
N2. tutorials		
N3.		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic Components and Circuits
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U32	C1-C3		N1, N2, N3
PEK_K01	K1MTR_K03	C4-C5		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praktyka programowania w języku C**

Name in English: **The Practice of Programming in C**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD033101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
Lab6		3
Lab7		3
Lab8		3
Lab9		3
Lab10		3
		Total hours: 30

TEACHING TOOLS USED	
N1.	
N2. tutorials	
N3.	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The Practice of Programming in C
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19	C1		N2 - N4
PEK_K01	K1MTR_K03, K1MTR_K04	C1		N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy techniki mikroprocesorowej**

Name in English: **Principles of microprocessor technology**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD034001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		1
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - self studies and preparation for examination
- N3. problem exercises
- N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
F2	PEK_W02	
P = F1+F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02	
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Principles of microprocessor technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W16	C1, C2		N1, N2, N4
PEK_W02	K1MTR_W16	C1, C2		N1, N2, N4
PEK_U01	K1MTR_U16	C3		N3
PEK_U02	K1MTR_U16	C3		N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do sieci komputerowych**

Name in English: **Introduction to Computer Networks**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD034103**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED
N1. N2. tutorials N3. self study - preparation for laboratory class N4. N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W1, PEK_W2	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)
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Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U1, PEK_U2	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to Computer Networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W20	C1		N1,N3,N4
PEK_W02	K1MTR_W20	C1		N1 - N5
PEK_U01	K1MTR_U20	C2		N2 - N5
PEK_U02	K1MTR_U20	C2		N2 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów elektronicznych**

Name in English: **Fundamentals of Electronic Design**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD035001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 16

TEACHING TOOLS USED	
N1.	
N2.	
N3. tutorials	
N4.	
N5.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Fundamentals of Electronic Design AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics	
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Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza)	K1MTR_W31	C1		N1 - N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Teodor Gotszalk email: teodor.gotszalk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie optoelektroniki**

Name in English: **Applications of optoelectronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD035002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Znajomość podstaw fizyki (w tym optyki geometrycznej) oraz podstaw fizyki ciała stałego
2. Completion of Fundamentals of electrical engineering course
3. Completion of Electronics Elements and Devices course

SUBJECT OBJECTIVES

- C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber
- C2. Students become acquainted with the structure, parameters and conditions of optoelectronic components

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has ordered in terms of theoretical knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components telecommunications track and knows areas of photonic systems application in particular in the automotive, energy and microsystems.

II. Relating to skills:

PEK_U01 - Student can use optical fiber systems and simple elements known in engineering practice

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction do optoelectronics	1
Lec2	The basics of optical phenomena in semiconductors	2
Lec3	Optical fiber technique	3
Lec4	Ligth sources	2
Lec5	Photodetectors	2
Lec6	Basics of the solar cells	1
Lec7	Areas of application of optoelectronic devices	3
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Attenuation of a multisegment optical fiber transmission system measurement	2
Lab2	Study of the attenuation of optical fibers	2
Lab3	Testing of optical polarizer	2
Lab4	Investigation of spectrum characteristics of light sources	2
Lab5	Investigation of matching efficiency of optical connectors in different transmission optical windows	2
Lab6	Machine Vision for manufacturing quality assurance	2
Lab7	Optical microscope and interferometry measurements for 2D/3D	2
Lab8	Measurement of surface scattering and photometric light characteristics \	2
Lab9	Industrial laser technologies	2
Lab10	Metods of laser beam measurement and process monitoring	2
Lab11	Panels and solar cells	2
Lab12	Optical fiber sensors	2
Lab13	Optotelecommunication track	2
Lab14	Optical fiber connection technology (welding of fiber optics, measurement of the geometry of the optical fiber)	2

Lab15	Semiconductor lighting systems	2
		Total hours: 30

TEACHING TOOLS USED		
<p>N1. Traditional lecture with presentations and discussion N2. Self work - independent studies and preparing for the test N3. tutorials N4. self study - preparation for laboratory class N5. A brief test at the beginning of the laboratory activities</p>		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test, discussion
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	brief tests, discussion, reports after exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE		
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PRIMARY LITERATURE

- [1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
- [2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
- [3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
- [4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
- [5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
- [6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001

SECONDARY LITERATURE

- [1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
- [2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
- [3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
- [4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
- [5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
- [6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applications of optoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W30	C1, C2	Lec1-Lec7	N1-N3
PEK_U01	K1MTR_U33	C2	Lab1-Lab15	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory i akulatory**

Name in English: **Sensors and actuators**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD035101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None.

SUBJECT OBJECTIVES

C1. Various methods of actuation and detection in microscale will be presented.

C2. To familiarize oneself with basic properties of micromechanic sensors

C3. Review of chosen micromachines which integrate sensors and actuators will be shown.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Organization of knowledge in the fields of micromechanic sensors and actuators.

II. Relating to skills:

PEK_U01 - Is able to use selected methods and instruments to measure basic parameters of micromechanic sensors (acceleration, pressure and optical) and actuators (electrostatic and pneumatic) to be applied in mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Review of chosen methods of actuation and sensing utilized with MEMS	3
Lec2	Introduction to fundamental mechanics of microstructures, bending, tensing in various micromechanic structures.	2
Lec3	Piezoresistive pressure sensor – principle of operation, construction.	2
Lec4	Piezoresistive pressure sensor – parameters, conditioning of electric signal, examples of realisations	2
Lec5	Acceleration sensors, gyroscopes – principles of operation, construction, parameters and examples of realisations.	2
Lec6	Micromachines as devices with various sensors and actuators.	2
Lec7	Final colloquium	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Piezoresistive pressure sensor	3
Lab2	Barometric altitude meter.	3
Lab3	XYZ MEMS accelerometer.	3
Lab4	E-compass.	3
Lab5	Pneumatic actuation in microscale.	3
Lab6	Capacitive MEMS pressure sensors	3
Lab7	Thermoconductive flow meter.	3
Lab8	Fluid flow in microscale.	3
Lab9	Micromechanic valves.	3
Lab10	Reserve term.	3
		Total hours: 30

TEACHING TOOLS USED

- N1. laboratory experiment
- N2. self study - preparation for laboratory class
- N3. report preparation
- N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Final colloquium.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Reports.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lecture materials.

SECONDARY LITERATURE

- 1.M. Bao, Analysis and Design Principles of MEMS Devices, Elsevier 2005
2. Data sheets of discised sensors and actuators.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors and actuators
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N4
PEK_U01	K1MTR_U15	C1, C2	Lec1-Lec6, Lab1-Lab9	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów logicznych**

Name in English: **Logic Circuits Modeling**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD035102**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED
N1.
N2.
N3.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logic Circuits Modeling
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W16, K1MTR_W19	C1		N1, N2
PEK_U01	K1MTR_U22	C1, C2, C3		N1, N3
PEK_U02	K1MTR_U19	C1, C2, C3		N1, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podzespoły elektroniczne**

Name in English: **Electronic Components**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD035201**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED		
N1.		
N2.		
N3.		
N4. tutorials		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Electronic Components AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W01	C1		N1, N2, N4
PEK_U01	K1MTR_MM_U01	C2		N2 - N4

SUBJECT SUPERVISOR		
Prof. dr hab. inż. Andrzej Dziejczak email: andrzej.dziejczak@pwr.edu.pl		

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy (MEMS)**

Name in English: **Microsystems (MEMS)**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD036001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED	
N1.	
N2.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems (MEMS)
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza)	K1MTR_W15	C1		N1
PEK_U01 (umiejętności)	K1MTR_U15	C1, C2		N1, N2
PEK_K01 (kompetencje)	K1MTR_K03	C2		N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów elektronicznych**

Name in English: **Fundamentals of Electronic Design**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCD036002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project

Number of hours

Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		2
Proj9		2
Proj10		2
Proj11		2
Proj12		2
Proj13		2
Proj14		2
Proj15		2
		Total hours: 30

TEACHING TOOLS USED	
N1.	
N2. tutorials	
N3.	
N4.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01, PEK_K02	
P = F1		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electronic Design
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 (umiejętności)	K1MTR_U32, K1MTR_U34	C1, C2		N1 - N4
PEK_K01 (kompetencje)	K1MTR_K04	C2		N1, N2, N4
PEK_K02	K1MTR_K03	C2		N2, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie numeryczne konstrukcji mikroelektronicznych**

Name in English: **Numerical prototyping of microelectronic structures**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics and physics
2. Basic knowledge on numerical methods
3. Basic computer skills

SUBJECT OBJECTIVES

- C1. Familiarize students with the basics of numerical prototyping of microelectronic structures
- C2. Gaining skills for computer software usage concerning numerical modelling based on finite element method as FlexPDE, Ansys
- C3. Getting familiarize with typical problems connected with numerical prototyping including simulation, optimization and design of experiments, etc.
- C4. Consolidation of skills for self and team work based on supplied instruction materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is capable of selecting appropriate engineering tools for computer aided engineering and use such software as FlexPDE, Ansys, SolidWorks in order to solve typical problems of numerical prototyping in micro-engineering

PEK_U02 - Is able to analyze and interpret the achieved results using appropriate experiment design methods, optimization, numerical modelling and simulation as well as analysis and data interpretation methods

PEK_U03 - Can properly identify and prioritize the dilemmas connected with the interdisciplinary problems.

III. Relating to social competences:

PEK_K01 - Can properly prioritize tasks in order to finalize a specified work.

PEK_K02 - Can properly identify and solve the dilemmas associated with a profession practice.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical modelling and software tools as FlexPDE and Ansys	2
Lab2	Introduction to numerical modelling of micromechanical structures	2
Lab3	Analysis and optimization methods of micromechanical structures in FEM software tools as FlexPDE and Ansys	2
Lab4	Analysis of strain and stress distribution	2
Lab5	Analysis of heat dissipation and temperature distribution	2
Lab6	Analysis of electrostatic field distribution	2
Lab7	Extraction of basic electrical parameters as resistance.	2
Lab8	Analysis of laminar and turbulent flows	2
Lab9	Analysis of stress and strain distribution for bimaterial structures	2
Lab10	Numerical prototyping with parametric models	2
Lab11	Analysis of a coupled electro-thermo-mechanical field	2
Lab12	Methods of thermo-electric phenomena modelling	2
Lab13	Optimization of a micromechanical pressure sensor	2
Lab14	Individual projects - problem selection and analysis	2
Lab15	Individual project - assessment	2
		Total hours: 30

TEACHING TOOLS USED

- N1. case study
- N2. self study - preparation for laboratory class
- N3. tutorials
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02	tests and laboratory reports
P = (F1+...F12)/12		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Zienkiewicz O.C., Taylor R.L., "The Finite Element Method: Volumes 1-3", Butterworth-Heinemann, London, 2000
2. Thompson E., "Introduction to the Finite Element Method", John Wiley and Sons, 2005
3. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006

SECONDARY LITERATURE

1. Montgomery D., "Design and Analysis of Experiments", John Wiley and Sons, 2005
2. William D., Callister Jr., "Materials Science and Engineering an Introduction", John Wiley and Sons, 2007
3. Montgomery D., Runger G., "Applied Statistics and Probability for Engineers", John Wiley and Sons, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical prototyping of microelectronic structures
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U22	C1-C3	La1-La13	N1-N3
PEK_K01	K1MTR_K04, K1MTR_K05	C4	La14-La15	N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody przetwarzania sygnałów**

Name in English: **Methods of Signal Processing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036103**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED
N1.
N2.
N3. tutorials
N4.
N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
F2	PEK_W01	
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	
F2	PEK_U01, PEK_K01	
F3	PEK_U01, PEK_K01	
F4	PEK_U01, PEK_K01	
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of Signal Processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1		N1,N3,N4,N5
PEK_U01	K1MTR_U01	C2		N2, N5
PEK_K01	K1MTR_K06	C3		N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w medycynie**

Name in English: **Microsystems in medicine**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036104**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No requirements

SUBJECT OBJECTIVES

C1. Familiarize students with the design and operation of selected microsystems and possibilities of their application in biology and medicine, as well as devices and apparatus microsystems for specific tasks

C2. Learn how to work with the selected microsystems for specific tasks in biology/medicine.

C3. Fusing ability to work independently and in a team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has a general knowledge of the structure and operation of the selected microsystem devices, and possibilities of their application in biology and medicine, he knows some devices and microsystem instruments for specific tasks in biology / medicine.

II. Relating to skills:

PEK_U01 - Student can work with selected microsystem devices and instruments designed for specific tasks in biology / medicine.

III. Relating to social competences:

PEK_K01 - Student is able to work independently and in laboratory group by adopting different roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Microtechnologies in molecular genetics (DNA, chip, PCR)	2
Lec2	Cardiac assist devices, artificial heart	2
Lec3	Artificial sense organs: electronic hearing, bionic eye	4
Lec4	Invasive and non-invasive microsystems for measuring blood pressure	2
Lec5	Miniature robots for colonoscopy and endoscopy	1
Lec6	Tonometer, sensors and microsystems for medical diagnosis	1
Lec7	Lab-on-a-chips and biochips	1
Lec8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Flow and mixing of the liquids in the microchannels	3
Lab2	Dosing of micro- and nanovolumes with conductivity detection	3
Lab3	Droplet microfluidic system	3
Lab4	Microcytometer to study biological cells	3
Lab5	DNA analyser with fluorometric detection	3
		Total hours: 15

TEACHING TOOLS USED

- N1. Traditional lecture with the use of transparencies and slides
- N2. Laboratory: short tests beginning laboratory
- N3. Tutorials
- N4. Self study - preparation for laboratory exercises
- N5. Self study – independent studies and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Short tests beginning laboratory
F2	PEK_K01	Laboratory reports and participation in discussions
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bibliography

SECONDARY LITERATURE

Scientific magazines and materials from lectures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in medicine
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1	Lec1-Lec7	N1, N3, N5
PEK_U01	K1MTR_U15	C2, C3	La1-La5	N2, N3, N4

PEK_K01	K1MTR_K03	C3	La1-La5	N3, N4, N5
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SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w motoryzacji**

Name in English: **Automotive microsystems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036105**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic physics (mechanics, electricity and magnetism)
2. Completion of the course Fundamentals of Electrical Engineering
3. Completion of the course Components and Electronic Systems

SUBJECT OBJECTIVES

- C1. To familiarize students with the basic microsystems (sensor systems), used in automotive engineering
- C2. Introduction to the structure, working conditions and measurement of the main parameters used in the above-mentioned sensor systems
- C3. Strengthening teamwork skills

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has the basic knowledge of the operation, construction, properties and characteristics of sensor systems and sensors (including intelligent and microsensors) used in vehicles.

II. Relating to skills:

PEK_U01 - Able to select and use the appropriate sensors to measure various physical quantities, investigate the fundamental characteristics of the sensors and use them to control systems and control vehicles.

III. Relating to social competences:

PEK_K01 - Able to interact and work in a group (a group of laboratory), taking part in a variety of roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sensor systems for automotive - historical overview	2
Lec2	Fuel supply systems - tasks, principles of operation, sensors	2
Lec3	Ignition systems - tasks, principles of operation, sensors	2
Lec4	Combustion control systems of air-fuel mixture	2
Lec5	Microsystems for active and passive safety	3
Lec6	Microsystems for navigation and driver information	2
Lec7	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Lambda sensor for stoichiometric mixture	3
Lab2	Sensors: throttle position, absolute pressure (MAP), oil pressure, fuel level	3
Lab3	Sensors for the position and speed of the crankshaft	3
Lab4	Accelerometers	3
Lab5	Additional term	3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. report preparation
- N3. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	quiz, a report from the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Marek J. „Sensors for Automotive Technology”, Wiley-VCH, Darmstadt 2003
 [2] Herner A. „Elektronika w samochodzie”, WKŁ Warszawa 2001
 [3] Gajek A., Juda Z., Czujniki, WKŁ Warszawa 2008,

SECONDARY LITERATURE

- [1] „Czujniki w pojazdach samochodowych”, Informator techniczny f-my Bosch, 2002
 [2] „Mikroelektronika w pojazdach”, Informator techniczny f-my Bosch, 2002
 [3] „Układy bezpieczeństwa i komfortu jazdy”, Informator techniczny f-my Bosch, 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automotive microsystems
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2	Lec1 - Lec6	N1

PEK_U01	K1MTR_U15	C1, C2	Lab1 - Lab5	N2, N3
PEK_K01	K1MTR_K03	C3	Lab1 - Lab5	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fotonika**

Name in English: **Photonics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036201**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of Physics (including geometric optics) and fundamentals of the physics of solids
2. Successful completion of the course: Fundamentals of electrical engineering, Electronics Elements and Devices, Applications of the optoelectronics

SUBJECT OBJECTIVES

- C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber, structure, parameters and conditions of opto-electronic components supply
- C2. To familiarize with the semiconductor detectors and sources of light, their design and working conditions
- C3. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has ordered and supported in theory, knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components and systems for application areas as well as student knows telecommunications optical track in particular in the automotive, energy and microsystems

II. Relating to skills:

PEK_U01 - Student can use known methods and mathematical models as well computer simulations for the analysis and performance evaluation of optoelectronic components and simple optical fiber systems, student can correctly use the selected methods and facilities to enable the measurement of the basic parameters of elements and integrated optoelectronic. Student can develop documentation for implementation of engineering tasks and prepare a text containing an overview of the results of the implementation of this task

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Optical phenomena in semiconductors	2
Lec2	Materials for optoelectronics	2
Lec3	Manufacturing technology of optoelectronic structures	2
Lec4	Light sources	2
Lec5	Advanced methods of detection and processing of light energy	2
Lec6	Displays	2
Lec7	Optoelectronics in technique	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introductory training	3
Lab2	Colour theory	3
Lab3	Light sources - LED, LD diodes	3
Lab4	Light radiation detectors	3
Lab5	Solar cells I	3
Lab6	Solar cells II	3
Lab7	Optrods	3
Lab8	Optical fiber track	3
Lab9	Lighting panels	3
Lab10	Supplementary term	3
		Total hours: 30

TEACHING TOOLS USED

- N1. Traditional lecture with presentations and discussion
- N2. Laboratory: a short, 10-minute test at the beginning of the exercises,
- N3. Self work - preparing for the lab exercises
- N4. Self work - independent studies and preparation for the seminar on
- N5. tutorials, consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	discussions, test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test at the beginning of the exercises, laboratory reports, evaluation class implementation exercises

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
- [2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
- [3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
- [4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
- [5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
- [6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001,

SECONDARY LITERATURE

- [1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
- [2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
- [3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
- [4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
- [5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
- [6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,
- [7] K. Booth, S. Hill, Optoelektronika, WKŁ, Warszawa 2001,
- [8] R. Bacewicz, Optyka ciała stałego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Photonics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W02	C1, C2	Lec1-Lec8	N1-N5
PEK_U01	K1MTR_MM_U02	C1-C3	Lab1-Lab10	N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikro- i nanoelektronika**

Name in English: **Micro- and Nanoelectronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD036202**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics.
2. Basic knowledge of mathematics.
3. Basic knowledge of chemistry.

SUBJECT OBJECTIVES

- C1. To familiarize students with the techniques of modern production systems of micro-and nano-
- C2. To familiarize students with the properties of components made using the techniques of micro-and nano-
- C3. To familiarize students with the current state of technology and development trends of micro-and nano-

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student has structured and theoretically founded knowledge of the materials, technology, construction and selected electrical parameters and stability of modern elements and components in electronic circuits and mechatronic systems.

PEK_W02 - The student knows and understands the basic processes involved in the manufacture of micro-devices and nano applied in mechatronics. Versed in the current state of technology and development trends of micro-and nano-electronics.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, development trends of modern semiconductor technology, a review of the fundamental processes of micro-and nanotechnology. Preparation of substrates (doped silicon, strained silicon, SiGe, SOI technology and SON), silicon epitaxy	2
Lec2	Thermal oxidation of silicon, the production of layers of dielectric and polysilicon LPCVD technique, dielectrics with high and small k, a porous ULK materials	2
Lec3	Advanced techniques for micro-and nanolithography (photolithography, electronolithography, rentgenolithography, ionolithography, interference lithographs, scanning probe lithography)	2
Lec4	Doping layers: diffusion and ion implantation, annealing (RTA)	2
Lec5	Cleaning of substrates, wet and dry etching processes of layers and structures of MEMS and NEMS	2
Lec6	Preparation of metallic contacts and connections (silicides, Al, Cu), thin-film materials used as diffusion barriers and etching stop layer	2
Lec7	Properties of individual nanoparticles: carbon nanotubes, nanodiament, graphene. Application in the new devices	2
Lec8	Fundamentals of thin and thick film technology.	2
Lec9	Principles of design thick film components.	2
Lec10	High temperature thick films - materials, processes, properties, application.	2
Lec11	Polymer thick films - materials, processes, properties, applications.	2
Lec12	MCM (Multichip Module).	2
Lec13	Technology LTCC (Low Temperature Cofired Ceramics) - materials, processes, properties.	2
Lec14	The use of LTCC ceramics in microelectronics.	2
Lec15	Technology development trends of micro-nano.	2
		Total hours: 30

TEACHING TOOLS USED

- N1. multimedia presentation
- N2. tutorials
- N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. T. Norio, Nanotechnology: Integrated Processing Systems for Ultra-Precision and Ultra-Fine Products, OUP, England, 2000
2. S. Dimitrijević, Understanding Semiconductor Devices OUP, USA, 2000
3. Ch. P. Poole, F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003
4. L.J.Maissel, R.Glang, Handbook of Thin Film Technology, Mc Graw Hill Book Comp., New York London, 1988
5. W.Menz, Microsystem Technology, 1999, Albert-Ludwigs University Freiburg, Germany
6. R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE

Magazines Sensors and Actuators, Vacuum, Conference Proceedings (COE, ELTE, IMAPS Poland Chapter, Ceramic Microsystems).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Micro- and Nanoelectronics** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W01	C1-C3	Lec1-Lec15	N1, N2, N3
PEK_W02	K1MTR_MM_W03	C1-C3	Lec1-Lec15	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**

Name in English: **Diploma seminar**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS credit no greater than it is due to the resolution of the Council of the Faculty

SUBJECT OBJECTIVES

C1. The student's self presentation skills qualification from the scope of the knowledge, skills and social competence

C2. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can present their own skills with a range of knowledge, skills and social competences typical for the direction of Mechatronics

III. Relating to social competences:

PEK_K01 - Student is able to think and act in a way that is creative and enterprising, he can interact and work in a group

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction	1
Sem2	Information about diploma work and diploma exam - requirements	1
Sem3	Overview and scope of the topics diploma works foreseen and the rules for creating the correct technical and scientific texts	4
Sem4	Multimedia presentations, CV (expanded version), discussion	4
Sem5	Discussion of the issues concerning diploma exam, comments	8
Sem6	Multimedia presentations of the diploma works, discussion	6
Sem7	Presentation and preparations for the diploma exam	4
Sem8	Summary of coursework and grading	2
		Total hours: 30

TEACHING TOOLS USED

- N1. Presentation of selected issues relating to the thesis and discussion
- N2. Preparing a multimedia presentation on the task issues - self work
- N3. Independent study and preparation for diploma thesis final exam - self work
- N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	The ability to discuss the issues raised in the discussion, activity in the course classes

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- 1) Rules of studies at Wrocław University of Technology
- 2) Publications from the scope of the thesis carried out
- 3) Lecture materials

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_, K1MTR_, K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_MM_W05, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31	C1, C2	Sem3-Sem7	N1, N2, N4
PEK_K01	K1MTR_K03	C2	Sem2-Sem7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca dyplomowa**

Name in English: **Diploma thesis**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				360	
Form of crediting				Examination	
Group of courses					
Number of ECTS points				12	
including number of ECTS points for practical (P) classes				12	
including number of ECTS points for direct teacher-student contact (BK) classes				12.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS deficit no greater than it is due to the resolution of the Faculty Council

SUBJECT OBJECTIVES

C1. Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to studiowanego the direction of Mechatronics

C2. Writing by a student "thesis" (as work) and to present an oral presentation concerning the issues of the scope of the study Mechatronics, on the basis of the information from the literature and the results of their own work

C3. Persisting the ability to work independently and in a team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can create technical texts ("thesis") and multimedia presentations from the scope of the issues towards Mechatronics

III. Relating to social competences:

PEK_K01 - Student can work independently and interact in a group, taking different roles

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Collecting the literature of the subject and to become acquainted with it	0
Proj2	Own work - critical assessment and interpretation of laboratory results	0
Proj3	Writing a thesis as works	0
		Total hours: 0

TEACHING TOOLS USED

- N1. Presentation of selected issues relating to the thesis and discussion
- N2. Own work - study of literature from the scope of the topic of the thesis and research work
- N3. Own work - writing technical and scientific text controlled by the promoter
- N4. Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Work in a semester, the deliver of thesis as works
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Specialist subject literature agreed with the promoter

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_, K1MTR__, K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U19, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31	C2	Proj2, Proj3	N1, N3, N4
PEK_K01	K1MTR_K03, K1MTR_K10	C3	Proj1, Proj2, Proj3	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Ryszard Korbutowicz email: ryszard.korbutowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Laboratorium mikro- i nanoelektroniki**

Name in English: **Laboratory on micro- and nanoelectronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037201**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics
2. Basic knowledge of chemistry

SUBJECT OBJECTIVES

- C1. Introducing students with the fabrication techniques of modern microelectronics devices
- C2. Introducing students with the properties of the elements fabricated using -techniques of the micro- and nanoelectronics
- C3. Introducing students with the organization and operation of modern microelectronic laboratories

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Students can design a manufacturing process used to manufacture electronic components including selected commercial and economic criteria, using appropriate methods, techniques, tools and materials. Apply principles of occupational health and safety, and knows the rules of working in a laboratory environment and industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The organization and operation of modern semiconductor laboratory	3
Lab2	The use of CVD technology (PECVD techniques, ICPCVD, RIE) in microelectronics	3
Lab3	Technological equipment for thick film and LTCC technology	3
Lab4	Fabrication of the microelectronic circuits using thick-film technology	3
Lab5	Fabrication of the microelectronic circuits using LTCC technology	3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
 N2. self study - preparation for laboratory class
 N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	small exam laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1) L. Golonka, K. Malecha, "Ceramic microsystems", Printpap, Łódź, 2011

SECONDARY LITERATURE

1) L. Golonka, "Technology and applications of low temperature cofired ceramic (LTCC) based sensors and microsystems", Bulletin of the Polish Academy of Sciences, Technical Science, vol. 54, no. 2, 2006, 221-231

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laboratory on micro- and nanoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U03	C1-C3	La1-La5	N1

SUBJECT SUPERVISOR

dr hab. inż. Karol Malecha email: karol.malecha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**

Name in English: **Numerical methods**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037202**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics
2. Basic knowledge on software engineering
3. Basic knowledge on computer skills

SUBJECT OBJECTIVES

- C1. Familiarize students with numerical methods and algorithms used in engineering
- C2. Familiarize students with pros and cons of numerical methods and techniques
- C3. Hands-on learning the scripting Python language
- C4. Consolidation of skills for self and team work based on supplied teaching materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has the basic, structured and theoretically founded knowledge in the field of numerical methods applied in engineering. Range of the contained knowledge covers such problems as: error analysis, numerical differentiation and integration, solving linear and nonlinear equations and set of equations, numerical interpolation and approximation, single and multi-criteria optimization along with design of experiments

PEK_W02 - Contains the basic knowledge on numerical modelling of continuum and discrete simulation of physical phenomena in macro, micro and meso scale.

II. Relating to skills:

PEK_U01 - Is capable of selecting appropriate engineering methods, software tools and numerical algorithms in order to solve typical problems concerning numerical prototyping in engineering.

PEK_U02 - Is able to interpret the achieved results and use appropriate methods of experimental data validation

PEK_U03 - Can properly prioritize tasks in order to finalize a specified work concerning numerical prototyping in engineering

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical methods, Python scripping language and Modelus software	2
Lab2	Numerical differentiation and integration methods	2
Lab3	Linear and nonlinear equations	2
Lab4	Linear and nonlinear set of equations	2
Lab5	Interpolation, approximation and extrapolation methods	2
Lab6	Numerical methods of solving partial differential equations	2
Lab7	Design of experiments methods and data analysis	2
Lab8	Individual project assessment	1
		Total hours: 15

TEACHING TOOLS USED

N1. case study

N2. self study - preparation for laboratory class

N3. tutorials

N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	tests
F2	PEK_U01 - PEK_U03	laboratory reports
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Janowski WE., „Matematyka” tom I i II, PWN, 1968
2. Volk W., „Statystyka stosowana dla inżynierów”, WNT, 1973
3. Feynmann R.P.; „Feynmana wykłady z fizyki” tom I i II, PWN, 1968

SECONDARY LITERATURE

1. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006
2. Montgomery D., “Design and Analysis of Experiments”, John Wiley and Sons, 2005
3. Pang T., “ An Introduction to Computational Physics”, Cambridge University Press, 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W04	C1-C3	La1-La7	N1-N3
PEK_U01	K1MTR_MM_U04	C1-C3	La1-La7	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Montaż zespołów elektronicznych i fotonicznych**

Name in English: **Packaging of Electronic and Photonics Systems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037203**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1
Lec2		2
Lec3		2
Lec4		1
Lec5		2
Lec6		2
Lec7		2
Lec8		1
Lec9		1
Lec10		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		3
Lab3		3
Lab4		3
Lab5		3
Lab6		1
		Total hours: 15

TEACHING TOOLS USED
N1.
N2.
N3. tutorials
N4.
N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W02, PEK_U01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Packaging of Electronic and Photonics Systems
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W18	C1		N1, N3, N4
PEK_W02	K1MTR_W18	C2		N2, N3, N5
PEK_U01	K1MTR_U18	C1,C2,C3		N1-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Felba tel.: 713531053 email: jan.felba@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia peryferyjne systemów komputerowych**

Name in English: **Peripheral Devices in Computer Systems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCD037204**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1
Lec2		3
Lec3		4
Lec4		4
Lec5		2
Lec6		2
Lec7		7
Lec8		7
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		6
Lab2		6
Lab3		6
Lab4		6
Lab5		6
		Total hours: 30

TEACHING TOOLS USED	
N1.	
N2.	
N3.	
N4.	
N5.	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)	

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_K01	
P = Ocena uśredniona (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Peripheral Devices in Computer Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W02, K1MTR_MM_W06	C1, C2		N1 - N3
PEK_U01	K1MTR_MM_U02	C1, C2		N4, N6
PEK_K01	K1MTR_K03	C1, C2		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska**

Name in English: **Engineering Graphics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM031001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses			X		
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		4
Lec4		2
Lec5		2
Lec6		2
Lec7		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2.
- N3.
- N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02	
F3	PEK_U03	
P = 0.3*F1+0.5*F2+0.2*F3		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Engineering Graphics AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W06	C1, C2		N1
PEK_U01	K1MTR_U05	C1		N1, N3, N4
PEK_U02, PEK_U03	K1MTR_U05, K1MTR_U09, K1MTR_U29	C2, C3		N2,N3,N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wojciech Wieleba tel.: 71 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy zarządzania**

Name in English: **Management Essentials**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM031006**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No initial prerequisites are required

SUBJECT OBJECTIVES

- C1. Acquiring knowledge about basic trends and management concepts
- C2. Acquiring knowledge about the nature and mechanisms of an organization
- C3. Acquiring knowledge about the regularity and management tools, as well as the analysis of management problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student is able to characterize different trends occurring in the evolution of organization and management theory, and to describe the most important concepts of both traditional and modern management

PEK_W02 - The student is able to characterize basic mechanisms of organization, to distinguish between types of organizational structures, to list components of the organization and its environment

PEK_W03 - The student is able to describe how to implement various functions in the organization and management style

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Management - its essence and meaning	2
Lec2	Evolution of the organization and management theory	2
Lec3	Organization as a management object in the surroundings	2
Lec4	Aims and functions of the management	2
Lec5	Organizational structure - conditions and evolution trends	2
Lec6	Essence of managerial work (management styles, management skills), human resources management	3
Lec7	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management Essentials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W04, K1MTR_W28	C1-C3	Lec1-Lec7	N1

SUBJECT SUPERVISOR

dr inż. Joanna Gąbka tel.: 41-84 email: joanna.gabka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**

Name in English: **Information Technology**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM031007**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. none

SUBJECT OBJECTIVES

- C1. The harmonization of terminology in the field of information technology and to present the origins, history and current state of development of computer science.
- C2. Strengthening the knowledge on the functioning of computers and provide general principles for constructing algorithms (computer).
- C3. General guidance on the preparation of publications and technical presentations.
- C4. Internet and privacy on the Internet, adherence to good manners online, law on the Internet, copyright law.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the basic principles of design and theoretical description of modern computers, knows the rules of binary arithmetic (integer and non-integer).

PEK_W02 - The student knows the basic principles of designing algorithms.

II. Relating to skills:

PEK_U01 - Able to effectively use the tools to support the creation of technical publications, can separate form from content.

PEK_U02 - Students can use the available "office tools" to solve basic engineering tasks.

PEK_U03 - The student can independently construct a simple algorithm solves the given simple problem.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Technical Publication. The content and form. Styles.	2
Lec2	Technical Publication. Automatically lists.	2
Lec3	Computers and computer arithmetic.	2
Lec4	Algorithms. Formal methods of presentation of the algorithm. Finite automaton.	2
Lec5	How to create algorithms?	2
Lec6	The computational complexity. "Difficult" task.	2
Lec7	Internet and around or "Cicer cum caule".	2
Lec8	quiz	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Styles and their modifications, illustrations, and working with a spreadsheet.	2
Lab2	Automatic tables of contents, illustrations, bibliography ...	2
Lab3	(Final) document formatting.	2
Lab4	Calculation errors. Python	2
Lab5	Errors - practical calculations.	2
Lab6	Computational capabilities of the computer.	2
Lab7	Elements of Programming (conditional statements, loops, ...) Interesting tasks.	2
Lab8	Summary and Assessment.	1
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for laboratory class
- N3. report preparation
- N4. computational laboratory experiment.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	quiz
F2	PEK_W02	quiz
P = F1+F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	laboratory report
F2	PEK_W02	laboratory report, quiz.
F3	PEK_U01	laboratory report
F4	PEK_U02	laboratory report
F5	PEK_U03	laboratory report, quiz.
P = F1+F2+F3+F4+F5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Algorithmics: The Spirit of Computing (3rd Edition) by David Harel and Yishai Feldman (Jun 11, 2004)

SECONDARY LITERATURE

2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C2	Lec1-Lec8	N1, N2, N3
PEK_W02	K1MTR_W02	C2	Lec1-Lec8	N1, N2, N3, N4
PEK_U01	K1MTR_U19	C3	Lab1 - Lab8	N1, N2, N3
PEK_U02	K1MTR_U19	C2, C3	Lab1 - Lab8	N1, N2, N3
PEK_U03	K1MTR_U19	C2	Lab1 - Lab8	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wstęp do mechatroniki**

Name in English: **Introduction to Mechatronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM031008**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of physics and mathematics
2. Technical interest - interdisciplinary

SUBJECT OBJECTIVES

- C1. Show area, competencies and requirements for Mechatronics - as a guide for the entire study program
- C2. Aware of the problems of interdisciplinary work and applied solutions
- C3. Introduce the basic components of mechatronic systems and integration between
- C4. Make familiar with a variety of application examples of mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can explain the meaning and application of mechatronics in technology and interdisciplinary issues

PEK_W02 - Can discuss the various components of mechatronic systems and integration issues between them

PEK_W03 - Can discuss examples of mechatronic solutions for various applications

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, what is mechatronics, application areas, competence	2
Lec2	Interdisciplinary projects, teamwork, communication and documentation language	2
Lec3	Control and regulation	2
Lec4	Signals and digital transmission, sensor technology	2
Lec5	Actuators and drives, human-machine interface	2
Lec6	PLCs, CNC, RC, and IPC	2
Lec7	Algorithms and programming, operating systems	2
Lec8	Embedded Systems and RT	2
Lec9	Modeling and simulation in mechatronics	2
Lec10	Applications (W5)	2
Lec11	Applications (W12)	2
Lec12	Applications (W10)	2
Lec13	Applications for medicine, entertainment, etc	2
Lec14	Design of mechatronic systems	2
Lec15	Final assessment	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation

N2. problem lecture

N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final assesment
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

David Bradley & David W. Russell, Mechatronics in Action: Case Studies in Mechatronics - Applications and Education, Springer 2010

David G. Alciatore, Michael B. Hstand, Introduction to Mechatronics and Measurement Systems, Fourth edition, McGrawHill, 2011

SECONDARY LITERATURE

A. Milella, D.Di Paola, G. Cicirelli, Mechatronic Systems Applications, InTech2010

MartínezAlfaro H. (ed.) Advances in Mechatronics, InTech 2011

Devdas Shetty, Richard A.Kolk, Mechatronics System Design, SI Version, Cengage Learning 2010

Ryszard Jabłoński & Mateusz Turkowski & Roman Szewczyk, Recent Advances in Mechatronics, Springer 2007

Klaus Janschek, Mechatronic Systems Design: Methods, Models, Concepts, Springer 2012

Ganesh R. Naik (ed.), Intelligent Mechatronics, InTech 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to Mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W26	C1, C2	Lecture 1 - Lecture 2	N1-N3
PEK_W02	K1MTR_W10, K1MTR_W15, K1MTR_W16, K1MTR_W19, K1MTR_W22	C3	Lecture 3 - Lecture 8	N1-N3
PEK_W03	K1MTR_W22, K1MTR_W23	C4	Lecture 9 - Lecture 14	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**

Name in English: **Material Science I**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM032002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - self studies and preparation for examination
- N3. self study - preparation for laboratory class
- N4. tutorials
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK _ W01 _ PEK - W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - U01 - PEK - U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Material Science I AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK - W01	K1MTR_W07	C1		N1, N2
PEK - W02	K1MTR_W02, K1MTR_W07	C1,C2		N1, N3
PEK - W03	K1MTR_W02, K1MTR_W07	C3		N1, N2, N4
PEK - U01	K1MTR_U07	C1 - C3		N3, N5
PEK - U02	K1MTR_U07	C2		N3, N5
PEK - U03	K1MTR_U07	C3		N3, N5

SUBJECT SUPERVISOR

doc. dr inż. Grzegorz Pękalski tel.: 320-27-61 email: grzegorz.pekalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I (Statyka)**

Name in English: **Mechanics I (Statics)**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM032005**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

- C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements
C3. The acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames

PEK_W02 - has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)

PEK_W03 - He has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:

PEK_U01 - He is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)

PEK_U02 - He is able to determine the position of centre masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia in coplanar system

PEK_U03 - He can calculate the velocity and acceleration of any points of typical mechanical systems and their components

III. Relating to social competences:

PEK_K01 - He can search information and is able to critical review

PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view.

PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment's pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter's method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann's method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The notion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Acceleration in plane motion of a rigid body. Instantaneous center of accelerations.	2
Lec15	Test	2
		Total hours: 30
Form of classes – Classes		Number of hours
CI1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
CI2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
CI3	Determination of reaction forces in bearings of any planar systems by analytical methods	2
CI4	Determination of reaction forces in bearings of spatial systems (one example)	1
CI5	Determination of forces in freely selected truss rods (by Ritter's method)	1
CI6	Test 1: vectors, trusses	1
CI7	Determination of internal forces in beams	1
CI8	Determination of internal forces in beams (cont.). Articulated beams.	2
CI9	Determination of internal forces in frames (simple planar frames at most with one node)	2
CI10	Test 2: the internal forces in planar systems	1
CI11	Determination of mass centres and static moments in discrete multi-mass systems.	1
CI12	Determination of mass centres and static geometrical moments in static continuous planar systems.	2
CI13	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
CI14	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
CI15	Test 3: centres of masses, static and inertial moments.	1
CI16	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
CI17	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
CI18	Determination of velocity in rigid body plane motion	2
CI19	Test 4: kinematics	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

N2. calculation exercises

N3. 4 tests instead of two colloquia forcing students to more systematic own work during the semester, including greater use of consultation

N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test 1 and 2 and/ or oral replies
F2	PEK_U02	test 3 and/ or oral replies
F3	PEK_U03	test 4 and/ or oral replies
P = 2 jeśli ocena F1=2. Jeśli nie to $P=(2F1+F2+F3):4$		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
4. M. Kulisiewicz St. Piesiak: "The dynamics of mechanical systems in technical tasks" Part I: "Fundamentals of Kinematics", WUT, 2002
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics " WUT. 1996

SECONDARY LITERATURE

- 1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
- 2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
- 3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
- 4 S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
- 5 W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I (Statics)
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W01, K1MTR_W02, K1MTR_W08	C1, C2	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MTR_U08	C1, C2	CL 1 to Cl 19	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**

Name in English: **Metrology of geometrical quantities**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM032006**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

- C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
- C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
- C3. Learning how to use the equipment for measurement of geometrical quantities.
- C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
- C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
- C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know differences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.

PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.

PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:

PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.

PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.

PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:

PEK_K01 - Search for information and its critical analysis

PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.

PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec3	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations measurements.	2
Lec4	Tolerance and machine parts measurement.	3
Lec5	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec6	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec7	Basics of coordinate measurement technique	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions. Direct and indirect measurements of cones.	2
Lab4	Identification and measurement of threads.	2
Lab5	Assessment of the geometrical structure of the surface.	2
Lab6	Identification and measurement of cylindrical gears.	2
Lab7	Measurements of selected shape deviations and displacement.	3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. laboratory experiment
- N3. report preparation
- N4. self study - preparation for laboratory class
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE

[1] Adamczak S., Makiela W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makiela W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszek K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MTR_W03	C1; C2; C3; C4; C5; C6	Wy1-Wy7	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MTR_U29	C1; C2; C3; C4; C5; C6	La1 - La7	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MTR_K03, K1MTR_K04, K1MTR_K09	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do informatyki**

Name in English: **Introduction to programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM032101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
 N2. self study - preparation for laboratory class
 N3.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_K01	
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to programming
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19			

PEK_U01	K1MTR_U19			
PEK_K01	K1MTR_K03			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy technik wytwarzania**

Name in English: **Fundamentals of manufacturing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM033004**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1MTR_W04	C1		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria programowania i UML**

Name in English: **Software Engineering and UML**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM033005**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Understands the principles of computer algorithms processing
2. Knows the semantics and syntax of C

SUBJECT OBJECTIVES

- C1. Explain the functions, methods and tools (UML) software engineering
- C2. Learn object-oriented thinking
- C3. Prepare for practical classes with object-oriented programming

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Understands the essence of methodical troubleshooting and application development tools

PEK_W02 - Has knowledge of object-oriented programming paradigm and writing UML

PEK_W03 - Can read and understand simple programs in C ++

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to object-oriented programming, examples, tools, CASE	2
Lec2	Models of software development (life cycle)	2
Lec3	Object-oriented requirements analysis (UML - Use case diagrams, activity)	2
Lec4	Object-oriented design (UML - basic models, static and dynamic)	2
Lec5	Object-oriented design (UML - basic models, static and dynamic)	2
Lec6	Implementation of object-oriented (C ++) - levels of classes	2
Lec7	Implementation of object-oriented (C ++) - a system level	2
Lec8	Final assesment	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final assesment
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bruegge Bernd, Dutoit Allen H. Inżynieria oprogramowania w ujęciu obiektowym, Helion 2011

Larman Craig, UML i wzorce projektowe. Analiza i projektowanie obiektowe oraz iteracyjny model wytwarzania aplikacji, Helion 2011

SECONDARY LITERATURE

Cohn M., Succeeding with Agile, Addison-Wesley 2010

Weisfeld M., The Object-Oriented Thought Process, Addison-Wesley, 2009

Freeman S., Pryce N., Growing Object-Oriented Software Guided By Tests, Addison-Wesley, 2010

Dathan B., Ramnath S., Object-Oriented Analysis and Design, Springer 2010

B.B Agarwald, S.P. Tayal, M. Gupta, Software Engineering and Testing, 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Software Engineering and UML
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19, K1MTR_W32	C1	Lecture 1 - Lecture 2	N1
PEK_W02	K1MTR_W19, K1MTR_W32	C2	Lecture 3 - Lecture 5	N1
PEK_W03	K1MTR_W19	C3	Lecture 6 - Lecture 7	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II (Dynamika)**

Name in English: **Mechanics II (Dynamics)**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM033006**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration)
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

- C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: a material point, system of material points with holonomic constrains, rigid body).
- C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
- C3. The acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving.
- Responsibility, honesty and fairness in conduct; observance of manners in the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)

PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)

PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body.

II. Relating to skills:

PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point.

PEK_U02 - He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using Newton's second principle. It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping.

PEK_U03 - He can derive the equations of motion and calculate its parameters (rotational velocity and acceleration) for rigid body loaded by torque and moves rotation. He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system

III. Relating to social competences:

PEK_K01 - He can search information and is able to critical review

PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view.

PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec2	A brief reminder of the kinematics of the material from the previous semester. Addendum: Kinematics of relative motion (Coriolis acceleration)	2
Lec3	Newton's second law (applicable in the dynamics of the free and constrained point)	2
Lec4	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec5	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations	2
Lec6	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle.	2
Lec7	The notion of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2

Lec8	The principle of conservation of energy. Conservative systems. Examples of applications.	2
Lec9	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems	2
Lec10	The principle of the center of mass motion and the principle of momentum in multi-mass systems	2
Lec11	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec12	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness	2
Lec13	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec14	Angular momentum in the plane motion of a rigid body and dynamics of plane motion.	2
Lec15	The kinetic energy of a rigid body in a general motion. König's theorem. Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
		Total hours: 30
Form of classes – Classes		Number of hours
CI1	Practical problems of plane motion of rigid body	2
CI2	Practical problems of kinematics of relative motion of point	2
CI3	Solving examples of tasks with dynamic free material point using Newton's second law (rectilinear and curvilinear motion)	2
CI4	Test 1: kinematics of plane motion and / or the relative motion	1
CI5	Examples of tasks from free vibration of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
CI6	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
CI7	Examples of the tasks of the dynamics and rotational motion of the rigid body. Dynamic force responses	2
CI8	Final test	2
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. calculation exercises
- N3. tutorials
- N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz, oral replies
F2	PEK_U02, PEK_U03	test, oral answer
P = (F1+3F2)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- 1 B. Gabryszewska, A. Pszonka: "Mechanics", Volume II "Kinematics and dynamics", WUT, 1998
- 2 J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
- 3 J. Misiak: "General Mechanics. Dynamics ". Volume II, WNT, Warsaw, 1993

SECONDARY LITERATURE

- 1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
- 2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
- 3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
- 4 M. Klasztorny: "Mechanics", Lower Silesia Ed. Education, Wrocław 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II (Dynamics)
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
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PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1	Lec. 1 to Lec. 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MTR_U01, K1MTR_U02	C2	CI 1 to CI 15	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**

Name in English: **Strength of materials, Mechanics of engineering materials**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM033007**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2	2			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematics (trigonometry, differential and integral equations), physics (statics, kinematics and dynamics)
2. reading comprehension
3. Savoir vivre

SUBJECT OBJECTIVES

- C1. Knowledge of fundamental of solid mechanics
- C2. The ability to create mathematical models of real structures and their calculations.
- C3. acquire skill in qualitative reasoning, interpretation and quantitative analysis of selected phenomena of range strength of materials in the simple and the complex way

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows and understands the concepts of displacement, strain, stress and the strength hypothesis

PEK_W02 - The student knows the mathematical foundations and their application in the theory of solids continuum

PEK_W03 - Student knows the mathematical models applied in the strength of materials

II. Relating to skills:

PEK_U01 - Student is able to suggest mathematical models and to solve elementary problems of the strength of materials

PEK_U02 - Student is able to design a simple structural member

PEK_U03 - Student is able to solve the statically indeterminate scheme

III. Relating to social competences:

PEK_K01 - Student has the knowledge and skills necessary for effective implementation of the tasks set, ie. he/she knows how

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic definitions and assumptions. Model of the solid. The principle of superposition and de Saint - Venant's law	2
Lec2	Strain analysis	1
Lec3	Stress analysis	1
Lec4	Stress-strain relationships (The Hooke's Law)	2
Lec5	Tension - compression	2
Lec6	Torsion	2
Lec7	Bending of simple beams- symmetrical bending	2
Lec8	Deflection of beams	2
Lec9	Classical fracture and failure hypotheses	2
Lec10	Tension (compression) and bending	1
Lec11	Compression (Tension) and bending	1
Lec12	Bending and torsion	1
Lec13	Tension, bending and torsion	1
Lec14	Bending of beams - unsymmetrical bending	2
Lec15	Columns - Euler's buckling load	2
Lec16	Energy methods	2
Lec17	Pressure vessels	2
Lec18	Fatigue (Design of cyclic load)	2

Lec19	1. Riveted joint, Bolted joint, Lap-welded joint - -calculations 2. Torsion - Thin walled irregular sections 3. Curved members 4. Kinetostatic	0
		Total hours: 30
Form of classes – Classes		Number of hours
CI1	Calculations on internal forces	2
CI2	Strain-stress analysis with the common loadings	2
CI3	Hooke's Law	2
CI4	Tension (compression)	2
CI5	Torsion of circular shafts	2
CI6	Torsion of thin-walled tubes	2
CI7	Stresses in bending beams	2
CI8	Deflection of beams	2
CI9	Strain and stresses of statically determinate beams under simultaneous bending, torsion and tensile (compression)	4
CI10	Buckling	2
CI11	Energy methods	4
CI12	Pressure vessels	2
CI13	Kinetostatics	2
		Total hours: 30

TEACHING TOOLS USED		
N1. traditional lecture with the use of transparencies and slides		
N2. self study - self studies and preparation for examination		
N3. problem exercises		
N4. calculation exercises		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_WO3	tests, control work, project or other learning achievements during semester, on the basis of Student presence during lectures
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	individual test, oral answers, tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bielajew N.M., Wytrzymałość materiałów
 Brzoska Z., Wytrzymałość materiałów
 Huber M.T., Stereomechanika techniczna (Wytrzymałość materiałów)
 Katarzyński S., Kocańda S., Zakrzewski M., Badanie własności mechanicznych metali
 Kocańda S., Szala J., Podstawy obliczeń zmęczeniowych
 Niezgodziński M.E., Niezgodziński T., Wytrzymałość materiałów
 Niezgodziński M.E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe
 Walczak J., Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności
 Zakrzewski M., Zawadzki J., Wytrzymałość Materiałów

SECONDARY LITERATURE

Jakubowicz A., Orłoś Z., Wytrzymałość materiałów
 Malinin N. N., Rżysko J., Mechanika materiałów

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials, Mechanics of engineering materials
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 PEK_W02 PEK_W03	K1MTR_W07	C1	Wy1+Wy19	N1, N2, N3, N4
PEK_U01 PEK_U02 PEK_U03	K1MTR_U01, K1MTR_U02, K1MTR_U09	C2	Ćw1+Ćw13	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w C**

Name in English: **C Programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM033102**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the semantics and syntax of C
2. Has a basic knowledge of computer algorithms

SUBJECT OBJECTIVES

- C1. Learn the ability to use procedural programming paradigm on C language example
- C2. Learn skills of programs development and implementation for data processing

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can apply the procedural programming paradigm, ie. To break down the problem into a set of programming functions through various tasks in C

PEK_U02 - Can apply C language to the processing of complex data sets, one and two-dimensional, using dynamic data structures

PEK_U03 - Can test and debug programs written in C, use the C language library documentation, knows and applies the principles of proper programming style

III. Relating to social competences:

PEK_K01 - Can search for technical information and analyze it critically

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues, familiarize with the environment of MS Visual Studio	2
Lab2	Signal Processing - generation of selected waveforms data with random disturbances, writing the data to file	2
Lab3	Signal Processing - reading a file, dynamic memory allocation for one dimensional data, programming of filtering algorithms	2
Lab4	Signal processing - robustness, test and debug the program, code documentation	2
Lab5	Image processing - image loading from a file, dynamic memory allocation for multi-dimensional data	2
Lab6	Image processing - data structures	2
Lab7	Image processing - programming of various two-dimensional data processing algorithms	2
Lab8	Image processing - image generating	2
Lab9	Image processing - fault tolerance, organization and project documentation	2
Lab10	Dynamic data structures - work with a dynamic one or doubly linked lists, or a tree	2
Lab11	Dynamic data structure - build a dynamic data structure based on the data stored in the file	2
Lab12	Dynamic data structures - search for items, swap, delete, sort	2
Lab13	Development of individual programs (algorithmization)	2
Lab14	Development of individual programs (implementation and testing)	2
Lab15	Individual Assessment - developed programs	2
		Total hours: 30

TEACHING TOOLS USED

- N1. self study - preparation for laboratory class
- N2. Self - implementation and documentation
- N3. tutorials
- N4. Online knowledge base

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01	Verbal answers, quizzes, statements (the assesment program + documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

B.W. Kernighan, D. M. Ritchie : Język ANSI C
N. Wirth : Algorytmy + Struktury Danych = Programy

SECONDARY LITERATURE

S. Prata : Szkoła Programowania. Język C++
B. Stroustrup : Język C++
P. Chomicz, R. Uljasz : Programowanie w języku C i C++. Poradnik programisty

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **C Programming** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N1, N2, N3
PEK_U02	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N1, N2, N3

PEK_U03	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N2, N3, N4
PEK_K01	K1MTR_K01	C1	Lab. 1 - Lab.15	N1, N2, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza i synteza układów kinematycznych**

Name in English: **Analysis and Synthesis of Kinematic Systems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM034005**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, analytical geometry, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in function analysis, derivatives, fundamental operations on matrices and vectors

SUBJECT OBJECTIVES

- C1. Acquire knowledge in topology, kinematics and dynamics of kinematic systems
- C2. Acquire knowledge in basic mechanisms design (type and dimensional synthesis)
- C3. Getting skills in determining kinematic system analysis (topology, kinematics, kinetostatics)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Understands theoretical fundamentals of analysis and synthesis of kinematic systems

PEK_W02 - Has the knowledge of kinematic and kinetostatic analysis methods

PEK_W03 - Has the knowledge of dimensional synthesis of basic mechanisms

II. Relating to skills:

PEK_U01 - Is able to evaluate topological properties of kinematic systems

PEK_U02 - Is able to determine kinematic and kinetostatic quantities

PEK_U03 - Is able to create models of mechanisms

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms (links, joints, mobility, redundant constraints)	3
Lec2	Linkages (characteristics). Fundamental kinematic equations	3
Lec3	Kinematics cont.	2
Lec4	Analytical methods in kinematics	2
Lec5	Planetary transmissions, harmonic drive	2
Lec6	Introduction to dynamics, inertia forces, joint forces	2
Lec7	Kinetostatic analysis, virtual work method	2
Lec8	Friction in joints	2
Lec9	Robot topology, characteristics, analysis of planar systems	2
Lec10	Analysis of manipulators cont. jacobian, forces	2
Lec11	Matrix notation for 3D systems	2
Lec12	Structural synthesis, conceptual design	2
Lec13	Dimensional synthesis of linkages	2
Lec14	Dimensional synthesis of linkages cont	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction, presentation of Adams system - examples of analysis	2
Proj2	Rules of drawing diagrams of mechanisms, topology analysis, mobility (test, project)	2
Proj3	Introduction to modelling mechanisms in Adams	2
Proj4	Rules of creating models of mechanisms in Adams	2
Proj5	Rules of creating models of mechanisms in Adams cont (test)	2
Proj6	Mechanism position determination, instant centers of rotation (test, project)	2
Proj7	Kinematic analysis of linkages - velocity and acceleration determination using vector methods (test, project)	2

Proj8	Kinematic analysis of linkages - analytical methods (project)	2
Proj9	Inertia forces, kinetostatic analysis (test, project)	2
Proj10	Kinematics and kinetostatics in Adams (project)	2
Proj11	Planar manipulators - matrix method in kinematics (project)	2
Proj12	Modelling of manipulators using Adams - forward and inverse tasks, driving forces (project)	2
Proj13	Modelling of manipulators cont.	2
Proj14	Planetary transmission analysis - velocity ratio (project)	2
Proj15	Planetary transmission analysis cont.	2
		Total hours: 30

TEACHING TOOLS USED

- N1. problem lecture
- N2. self study - preparation for project class
- N3. individual project solution
- N4. tutorials
- N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence
F2	PEK_U01, PEK_U02, PEK_U03	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Miller S.: Kinematic systems. Basics of design (in Polish). WNT Warszawa 1988; Gronowicz A. et al: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Synthesis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis and Synthesis of Kinematic Systems
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1, C2, C3	Lec1 - Lec15	N1, N2, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MTR_U09	C3	Pr1 - Pr15	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy technik wytwarzania**

Name in English: **Fundamentals of manufacturing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM034006**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			45		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have knowledge of technical drawing, marking dimensions and tolerances of form and position tolerances, surface roughness.
2. Students should have a basic knowledge of mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

- C1. Transfer of basic knowledge of manufacturing techniques used in mechanical and electronic industries.
- C2. Transfer informations about the main ways and techniques of production, grouped in mechanical technologies such as: casting, welding, processing of plastic and machining.
- C3. In the area of electronic discussion of such technologies as micro-and nanotechnology production of layers with different properties used in electronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is able to characterize the manufacturing techniques of different layers used in microelectronic integrated circuits.

PEK_U02 - He can choose the appropriate technology welding, casting and plastic forming and defining the basic parameters of these processes.

PEK_U03 - Students should be able to plan a laboratory experiment in the field of machining, and be able to carry out measurements and analyze the results.

III. Relating to social competences:

PEK_K01 - Students should be aware of professional behavior on the bench and know the main principles of safe operation of lathes.

PEK_K02 - Objectively examine the arguments, rational translations and justify their point of view using the knowledge of manufacturing techniques

PEK_K03 - Students should understand the need for continuous learning and deepen their knowledge and skills with the changing technical and social considerations.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Preparation of thick layer microelectronic circuits.	3
Lab2	Preparation of multilayer LTCC circuits.	3
Lab3	Preparation and characterization of semiconductor layers.	3
Lab4	Preparation and characterization of dielectric layers.	3
Lab5	Preparation and characterization of metal layers.	3
Lab6	Performing cast in sand molds and disposable assets.	3
Lab7	Precision casting using the lost model.	3
Lab8	Manufacture of plastic products.	3
Lab9	Welding (shielded metal Gas metal arc welding, gas tungsten arc welding , micro-plasma welding, gas welding)	3
Lab10	Welding and soldering (resistance and friction welding processes, soldering and brazing)	3
Lab11	Cold deformation and annealing, cupping test plates.	3
Lab12	Rolling of sheets and profile, cutting and bending	3
Lab13	Turning and drilling	3
Lab14	Methods of abrasive machining	3
Lab15	Milling and electrodischarge machining	3
		Total hours: 45

TEACHING TOOLS USED

- N1. laboratory experiment
 N2. self study - preparation for laboratory class
 N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	test, report on laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Jaworski R. i inni. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr., Wrocław 1981
2. S. Kajzer, R. Kozik, R. Wusatowski: Wybrane zagadnienia z procesów obróbki plastycznej metali. Wyd. PŚI. Gliwice 1997
3. Techniki wytwarzania – obróbka ubytkowa. Laboratorium” pod redakcją Piotra Cichosza Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SECONDARY LITERATURE

1. www.tworzywa.pwr.wroc.pl
2. www.dbc.wroc.pl/Content/7156/Techniki_wytwarzania_Spawalnictwo_A.Ambroziak_linkowane.pdf

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Fundamentals of manufacturing** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01; PEK_U02; PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U29	C1; C2; C3	La1 -La15	N1; N2; N3

PEK_K01; PEK_K02; PEK_K03	K1MTR_K01, K1MTR_K05, K1MTR_K08	C1; C2; C3	La1 - La15	N2; N3
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SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy wytwarzania i montażu**

Name in English: **Systems for Manufacturing and Assembly**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM034007**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has a basic knowledge of manufacturing techniques.

SUBJECT OBJECTIVES

- C1. The student is to get to know the structure and technological and utility characteristics of the main types of machine tools.
- C2. The student is to get to know how the automatic lathes and numerically controlled machine tools used in automated machining systems work.
- C3. The student is to learn the fundamentals of automated assembly and to familiarize herself/himself with the devices used.
- C4. The student is to acquire a basic knowledge about the packaging technologies used in electronics and about the packaging equipment used.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the structure of and distinguishes the main types of machine tools and can describe their functionalities. The student knows the structure of and principles of operation of automatic lathes and numerically controlled machine tools and can distinguish them from the conventional machine tools.

PEK_W02 - The student knows the principles of automatic assembly and the solutions used.

PEK_W03 - The student can distinguish the different technologies of packaging electronic elements and can describe the operation of the packaging equipment used.

II. Relating to skills:

PEK_U01 - The student can select cutting machine tools proper for specific technological tasks and develop a concept of an automated manufacturing system.

PEK_U02 - The student can assess the producibility of a design of products to be assembled and employ proper means of automated assembly.

PEK_U03 - The student can employ a proper method of assembling electronic components and select suitable equipment for it.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of mechatronics engineer activity and improving her/his professional and social competences.

PEK_K02 - The student can critically analyze the functioning of a manufacturing system in order to improve its performance.

PEK_K03 - The student is aware of the responsibility for her/his own work and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The notion of a manufacturing machine, the technological and utility characteristics of manufacturing machines.	2
Lec2	The work components and assemblies of manufacturing systems.	2
Lec3	Drives in contemporary manufacturing systems.	2
Lec4	The main types of machine tools and their technological capabilities.	2
Lec5	The automation of production processes.	2
Lec6	The structure and operation of automatic lathes and automated manufacturing systems.	2
Lec7	The fundamentals of machine tool control.	2
Lec8	NC machine tools in manufacturing systems.	2
Lec9	Robotization in manufacturing processes.	2
Lec10	The automatic assembly of products.	2
Lec11	The levels and technologies of packaging in electronics.	2
Lec12	Systems of wire bonding and flip-chip bonding principles and systems.	2
Lec13	Equipment for manual soldering and wave soldering in electronic packaging.	2
Lec14	Systems for reflow soldering.	2
Lec15	Diagnostic systems in electronic packaging.	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory and discuss safety rules.	1
Lab2	Positioning accuracy measurement of milling machine table.	2
Lab3	Plastic components manufacturing and assembly.	2
Lab4	Analyses of tool changing times in machine tools centre.	2
Lab5	Use of measurement probe to assess the dimensional accuracy of workpiece.	2
Lab6	Machine tool thermal faults compensation in manufacturing process.	2
Lab7	Soldering technology in electronic packaging.	2
Lab8	Diagnostic of joints in electronic packaging.	2
		Total hours: 15

TEACHING TOOLS USED	
<p>N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. self study - preparation for laboratory class N4. laboratory experiment N5. report preparation</p>	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	final test
F2	PEK_W03	final test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	entrance tests and report on the laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bukat K., Hackiewicz H., Lutowanie bezołowiowe, BTC, Warszawa, 2007
2. Felba J., Montaż w elektronice, Oficyna Wydawnicza PWR, Wrocław, 2010
3. Honczarenko J., Roboty przemysłowe. Elementy i zastosowanie., WNT, 1996
4. Kisiel R., Podstawy technologii dla elektroników – poradnik praktyczny, BTC, Warszawa, 2005
5. Koch T., Systemy zrobotyzowanego montażu., Oficyna Wyd. Politechniki Wrocławskiej, 2006
6. Kosmol J., Automatyzacja obrabiarek i obróbki skrawaniem., WNT, 2000
7. Kowalski T., Lis G., Szenajch W., Technologia i automatyzacja montażu maszyn., Oficyna Wyd. Politechniki Warszawskiej, 2000
8. Łunarski J., Szabajkiewicz W., Automatyzacja procesów technologicznych montażu maszyn., WNT, 1993
9. Praca zb. pod red. M. Marciniaka, Elementy automatyzacji we współczesnych procesach wytwarzania. Obróbka, mikroobróbka, montaż., Oficyna Wyd. Politechniki Warszawskiej, 2007
10. Tummala R. R. Fundamentals of Microsystem Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE

1. Ganesan S., Pecht M., Lead-free Electronics, John Wiley & Sons Inc., New York, 2006
2. Harper Ch. A., Electronic Packaging and Interconnection Handbook, McGraw-Hill, Inc., New York, 1991
3. Michalski J., Technologia i montaż płytek drukowanych., WNT, Warszawa, 1992
4. Suhir E., Lee Y.C., Wong C.P., Micro- and Opto- Electronic Materials and Structures, Springer S+B Media, Inc., New York, 2007
5. Weck M., Werkzeugmaschinen. Mechatronische Systeme, Vorschubantriebe, Prozeßdiagnose. , Springer-Verlag, 2001
6. Wong C.P, Kyoung-Sik Moon, Yi Li, Nano-Bio- Electronic, Photonic and MEMS Packaging, New York: Springer, 2010.
7. Zdanowicz R., Robotyzacja procesów wytwarzania., Wydawnictwo Politechniki Śląskiej, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems for Manufacturing and Assembly
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W02	K1MTR_W11	C1-C3	Lec1 - Lec10	N1, N2
PEK_W03	K1MTR_W18	C4	Lec11 - Lec15	N1, N2
PEK_U01 - PEK_U02	K1MTR_U03, K1MTR_U11	C1 - C3	Lab2 - Lab6	N3, N4, N5
PEK_U03	K1MTR_U18	C4	Lab7 - Lab8	N3, N4, N5
PEK_K01 - PEK_K03	K1MTR_K04, K1MTR_K06, K1MTR_K13	C1-C4	Lab1 - Lab8	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sieci przemysłowe**

Name in English: **Industrial networks**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM034103**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

- C1. Explain the construction of industrial networks
- C2. Explain the operation of industrial networks
- C3. Explain the use of industrial networks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can describe the construction of industrial networks.

PEK_W02 - Can explain the operation of industrial networks.

PEK_W03 - Is able to select a network to an application

II. Relating to skills:

PEK_U01 - Is able to design industrial network.

PEK_U02 - Can build an industrial network.

PEK_U03 - Can set up a network of industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic control and monitoring in industrial environments	2
Lec2	Network models	2
Lec3	The physical layer	2
Lec4	Data link layer	2
Lec5	Examples of industrial networks - construction, characteristics, application areas	3
Lec6	Methods for data exchange in industrial networks. Network Configuration. Specialized software.	3
Lec7	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	PPI and MPI interfaces	2
Lab3	Modbus network	2
Lab4	AS-i network	2
Lab5	Interbus network	2
Lab6	Profibus network	2
Lab7	Profinet network	2
Lab8	CAN network	2
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for laboratory class
- N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Test, REPORT OF LABORATORY PRACTICE
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Solnik W., Znajda Z.: Komputerowe sieci przemysłowe Profibus DP i MPI. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004
 Kwiecień A.: Analiza przepływu informacji w komputerowych sieciach przemysłowych. WPK J. Skalmierskiego, Gliwice 2000
 Mielczarek W.: Szeregowe interfejsy cyfrowe. Helion 1993

SECONDARY LITERATURE

Legierski T. i inni: Programowanie sterowników PLC, Wydawnictwo Pracowni Komputerowej Jacka Sklamierskiego, Gliwice 1998
 Kasprzyk J. Programowanie sterowników przemysłowych, Wydawnictwo Naukowo-Techniczne, Warszawa 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Industrial networks
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W20	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W02	K1MTR_W20	C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W03	K1MTR_W20	C3	Lec5	N1
PEK_U01	K1MTR_U20	C1	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U02	K1MTR_U20	C2	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U03	K1MTR_U20	C3	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w C++**

Name in English: **C++ Programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM034104**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He knows the semantics and syntax of C
2. He can write, test and debug programs written in C
3. Has knowledge of object-oriented programming paradigm and writing UML

SUBJECT OBJECTIVES

- C1. Learn the skills to apply object-oriented programming paradigm for solving practical tasks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Able to implement a C ++ program from a given specification and UML

PEK_U02 - Able to apply object-oriented programming paradigm, ie. Modeled in UML, then implement in C ++ program for a given problem

PEK_U03 - Can apply the correct style of programming, test, and debug a program developed and compile the code

III. Relating to social competences:

PEK_K01 - Can search and critically analyze information

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Class, attribute, method, constructor, destructor, object, overloading methods	2
Lab2	Accessors overloaded constructor, copy constructor, new and delete operators	2
Lab3	Inheritance, functions befriended	2
Lab4	Operators, operator overloading, this indicator	2
Lab5	Streams, File operations	2
Lab6	Association, aggregation, composition	2
Lab7	Polymorphism	2
Lab8	Simulation of the control system	2
Lab9	Implementation game MasterMind / Pond / etc.	2
Lab10	Templates	2
Lab11	Exceptions	2
Lab12	Object Modeling with UML	2
Lab13	Implementation of the program modeled in UML	2
Lab14	Testing and debugging the program, documenting code	2
Lab15	Final assesment	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

N2. Own work - implementation, testing and documenting programs

N3. tutorials

N4. Online knowledge base

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01	Oral answers, quizzes, reports (implemmented program + documentation UML)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Liberty, C++ dla każdego, Helion 2002
 B. Stroustrup, Język C++, WNT 2002
 J.Grębosz, Symfonia C++, Editions 2000 rok 2006
 B. Eckel, Thinking in C++ Edycja polska, Helion 2002

SECONDARY LITERATURE

N. M. Josuttis, C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion 2003
 M.Flenov, C++ Elementarz hakera, Helion 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
C++ Programming
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1,N2,N3
PEK_U02	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1, N2, N3
PEK_U03	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1, N2, N3
PEK_K01	K1MTR_K01	C1	Lab. 1 - Lab. 15	N1, N2, N3

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania zespołów mechanicznych**

Name in English: **Fundamentals of machine elements design**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM035001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1		2
Proj2		4
Proj3		4
Proj4		4
Proj5		4
Proj6		6
Proj7		4
Proj8		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - self studies and preparation for examination
- N3. self study - preparation for project class
- N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	
F2	PEK_U01, PEK_U02	
F3	PEK_U01, PEK_U02, PEK_K01	
F4	PEK_U01, PEK_U02, PEK_K01, PEK_K02	
P = F1+F2+F3+F4		

PRIMARY AND SECONDARY LITERATURE	
<u>PRIMARY LITERATURE</u>	
<u>SECONDARY LITERATURE</u>	

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Fundamentals of machine elements design AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1,C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1,N2,N4

PEK_W02	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1,C2	Lec1, Lec2, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1,N2,N4
PEK_U01	K1MTR_U05, K1MTR_U09, K1MTR_U23	C2,C3	Pr3, Pr4, Pr5	N1,N2,N3,N4
PEK_U02	K1MTR_U05, K1MTR_U09	C2,C3	Pr6, Pr7, Pr8	N1,N2,N3,N4
PEK_K01	K1MTR_K02, K1MTR_K04	C3	Pr1, Pr8	N1,N2,N3,N4
PEK_K02	K1MTR_K02, K1MTR_K04	C3	Pr1, Pr8	N1,N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe, elementy hydrauliczne i elementy pneumatyczne**

Name in English: **Drive systems, hydraulic components and pneumatic components**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM035004**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of differential calculus. Basic knowledge of mechanics, materials, and automation.
2. Ability to conduct basic analysis of the workings of simple mechanisms. The ability to understand, use and transformation formulas describing the basic relationships and physical phenomena.
3. Basic ability to formulate conclusions on the basis of the knowledge or the results of a laboratory experiment.

SUBJECT OBJECTIVES

- C1. Acquaint students with hydrostatic and pneumatic power systems, principles of operation, basic relations, mathematical models describing the elements of the systems, methods of control and regulation. Presentation of the latest trends in the integration of electronic components and elements of hydraulic and pneumatic systems. Miniaturization of hydraulic components.
- C2. Present the student the role of individual components in the hydraulic and pneumatic power systems. Determination of the effect of the parameters of the individual elements on the mode of action the whole system. The acquisition of the knowledge needed to make aware changes in hydrostatic and pneumatic systems, which purpose is positive change the work parameters of the system.
- C3. Acquisition by the student the teamwork skills. Formulation of proposals by a group of students based on the results of laboratory tests and summary them in writing form.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student is able to define the principle of operation and basic parameters of hydraulic and pneumatic systems. The student is able to describe the work conditions which are necessary for the proper operation of hydraulic and pneumatic systems. The student is able to explain the impact of various system parameters on its performance.

PEK_W02 - The student describes the characteristics and principles of operation of the elements of hydraulic and pneumatic systems. The student independently analyzes the parameters of individual elements of systems by defining their principles of operation.

PEK_W03 - The student selects the individual components of hydraulic and pneumatic systems, creating the concept of a full system based on the initial assumptions. Student by exchanging elements or changing the control system interfere in existing hydraulic and pneumatic systems, making changes that have a positive impact on the output parameters of the whole system.

II. Relating to skills:

PEK_U01 - The student identifies and describes the principle of operation of the elements of hydraulic and pneumatic systems. Students performed a laboratory experiment on which assesses the impact of selected parameters on the operation of the element.

PEK_U02 - The student performs the laboratory experiments on the basis of which identifies the individual parameters of hydraulic and pneumatic systems. A student on the basis of their identifies and describes the physical phenomena whose existence has a significant impact on the performance of individual components or complete systems.

PEK_U03 - The student performs and controls the course of a laboratory experiment, records the results and makes them evaluated. The student collects and publishes the results in a written report and draws conclusions.

III. Relating to social competences:

PEK_K01 - The student takes part in the work of the group of students, the purpose of which is the performance of a laboratory experiment.

PEK_K02 - The student acquires abilities to present the results of their work in the form of a written report supplementing them orally during the consultation with the teacher.

PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the course, the terms of credit and the subject literature. Basic knowledge of the mechanics of liquids and gases. Flow characteristics.	2
Lec2	The principle of operation of the hydrostatic drive. Hydraulic fluids and their properties.	2
Lec3	Contaminations - the sources, causes and effects. Analogies between the mathematical models of hydraulic systems.	2
Lec4	Filters and filtration. Classification of the filters, principle of operation, place of installation in the system.	2
Lec5	The efficiency of hydraulic systems, hydraulic efficiency.	2
Lec6	Volumetric efficiency and the total efficiency of the hydraulic systems.	2
Lec7	Energy generators: pumps and compressors. Construction and characteristics.	2

Lec8	Actuators: cylinders and motors. Construction and characteristics. Mathematical models.	2
Lec9	Control elements: flow direction, pressure and flow rate.	2
Lec10	Methods of controlling the speed of the hydraulic actuators.	2
Lec11	Volumetric control and regulation.	2
Lec12	The technique of the proportional control - the basics: elements and hydrotronic systems.	2
Lec13	Designing of the hydrostatic power systems.	2
Lec14	The heat balance of hydraulic systems. Components and systems of the micro hydraulics.	2
Lec15	Exam.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of ratings.	2
Lab2	Experimental designation of working fluid properties - compressibility.	2
Lab3	Experimental designation of the flow resistance in the hydraulic lines - linear resistance.	2
Lab4	Local resistance in hydraulic systems. Orifice as local resistance, the phenomenon of cavitation.	2
Lab5	Determination of characteristics a positive displacement pump.	2
Lab6	Static characteristics of a conventional directional spool valve.	2
Lab7	Examination of the hydrostatic transmission.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

- N1. laboratory experiment
- N2. tutorials
- N3. report preparation
- N4. self study - self studies and preparation for examination
- N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01+PEK_W03	axam

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	laboratory reports, oral response, participation in problems discussions

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Kollek, Basics of the designing hydraulic drives and controls., wydawnictwo: Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław., rok: 2004, (in Polish)
2. E. Tomasiak, The drives and controls systems of the hydraulic and pneumatic., wydawnictwo: Wydawnictwo Polit. Śląskiej. Gliwice., rok: 2001, (in Polish)
3. S. Stryczek, Hydrostatic drive., wydawnictwo: WNT, rok: 1996, (in Polish),
4. A. Osiecki, The hydrostatic drive of machines., wydawnictwo: WNT, rok: 2004, (in Polish)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Drive systems, hydraulic components and pneumatic components
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1	K1MTR_W10	C1	Lec1÷Lec3	N2, N4, N5
PEK_W2, PEK_W3	K1MTR_W10, K1MTR_W24	C2	Lec4÷Lec14	N2, N4, N5
PEK_U1÷PEK_U3	K1MTR_U10, K1MTR_U23	C3	Lab1÷Lab7	N1, N2, N3
PEK_K1÷PEK_K3	K1MTR_K04	C3	Lab1÷Lab7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory w budowie maszyn i pojazdów**

Name in English: **Sensors in the machine and vehicle construction**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM035103**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		1
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. laboratory experiment
- N3. report preparation
- N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Sensors in the machine and vehicle construction AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03, K1MTR_W15	C1		N1
PEK_W02	K1MTR_W15	C1		N1
PEK_W03	K1MTR_W16	C1		N1
PEK_U01-PEK_U03	K1MTR_U03, K1MTR_U10, K1MTR_U15	C2		N2-N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowniki PLC**

Name in English: **PROGRAMMABLE LOGIC CONTROLLERS**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM035104**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the principles of operation of semiconductor electronic components.
2. Has a basic knowledge of industrial networks.

SUBJECT OBJECTIVES

- C1. Making familiar with the construction of a PLC.
- C2. Making familiar with the operation of the PLC.
- C3. Making familiar with PLC programming languages.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has a basic knowledge of the construction of a PLC.

PEK_W02 - Has a basic knowledge of the operation of the PLC.

PEK_W03 - Has a basic knowledge of PLC programming.

II. Relating to skills:

PEK_U01 - Can apply the appropriate PLC for the job.

PEK_U02 - Can configure the PLC.

PEK_U03 - Can program the PLC.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Principles of assessment of the course. Introduction. History of the PLC. Market PLC. Basic definitions.	2
Lec2	Architecture of PLC	2
Lec3	The principle of operation of the PLC. Program Structure and organization of memory.	2
Lec4	Standard graphical PLC programming languages.	2
Lec5	Standard text PLC programming languages.	2
Lec6	SFC sequence language	2
Lec7	Examples of applications using a PLC.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	ILC 130 - software tools, configuration	2
Lab3	ILC 130 - programming.	2
Lab4	Logo! - software tools, configuration	2
Lab5	S7-1200 - software tools, configuration	2
Lab6	S7-1200 - programming	2
Lab7	S7-300 - software tools, configuration	2
Lab8	S7-300 - programming	2
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for laboratory class
- N3. laboratory experiment
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	grade point average.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legierski T., Kasprzyk J., Wyrwał J., Hajda J.: Programowanie Sterowników PLC, Wyd. Prac. Komp. J. Skalmierskiego, Gliwice, 1998. Kwasniewski J.: Sterowniki PLC w praktyce inżynierskiej, Wyd. BTC, 2008.

SECONDARY LITERATURE

Simatic S7. Programowalny sterownik S7-1200. Podręcznik systemu. Siemens 2009. Logo!. Podręcznik. Siemens 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
PROGRAMMABLE LOGIC CONTROLLERS
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W33	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W10, K1MTR_W33	C2	Lec3,	N1
PEK_W03	K1MTR_W10, K1MTR_W33	C3	Lec4, Lec5c, Lec6, Lec7,	N1
PEK_U01	K1MTR_U16, K1MTR_U36	C1,C2	LA2,LA4,LA5,LA7	N2,N3,N4
PEK_U02	K1MTR_U16, K1MTR_U36	C1,C2	LA2,LA4,LA5,LA7	N2,N3,N4
PEK_U03	K1MTR_U16, K1MTR_U36	C3	LA3, LA4, LA6, LA8	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory w systemach wytwórczych**

Name in English: **Sensors in manufacturing systems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM035105**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has basic knowledge relating to the design-construction process, structure, functioning and operation of the main machine elements and assemblies and the principles of their matching and constructing.

SUBJECT OBJECTIVES

- C1. The student is to get to know the structure, characteristics and principles of operation of the sensors used in manufacturing systems.
- C2. The student is to acquire knowledge relating to the location and functions performed by sensors in manufacturing systems.
- C3. The student is to acquire the skill of selecting proper sensors in the design of manufacturing systems and their use for diagnosis and supervision purposes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the structure, characteristics and principles of operation of the sensors used in manufacturing systems.

PEK_W02 - The student knows what functions sensors perform in manufacturing systems and can indicate the locations of the sensors.

PEK_W03 - The student knows the fundamentals of the diagnostics and supervision of manufacturing systems and the strategies used.

II. Relating to skills:

PEK_U01 - The student can select sensors proper for the functions performed in manufacturing systems.

PEK_U02 - The student is able to design a measurement chain used in the diagnosis and supervision systems of manufacturing systems.

PEK_U03 - The student can determine the main characteristics of the sensors used in manufacturing systems.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of mechanics and machine building engineer activity and improving her/his professional and social competences.

PEK_K02 - The student can critically analyze the functioning of a manufacturing system in order to improve its performance.

PEK_K03 - The student is aware of the responsibility for her/his own work and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of sensors in manufacturing, the classifications of sensors.	1
Lec2	Physical operating principles of sensors and their basic characteristics.	2
Lec3	Sensors in machine tools and industrial robots.	2
Lec4	Sensors for measurements the geometry of the workpieces.	2
Lec5	Sensors for tool systems.	2
Lec6	Sensors for monitoring the machining process.	2
Lec7	Sensors for monitoring the various manufacturing processes.	2
Lec8	Sensors used in transport, storage and assembly systems.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to sensors and discuss safety rules.	2
Lab2	An analysis of the measuring capabilities of the system Svantek.	2
Lab3	Diagnostics of machine tool using Ballbar system.	2
Lab4	Possibilities of measurement using of strain gauges.	2
Lab5	The determination of the characteristics of the selected limit switches.	2
Lab6	The determination of the characteristics of the PSD sensor.	2

Lab7	Configuring the measuring circuit for determining the angle of rotation of the spindle.	2
Lab8	The determination of the characteristic of a laser triangulation sensor.	2
Lab9	Comparison of selected methods of temperature measurement.	2
Lab10	Analysis of sensors in the turning center.	2
Lab11	The measurement of cutting force components using piezoelectric dynamometer.	2
Lab12	The measurement capabilities of laser interferometer.	2
Lab13	The determination of the characteristic of an inductive displacement sensor.	2
Lab14	An analysis of the measuring capabilities of the ConoProbe 3.0 MK HD optical sensor.	2
Lab15	Catching up with the outstanding laboratory classes and completion of reports.	2
		Total hours: 30

TEACHING TOOLS USED		
<p>N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. self study - preparation for laboratory class N4. laboratory experiment N5. report preparation</p>		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	individual presentation
F2	PEK_W01 - PEK_W03	final test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	entrance tests, reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2010
2. Honczarenko J.: Obrabiarki sterowane numerycznie. WNT. Warszawa 2008
3. Nawrocki W.: Sensory i systemy pomiarowe. Wydawnictwo Politechniki Poznańskiej. Poznań 2001
4. Tönshoff H.K., Inasaki I.: Sensors in Manufacturing. Wiley-VCH Verlag. Weinheim - New York - Chichester - Brisbane - Singapore - Toronto 2001
5. Turkowski M.: Przemysłowe sensory i przetworniki pomiarowe. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000
6. Soloman S.: Sensors and Control Systems in Manufacturing, Second Edition, McGraw-Hill Professional, New York, Chicago, San Francisco, 2010

SECONDARY LITERATURE

1. Bishop R.H.: The Mechatronics Handbook. CRC Press. Boca Raton London New York Washington, D.C., 2002
2. Bishop R.H.: Mechatronic Systems, Sensors, and Actuators. Fundamentals and Modeling. CRC Press. Boca Raton, London, New York 2008
3. Fleischer J., Denkena B., Winfough B., Mori M.: Workpiece and Tool Handling in Metal Cutting Machines. Annals of the CIRP. Vol. 55/2/2006, pp.817-839
4. Fraden J.: Handbook of modern sensors. Physics, designs and applications. Springer Science + Business Media. New York 2004
5. Jemielniak K.: Automatyka diagnostyka stanu narzędzia i procesu skrawania. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002
6. Nyce D.S.: Linear Position Sensors - Theory and Application. John Wiley & Sons 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors in manufacturing systems
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W15	C1 - C3	Lec1 - Lec8	N1, N2
PEK_U01 - PEK_U03	K1MTR_U03, K1MTR_U15	C1 - C3	Lab1 - Lab15	N3, N4, N5
PEK_K01 - PEK_K03	K1MTR_K03, K1MTR_K04, K1MTR_K13	C1 - C3	Lab1 - Lab15	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie procesów technologicznych**

Name in English: **Technological design processes**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM035202**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to read and develop of technical drawing at the basic level.
2. Basic knowledge about typical possibilities of cutting machine tools processes.
3. Knowledge about machine tools construction and processing capabilities.

SUBJECT OBJECTIVES

- C1. Acquiring of knowledge about technological documentation and determinants of technical documentation range.
- C2. Acquiring of producibility analysis ability.
- C3. Acquiring of knowledge about proper manufacturing technology matching for production size and work piece shape.
- C4. Acquiring knowledge about proper order of operations in the process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		2
Proj9		2
Proj10		2
Proj11		2
Proj12		2
Proj13		2
Proj14		2
Proj15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for project class
- N3. tutorials
- N4. project presentation
- N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	
F2	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological design processes
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W11	C2		N1, N2, N3, N4
PEK_W02	K1MTR_W06, K1MTR_W11	C1, C3		N1, N2, N3
PEK_W03	K1MTR_W06	C1		N1, N2, N3, N4
PEK_U01 - PEK_U03	K1MTR_M_U03, K1MTR_M_U06	C2, C3		N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**

Name in English: **Ecology in industrial manufacturing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM035203**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has ordered knowledge of high school biology, chemistry and physics. He can interpret the basic relationship between human activities and behavior of living organisms and the environment.
2. He understands the need for industrial development and implementation of new solutions in the construction, operation and modernization of the equipment of the principles of sustainable development, the protection of natural resources and the environment.

SUBJECT OBJECTIVES

- C1. Understanding the structure and functioning of living nature, ecotoxins action and the greenhouse effect. Understanding the risks of escalation of industrial human activity. Legal regulations in the field of environmental protection. Understanding the environmental management systems standard ISO 14000.
- C2. Understanding the risks and ways of obtaining energy from conventional and renewable sources and principles of waste management - waste minimization and recycling, LCA method.
- C3. Familiarizing with the design, operation and modernization of the equipment, favoring the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows and understands the dangers of global warming, the development of technology, energy production, manufacturing and recycling

PEK_W02 - Student understands the need to introduce a new framework for environmental protection, environmental management systems is known, has expertise in the implementation of ISO 14000

PEK_W03 - Student knows and understands the risks of escalation of industrial man knows the rules and benefits of the implementation of environmental measures in the construction and operation of machinery

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sources of risks arising from industrial activities and the operation of machinery, ectotoxins, the greenhouse effect, energy generation	2
Lec2	International conventions and Polish legislation on environmental protection	2
Lec3	Environmental management. Environmental management systems and existing standards BS, EMAS, ISO 14000 and others	2
Lec4	Ecological consequences of energy production from conventional and renewable sources	2
Lec5	Waste minimization, recycling - efficient and environmentally friendly way of waste management	2
Lec6	Waste management, waste source, treatment, energy recovery and safe disposal	2
Lec7	Biodegradability, toxicity, carcinogenicity and mutagenicity of supplies, polychlorinated biphenyls	2
Lec8	Environment-friendly materials in the operation of machinery - oils, greases, lubricating greases, Ecological aspects of the construction, operation and modernization of the equipment	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

N2. tutorials

N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 ÷ PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010 ; Mackenzie A., i inni: Ekologia, PWN W-wa 2009 ; Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006 ; Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN 2007

SECONDARY LITERATURE

Papers: "Czysta Energia", „Utrzymanie ruchu”, „Recykling”, „Nasze Środowisko” , "Ekotechnika"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W05	C1 - C3	Lec1-Lec8	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Roboty przemysłowe**

Name in English: **Industrial robots**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM036002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		3
Lec2		3
Lec3		3
Lec4		3
Lec5		3
Lec6		3
Lec7		3
Lec8		3
Lec9		3
Lec10		3
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED

- N1. informative lecture
- N2. problem lecture
- N3. traditional lecture with the use of transparencies and slides
- N4. problem exercises
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Industrial robots
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W09, K1MTR_W23	C1, C2, C3		N1,N2,N3
PEK_W02	K1MTR_W10, K1MTR_W15	C1, C2, C3		N1,N2,N3
PEK_W03	K1MTR_W09	C1, C2, C3		N1,N2,N3
PEK_U01	K1MTR_U09, K1MTR_U24	C3,C4,C5		N4,N5
PEK_U02	K1MTR_U09, K1MTR_U24, K1MTR_U29	C4, C5		N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie projektami**

Name in English: **Project Management**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM036003**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture

Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		3
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. problem lecture N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 + PEK_W02	
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
<u>SECONDARY LITERATURE</u>

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Project Management AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02	K1MTR_W28	C1 - C3		N1 - N3
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie układów mechatronicznych**
Name in English: **Basics of mechatronical design of systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM036004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge and skills of analysis, synthesis and modeling of kinematic systems
2. knowledge and skills of synthesis and modeling of control systems

SUBJECT OBJECTIVES

- C1. The aim of the course is to familiarize students with the principles of construction, design, modern machinery in terms of mechatronics.
- C2. The aim is to acquire the skill of analysis, modeling and design of a simple mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He has detailed knowledge of selected issues related to the design and modeling of mechatronic systems

II. Relating to skills:

PEK_U01 - Ability to design, integrate, and model the simple mechatronic system, and then verify that it works

III. Relating to social competences:

PEK_K01 - Is aware of the importance and understanding of non-technical aspects and impacts of mechatronics engineer, including its impact on the environment, and the related responsibility for own decisions

PEK_K02 - Able to interact and work in a group, taking the different roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Synergy in designing mechatronics. Examples of use. The structure of mechatronic systems.	3
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Methods of the type synthesis of kinematic systems, methods of exploration of alternatives	2
Lec4	Design and modeling of control systems in a dynamic analysis computer system	2
Lec5	Basics of actuators - characteristics, applications	2
Lec6	Selected mechatronic actuators in machine building - piezoelectric, step motor, servodrives	2
Lec7	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	An introduction to the principles of design of mechatronic system. Presentation of the typical project	2
Proj2	Defining the overall concept, the tasks for the mechatronic system and the analysis and validation of the concept of a mechanical system	3
Proj3	Synthesis of mechanical part of mechatronic system - type synthesis	2
Proj4	Synthesis of mechanical part of mechatronic system - geometrical synthesis	2
Proj5	Building computational models - a preliminary verification of the concept	2
Proj6	The simulation researches to determine the basic properties of kinematic and dynamic	3
Proj7	Development of mechanical structure. Selection drives, gears, bearings, couplings, joints	3
Proj8	Model verification, simulation, analysis	2

Proj9	Develop an overall program strategy of mechatronic system, define tasks for the control system	2
Proj10	Determination of sensory data needs	2
Proj11	The selection of sensor and control systems	3
Proj12	The development of a general algorithm of mechatronic system operation and verify its correctness	2
Proj13	Presentation of mechatronic system design	2
		Total hours: 30

TEACHING TOOLS USED		
N1. problem lecture		
N2. multimedia presentation		
N3. self study - preparation for project class		
N4. tutorials		
N5. report preparation		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01, PEK_K02	Evaluation of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE		
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PRIMARY LITERATURE

1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.
2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.
3. Denny K. Miu: M. Springer –Verlag, Nowy York 1993.
4. Craig J.: Wprowadzenie do robotyki. WNT 1993.
5. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.
6. Frączek J., Wojtyra M.: Metoda układów wieloczołnowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007

SECONDARY LITERATURE

1. Bolton W.: Mechatronics. Longman, Nowy York 1999
2. Roddeck W.: Einfurung in die Mechatronik. B.G. Teubner Stuttgart 1997
3. MD. Adams – Reference Manual, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechatronical design of systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W24	C1	Le1-Le7	N1-N5
PEK_U01	K1MTR_U23	C2	pr1-Pr13	N1-N5
PEK_K01, PEK_K02	K1MTR_K02	C1, C2	Le1-Le7, pr1-Pr13	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **CAD/MES**

Name in English: **CAD/FEM**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		4
Lab2		4
Lab3		4
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
		Total hours: 30

TEACHING TOOLS USED

- N1. self study - preparation for laboratory class
N2. problem exercises
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
CAD/FEM
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U22	C2, C3		N2
PEK_U02	K1MTR_U22	C1, C2, C3		N2, N3
PEK_U03	K1MTR_U22	C2		N3, N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwarzanie sygnałów**

Name in English: **Signal Processing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036108**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge of the basics of calculus, complex functions, ordinary differential equations, Laplace and "Z" transforms, the theory of probability, high-level programming language, knows the simple analog electronic circuits (current and voltage dividers, filters and amplifiers).
2. Students can integrate complex functions, solve differential equations by operators, has abilities in "C programming".

SUBJECT OBJECTIVES

- C1. Getting the ability to analyze signals in time and frequency domain.
- C2. Acquisition of basic knowledge of algorithms and signal processing effects of one and two-dimensional signals (sampling, quantization, Fourier series, FFT, digital filtering, aliasing, image processing algorithms).
- C3. Acquiring skills to design digital filters, FIR and IIR and their application in practice, learning methods for encoding and compression of data (images and 1D signals).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has knowledge of the parameters of continuous and discrete signals (power, energy, mean rms, amplification, attenuation).

PEK_W02 - Knowledge of the basic signal processing algorithms (sampling, quantization, encoding, reproduction analog signal from a digital signal, Fourier series, FFT, convolution, DCT).

PEK_W03 - Knowledge of the principles of digital filtering and FIR and IIR filter design.

II. Relating to skills:

PEK_U01 - Student can calculate the basic signal parameters (power, energy, mean, rms, THD)

PEK_U02 - Student is able to choose the sampling frequency of the signals low-and high pass-band, can prevent the effects of aliasing, analyze the frequency response (to analyze the spectrum of a signal), perform filtering images and make simple morphological operations.

PEK_U03 - Student is able to design and program digital FIR and IIR filter and use it in practice.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Literature. The content of the lecture. The main terms of the signals processing. Deterministic and random signals. Kinds of signals (analog, digital, binary, with finite and infinite energy and power, finite and the infinite duration, finite and infinite amplitude).	2
Lec2	The definition of the trigonometric and the complex Fourier series. Notation a periodic signal of infinite duration and finite amplitude as a superposition of sinusoidal components. Calculation of the complex and trigonometric Fourier coefficients. The concept of discrete spectral signal. Amplitude and phase spectra of periodic signals. Total harmonic distortion factor.	2
Lec3	Digital signals. Notation discrete signals. Basic concepts of digital signal processing - the frequency and the sampling rate. Analog to Digital processing. The concept of sampling, quantization and coding, Digital-Analog conversion.	2
Lec4	Ambiguity discrete signals in the time domain and frequency domain. Aliasing phenomenon. Kotelnikov-Shannon-Nyquist theorem.	2
Lec5	Algorithms of discrete (DFT) and fast (FFT) Fourier transform.	2
Lec6	Discrete convolution. Design of Finite (FIR) and infinite (IIR) impulse response digital filters. Stability of digital filters.	2
Lec7	Lossy compression and lossless image compression. The final exam.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Measurement distorted waveforms current and voltage. Analysis and synthesis of signals (Fourier series).	2
Lab2	Temperature measurements. Programming filters with finite impulse response (filters implemented by the convolution, moving average filters, filters windowed sinc function).	2

Lab3	IIR filters design. Filtration of low-band signals.	2
Lab4	Image processing (filtration and morphology)	2
Lab5	The analysis of vibration signals from various sensors (numerical integration and differentiation of signals)	2
Lab6	Determination of the dynamic characteristics of the use of different types of excitations (pulse, white noise, chirp). FFT spectral analysis.	2
Lab7	Analysis of machine vibration at idle and under load (spectral analysis). Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for laboratory class
- N3. self study - self studies and preparation for examination
- N4. laboratory experiment
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	Final exam, oral and written parts
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U02	short quiz, laboratory reports, participation i discussion, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Smith S.W - Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców. BTC Warszawa 2007

SECONDARY LITERATURE

Lyons, R.G. -Wprowadzenie do cyfrowego przetwarzania sygnałów. WNT Warszawa 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Signal Processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W16	C1 - C3	Lec1 - Lect7	N1, N3
PEK_U01 - PEK_U03	K1MTR_U19, K1MTR_U21	C1 -C3	Lab1 - Lab7	N2,N4,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w medycynie**

Name in English: **Mechatronics in medicine**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036109**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design
3. Knowledge of powertrain.

SUBJECT OBJECTIVES

- C1. Presentation of the possibility of applying mechatronic solutions in medical devices and apparatus
- C2. Directions of development of surgical techniques and medical robots and manipulators construction presentation.
- C3. Possibility of applying the signals generated by the human body to control prostheses and artificial organs

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - have the knowledge to describe the basic issues of human musculoskeletal biomechanics

PEK_W02 - have the knowledge to propose the type and structure drive system supporting functions biomechanical inefficient or lost body parts

PEK_W03 - have the knowledge to propose a kind of biological signal that can be used to control the prosthesis or artificial organ

II. Relating to skills:

PEK_U01 - able to carry out physical properties tests of selected mechatronic systems used for the treatment and support functions of human locomotion

PEK_U02 - can use and modify the algorithms controlling the operation of mechatronic devices supporting human locomotion

PEK_U03 - able to interpret the results of physical testing of mechanical systems supporting human locomotion

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Human as a mechatronic system	1
Lec2	Examples of mechatronic solutions in a device supporting human locomotion	3
Lec3	Mechatronic solutions supporting equipment used in surgery	3
Lec4	The use of mechatronic systems for medical diagnosis	2
Lec5	Mechatronic external fixators of long bones: fracture treatment, limb lengthening, limb axis correction	2
Lec6	Artificial organs: heart, heart prosthesis, heart - lung machine, kidney - the mechanical structure, drive systems, control	2
Lec7	Active artificial limbs: construction, drive systems, control	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to computer navigation. The measurement of surface geometry.	2
Lab2	The use of computer navigation with medical imaging in medicine.	2
Lab3	The use of robotics in medicine. Controlling humanoid robots	2
Lab4	The use of robotics in medicine. Controlling humanoid robots	2
Lab5	The use dynamometric platform for analysis of load distribution	2
Lab6	Applications of 3D printing technology in medicine	2
Lab7	The use of the electromagnetic navigation to motion of the mandible examination	3
		Total hours: 15

TEACHING TOOLS USED

- N1. informative lecture
 N2. multimedia presentation
 N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	laboratory report, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Nałęcz M. (ed.), Biocybernetics and Biomedical Engineering, Volume 3: Artificial organs, Exit Academic Publishing House, Warsaw 2004
 Podśędkowski L.: Roboty medyczne. Budowa i zastosowanie. Wydawnictwo Naukowo - Techniczne, Warsaw, 2011

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics in medicine
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W08, K1MTR_W09	C1, C2, C3	Lec1, Lec2, Lec5	N1, N2
PEK_W02	K1MTR_M_W03, K1MTR_W26	C1, C2	Lec2, Lec3, Lec4, Lec5, Lec7	N1, N2
PEK_W03	K1MTR_W23	C3	Lec1, Lec3, Lec6, Lec7	N1, N2
PEK_U01	K1MTR_U02, K1MTR_U03	C1	Lab1, Lab4, Lab5, Lab7	N3
PEK_U02	K1MTR_U21	C1	Lab1, Lab2, Lab4, Lab6, lab7	N3
PEK_U03	K1MTR_U21	C1	Lab3	N3
PEK_K01	K1MTR_K01, K1MTR_K07	C1-C3	Lec1-Lec7, Lab1-Lab7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy mechatroniczne w technologiach wytwórczych**

Name in English: **Mechatronic systems in manufacturing technologies**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036110**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing techniques, mechanical and structural design propulsion systems.
2. He has knowledge of the measurement object and process monitoring. He knows the principles of design and testing of control systems.
3. Able to analyze circuits used in technical documentation and interpret the results obtained objects.

SUBJECT OBJECTIVES

- C1. Acquisition of basic knowledge related to mechatronic systems used in manufacturing technologies.
- C2. Acquiring the ability of selection to the manufacturing technology dedicated devices: sensors, actuators and mechatronic drives. He can choose the controls productive equipment used in specific mechatronic solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - know the basics of applications of mechatronic systems in a variety of manufacturing technologies, know dedicated to this: sensors, actuators and mechatronic units,

PEK_W02 - familiar with the basic principles of mechatronic design and control systems manufacturing facilities,

PEK_W03 - have knowledge of the selected mechatronic solutions for machining, metal forming and welding.

II. Relating to skills:

PEK_U01 - mechatronic solution is able to select a specific technology, manufacturing,

PEK_U02 - able to analyze the effects of the mechatronic system,

PEK_U03 - can design simple mechatronic system used in production systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discussion of the role of mechatronic systems in manufacturing technology.	2
Lec2	Overview of sensors, actuators and mechatronic members for the various manufacturing technologies.	2
Lec3	Introduction to designing mechatronic technologies used mostly in manufacturing.	2
Lec4	Selected applications in mechatronics equipment for machining.	2
Lec5	Selected applications of mechatronics in metal forming.	2
Lec6	Selected applications of mechatronics in welding equipments.	2
Lec7	Final conclusions and recommendations for the design of mechatronic systems in manufacturing technologies.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Mechatronic systems used in the physical modeling of the metal forming.	2
Lab2	Mechatronic systems used in the clinching sheets.	2
Lab3	Mechatronic systems used in advanced measurement methods temperature for manufacturing systems.	2
Lab4	Mechatronics in welding accessory (handles, wire feeders, darkening helmets).	2
Lab5	Mechatronics in equipment for soldering in microelectronics.	2
Lab6	Mechatronics in equipment for resistance welding.	2
Lab7	Welding robots.	3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. laboratory experiment
- N3. self study - preparation for laboratory class
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03;	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	Entrance, laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

The development of the subject of the lecture provides a lecturer.

SECONDARY LITERATURE

Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Mechatronic systems in manufacturing technologies** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MTR_W09, K1MTR_W15, K1MTR_W23	C1-C2	Lec1-Lec7	N1
PEK_U01-PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U15	C2	Lab1-Lab7	N2-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie zespołów mechanicznych**

Name in English: **Design of mechanical assemblies**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036202**

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			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		3
Lec3		2
Lec4		3
Lec5		3
Lec6		2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		4
Proj3		4
Proj4		4
Proj5		1
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - self studies and preparation for examination
- N3. self study - preparation for project class
- N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02	
F2	PEK_U01, PEK_U02, PEK_K01	
F3	PEK_U01, PEK_U02, PEK_K01, PEK_K02	
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Osiński Z. i inni.: Podstawy konstrukcji maszyn, PWN, Warszawa 1999.
2. Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.
3. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne, Rozprawy Naukowe nr 44, Politechnika Białostocka, Białystok 1997.

SECONDARY LITERATURE

1. Dietrich M. i inni.: Podstawy konstrukcji maszyn. WNT, Warszawa 1995.
2. Mazanek E. i inni.: Przykłady obliczeń z podstaw konstrukcji maszyn. WNT, Warszawa 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of mechanical assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N1,N2,N4
PEK_W02	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N1,N2,N4
PEK_U01	K1MTR_M_U01, K1MTR_U09, K1MTR_U22	C1,C2	Pr1 - Pr5	N1,N2,N3,N4
PEK_U02	K1MTR_U23, K1MTR_U24	C1,C2	Pr1 - Pr5	N1,N2,N3,N4
PEK_K01	K1MTR_K02, K1MTR_K04	C1,C2	Pr1 - Pr5	N1,N2,N3,N4
PEK_K02	K1MTR_K02, K1MTR_K04	C1,C2	Pr1 - Pr5	N1,N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja wytwarzania**

Name in English: **Manufacturing automation**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM036203**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the design-construction process, the structure, functioning and operation of the main machine elements and assemblies and the principles of matching and constructing them.
2. The student has sound knowledge of the structure of machine tools and their functionalities.
3. The student has an established knowledge in the field of sensorics applied in the manufacturing systems.

SUBJECT OBJECTIVES

- C1. The student is to get to know the functional structure of the manufacturing system and flexible manufacturing system design concepts.
- C2. The student is to get to know the functional subsystems of flexible manufacturing systems and the possibilities of their automation.
- C3. The student is to familiarize herself/himself with typical manufacturing automation solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the structure of the flexible manufacturing system (FMS) and can distinguish and describe its main components.

PEK_W02 - The student knows the functionalities of the manufacturing system and can propose different automation solutions for this system.

PEK_W03 - The student can distinguish between the flow systems of workpieces, tools, machining fluids and chips in FMS.

II. Relating to skills:

PEK_U01 - The student can select a flexible manufacturing system configuration functionally proper for carrying out the set tasks.

PEK_U02 - The student can select a proper system of the flow of tools and organize their circulation according to the technological tasks being carried out.

PEK_U03 - The student can design a system of the flow workpieces, taking into account the manipulation, transport and storage of the material.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of mechatronics and improving her/his professional and social competences.

PEK_K02 - The student is able to think and critically analyze the functioning of the production system in order to increase its effectiveness.

PEK_K03 - The student is aware of responsibility for her/his own work and its impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, the notion of a system, the manufacturing system.	2
Lec2	The functional structure of the manufacturing system.	2
Lec3	The conditions for the development of the flexible automation of manufacturing.	2
Lec4	Flexible manufacturing system (FMS) implementation concepts.	2
Lec5	Machine tools for FMS.	2
Lec6	Equipment for burr removal from workpieces in FMS.	2
Lec7	Coolants, chips disposal and washing workpieces in FMS.	2
Lec8	Tool management system in FMS.	2
Lec9	Part management system in FMS.	2
Lec10	Handling and transport systems in FMS.	2
Lec11	Storage systems in FMS.	2
Lec12	Information systems in FMS.	2
Lec13	The supervision and diagnosis of FMS operation.	2
Lec14	FMS availability.	2
Lec15	Final test.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory and discuss safety rules.	1
Lab2	Coordinate Measurements.	2
Lab3	Tool presetting for CNC machines.	2
Lab4	Modular and mechatronic tools.	2
Lab5	Select the operating parameters of the welding robot.	2
Lab6	Wireless management of information in storage systems.	2
Lab7	Coding systems for parts.	2
Lab8	Diagnostic double-action hydraulic press.	2
		Total hours: 15

TEACHING TOOLS USED
<p>N1. traditional lecture with the use of transparencies and slides</p> <p>N2. multimedia presentation</p> <p>N3. self study - preparation for laboratory class</p> <p>N4. laboratory experiment</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U1 - PEK_U03	entrance test, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Honczarenko J.: Elastyczna automatyzacja wytwarzania. WNT, Warszawa 2000.
2. Krzyżanowski J.: Wprowadzenie do elastycznych systemów wytwórczych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

SECONDARY LITERATURE

1. Kief H.B.: FFS-Handbuch, Carl Hanser Verlag 1998.
2. Luggen W.W.: Flexible manufacturing cells and systems, Prentice-Hall, Inc. Englewood Cliffs, NJ, 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing automation
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W01, K1MTR_M_W02	C1 - C2	Lec1 - Lec15	N1, N2
PEK_U01- PEK_U03	K1MTR_M_U02, K1MTR_U03	C3	Lab1 - Lab8	N3, N4
PEK_K01- PEK_K03	K1MTR_K03, K1MTR_K04, K1MTR_K13	C3	Lab1 - Lab8	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**

Name in English: **Diploma seminar**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM037001**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS points in required range.

SUBJECT OBJECTIVES

- C1. Acquiring ability to present own qualifications, knowledge, skills and social competences.
- C2. Consolidation the ability to think critically and work in team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can present their own skills with a range of knowledge, skills and social competences.

III. Relating to social competences:

PEK_K01 - Student is able to think and act in a way that is creative and enterprising, he can work in a group.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, general information about writing Master's thesis and master's examination.	2
Sem2	Rules of proper technical and scientific paper preparation and Master's thesis.	2
Sem3	Review of the issues concerning diploma exam, comments and discussion.	11
Sem4	Multimedia presentations of the diploma works and discussion – students presentation.	13
Sem5	Summary of coursework and grading.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Informative lecture.

N2. Self study - self studies and preparation for examination.

N3. Multimedia presentation.

N4. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	The appreciation of skill of solving in range of qualifying work the technical problems and their multimedia introduction as well as the leadership of discussion.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R. Zanderowski: Praca magisterska, licencjat: krótki przewodnik po metodologii pisania i obrony pracy dyplomowej, CeDeWuL, Warszawa 2009.
2. A. Lenar: Profesjonalna prezentacja multimedialna, Helion, Gliwice 2010.
3. Publikacje wynikające z zakresu realizowanej pracy dyplomowej.
4. Materiały z wykładów.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_K01	K1MTR_K01, K1MTR_K03, K1MTR_K04, K1MTR_K06, K1MTR_U24	C1	Sem3-Sem5	N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**

Name in English: **Numerical Methods**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM037202**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project

Number of hours

Proj1		1
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		2
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. problem discussion
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_K01	
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical Methods
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U03, K1MTR_U21	C2		N1, N2, N3, N4
PEK_K01	K1MTR_K03, K1MTR_K04	C3		N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie OSN**

Name in English: **Programing of machine numerical controled**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM037203**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		4
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		4
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		4
Lab5		2
Lab6		2
Lab7		2
		Total hours: 16

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. tutorials
N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Programing of machine numerical controled AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W04, K1MTR_W11	C1 - C3		N1, N3
PEK_U01 - PEK_U03	K1MTR_M_U05, K1MTR_M_U06, K1MTR_U24	C1 - C3		N1 - N4

SUBJECT SUPERVISOR		
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Monitorowanie maszyn i procesów**

Name in English: **Monitoring of machines and processes**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCM037205**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a firm knowledge of the structure and operation of the basic machinery of production. Knows the basic principles of design processes typical of machine parts.
2. Has a basic knowledge of calculus and statistics for the engineering signal processing and analysis.
3. Has a a basic understanding of sensory and build measurement systems.

SUBJECT OBJECTIVES

- C1. Acquisition of basic knowledge on the condition monitoring of production and their processes.
- C2. Gaining knowledge of the processing, analysis and evaluation of the diagnostic signal.
- C3. Acquisition of competence of accountability, integrity and fairness in the proceedings. Observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has basic knowledge of machine condition monitoring and process it implemented.

PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.

PEK_W03 - Has knowledge of the processing, analysis and evaluation of signals.

II. Relating to skills:

PEK_U01 - Provides support for used measurement and control equipment.

PEK_U02 - Able to analyze and evaluate the diagnostic signals.

PEK_U03 - Can choose the right way to measure, depending on the source of the interference of the machine.

III. Relating to social competences:

PEK_K01 - Takes responsibility and integrity in the conduct of laboratory experiments and objective evaluation of arguments.

PEK_K02 - Can think creatively and determine how to implement the research task.

PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Tasks systems monitoring, diagnosis and monitoring. Types of diagnostics and their goals.	2
Lec3	Monitoring the condition of machinery manufacturing.	4
Lec4	Supervising tools.	2
Lec5	Supervising the machining process.	2
Lec6	Supervising the accuracy of workpieces.	2
Lec7	Summary of lectures, additional explanations. Checking knowledge.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Supervising production process of cast iron.	2
Lab2	Supervising welding processes.	2
Lab3	Diagnostic equipment for plastic working.	2
Lab4	Diagnosis of CNC machine tools with the help of the tester QC10.	2
Lab5	Monitoring the machine geometry.	2
Lab6	Artificial intelligence tools in supervising of machines and processes.	2
Lab7	Processing and analysis of diagnostic signals.	3
		Total hours: 15

TEACHING TOOLS USED

- N1. tutorials
- N2. traditional lecture with the use of transparencies and slides
- N3. self study - preparation for laboratory class
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	test, report on laboratory exercises, participation in discussions of problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Żółtowski B., Cempel Cz.: "Engineering of machine diagnostics", Polskie Towarzystwo Diagnostyki Technicznej, Instytut Technologii Eksploatacji PIB Radom, Warszawa, Bydgoszcz, Radom, 2004
2. Cempel Cz., Tomaszewski F.: "Machine diagnostics. General. Examples of applications", Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom, 1992
3. Honczarenko J.: "Flexible manufacturing automation", WNT, Warszawa, 2000

SECONDARY LITERATURE

1. Czyszpak T.: "Application of fuzzy inference system in the diagnosis of machine tools and machining process", Prace Naukowe Katedry Budowy Maszyn - Politechnika Śląska 1427-9347 nr 2/2008, Gliwice, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Monitoring of machines and processes
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W02	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W03	K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17	C2	Lec1 - Lec7	N1, N2
PEK_U01	K1MTR_U02, K1MTR_U03	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U02	K1MTR_U17, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U03	K1MTR_U19, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K01	K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K07	C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K02	K1MTR_K05, K1MTR_K06	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K03	K1MTR_K01, K1MTR_K08, K1MTR_K09	C3	Lab1 - Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **SCADA i HMI**

Name in English: **SCADA AND HMI**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCM037208**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PROGRAMMABLE LOGIC CONTROLLERS

SUBJECT OBJECTIVES

- C1. Explain the construction of HMI and SCADA systems
- C2. Explain the operation and design of HMI and SCADA systems
- C3. Explain the use of HMI and SCADA systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can describe the construction of HMI and SCADA systems

PEK_W02 - Can explain the operation and design an HMI and SCADA system

PEK_W03 - He can propose the appropriate HMI or SCADA system for a specific application

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic monitoring and control of industrial processes applications	1
Lec2	Construction and operation of SCADA package for example packages In Touch Wonderware Corporation and Siemens WinCC.	2
Lec3	Features and components of packages.	1
Lec4	Tools and methods for creating synoptic screens.	1
Lec5	Animation of graphical objects and the creation and use of libraries of objects	1
Lec6	Scripting language.	2
Lec7	Timing diagrams in real time and present the history of the process charts.	1
Lec8	Alarms: definition, presentation, service, validation, view, save and print ..	1
Lec9	HMI-construction, operation, maintenance, programming	2
Lec10	Communication protocols, communication driver	1
Lec11	Industrial Databases	1
Lec12	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002

SECONDARY LITERATURE

Wonderware InTouch Podręcznik Użytkownika, Invensys Systems, Inc. 2005.
SIMATIC HMI WinCC flexible, Siemens, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
SCADA AND HMI
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W19	C2	Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11,	N1
PEK_W03	K1MTR_W19	C3	Lec1, Lec2, Lec9, Lec10,	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy metrologii**

Name in English: **Metrology principles**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR031101**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

- C1. Understanding the essence of measurement to recognize true state and relations between physical quantities.
- C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
- C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
- C4. Gaining basic knowledge about measurement interferences factors.
- C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods

PEK_W02 - Knows basic properties of measurements apparatus and measurements systems.

PEK_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Measurement essence and metrology significance in technics and economy. Technical and legal metrology. Basic terms. Measurements scales and units. SI system and basic units definitions. Measurement services.	2
Lec2	Standards and hierarchical unit scaling system. Measurements equipment: apparatus, systems, measurement chain. Sensors and their properties and application; conditions.	2
Lec3	Experiment planning and measurement methods: division dependent on conditions, properties, example of use.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	2
Lec5	Calibration and legalization of measurement instruments: sources of measurement error; conditions and procedures of calibration and legalization; accreditation requirements; errors and corrections calculation; calibration and legalization certificates.	2
Lec6	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec7	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

N2. tutorials

N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology principles
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03	C1, C2		N1, N2, N3
PEK_W02	K1MTR_W03	C3, C4		N1, N2, N3
PEK_W03	K1MTR_W03	C5		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy elektrotechniki**

Name in English: **Fundamentals of Electrotechnics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR032102**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	30			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basic concepts of vector analysis (adding vectors, scalar product and vector operations, differentiation of vector functions, and linear surface integrals).
2. Has basic knowledge of complex numbers and matrix calculus, solving systems of linear equations and analytic geometry in the plane.

SUBJECT OBJECTIVES

- C1. To acquaint the student with the knowledge necessary to understand the basic theory of the electromagnetic field.
- C2. Familiarize students with the basic knowledge about the analysis of linear circuits in steady state.
- C3. Teach the ability to analyze single and three phase electrical circuits with sinusoidal sources, including magnetic coupling.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows the basic laws and theoretical foundations of the theory of electromagnetic field and electric circuit theory.

PEK_W02 - Has basic knowledge of analysis of linear circuits with sinusoidal sources in steady state.

PEK_W03 - Has knowledge of the power and energy in single- and three-phase circuits and methods of its calculations and measurements.

relating to skills:

II. Relating to skills:

PEK_U01 - Can correctly use laws of electromagnetic field theory, determining the physical quantities in engineering (RLC parameters, the electric and magnetic field distributions).

PEK_U02 - Can correctly use various methods for solving electrical circuits in the analysis of linear circuits with sinusoidal sources.

relating to social competences

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Getting to know the subject matter, requirements and method of assessment. Electric charge. Law of conservation of charge. Coulomb's law. The field strength. The potential and voltage. Vector of electric induction. Gauss' law. Introduction to electrostatic field. Electrical capacitance. Capacitor.	2
Lec2	Field flow of electric current. Vector of current density. Electric current. Ohm's law. Joule's law. The law of continuity of the current. Kirchhoff's law.	2
Lec3	Magnetic field. Vector of magnetic induction. The magnetic flux. The Laplace formula and Biot-Savart law. Ampere's law. Field of magnetic vector. Faraday's Law. Self and Biot-Savart law. Ampere's law. Field of magnetic vector. Faraday's Law. Self and mutual inductance. mutual inductance.	2
Lec4	Electrical circuit. The concept of the signal. Branches and nodes. Active and passive components. The accumulation and dissipation of energy in passive components. Direction of currents and voltages. The relationship between voltages and currents on passive components. Wiring diagrams and structural circuit. Graphs. Matrix notation of circuit structure. Incidence matrix. Relations between arrays of incidence. Relationship between potentials in nodal and branch method.	3
Lec5	Classification of signals: aperiodic and periodic. The RMS value and average value of periodic signals. Electrical properties: linearity, stationarity and causality. The general form of the branch circuit. The equations of voltages and currents. Ohm's law and Kirchhoff's law in matrix notation. The balance of the instantaneous power for the electrical circuit.	2

Lec6	The response of RLC elements on alternating sinusoidal signal. Function of complex sinusoidal signal. Complex value. Algebraic form of complex signals. The Ohm's law and Kirchhoff's laws in complex form. Graphs, Phasor. The phase shift. Triangle of voltages, impedance and admittance. The concept of active, reactive and apparent power. Active and passive components of voltages and currents. The equivalent power source.	3
Lec7	Two- and multi-terminal equivalent circuits. The transformation of the triangle - the star. Method of superposition. Method of loop currents. The method of node potentials. Applying the method of loop currents and node potentials.	4
Lec8	Thevenin and Norton's theorem: the no-load voltage and short circuit current of two-terminal circuit. Impedance equivalence of two-terminal circuit. Equivalence of voltage and current sources. Equivalent sources.	2
Lec9	The resonance of voltages and currents. Conditions of resonance. Characteristics in frequency of resonant circuits. The importance of resonance in electrical engineering. Reactive power compensation. Electric filters.	2
Lec10	Magnetically coupled circuits. Mutual inductance. Positive and negative feedback. Decoupling branch of common node. Coreless Transformer.	4
Lec11	Three phase circuits. Multi-phase voltage source. Three phase circuits in star and triangle. Three- and four-wire circuits. Phase voltages and interphase voltages. Phase currents. The operator of rotation. Graphs and Phasors of 3phase circuits. Distribution of current in symmetrical and asymmetrical circuits. Power in three-phase circuits. Measurement of active and reactive power in balanced and unbalanced three- and four-wire systems.	4
		Total hours: 30
Form of classes – Classes		Number of hours
CI1	Coulomb's law. The electric field vector. Calculation of distribution electrostatic field at the given distribution of charge. Calculation of the capacitance.	2
CI2	Calculation of field flow distribution. Determination the magnetic field intensity distribution for the circuit with current. Resistance and self-inductance.	2
CI3	Determination of circuit parameters supplied by sinusoidal voltage, based on the measurement data.	1
CI4	Determination of complex parameters of waveforms. Inverse transformation. The design of phasor diagrams for the RLC elements connected in series and in parallel.	1
CI5	Calculation of the distribution of currents in the circuit using the branch and nodal methods. Use of the method of Thevenin and Norton in the analysis of electrical circuits.	2
CI6	Analysis of RLC circuits under conditions of resonance of voltages and currents. Calculation of currents in circuits coupled magnetically	2
CI7	Calculation of currents and voltages in the three-phase circuits, symmetrical and asymmetrical. Watt-meters in 3 phase circuits.	3
CI8	Test	2
		Total hours: 15

TEACHING TOOLS USED

- N1. problem lecture
- N2. tutorials
- N3. self study - self studies and preparation for examination
- N4. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam
F2	PEK_W02	Exam
F3	PEK-W03	Exam
$P = 0.4F1 + 0.3F2 + 0.3F3$		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02	
$P = 0,5 F1 + 0,5 F2$		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Electricity and Magnetism, Volume 3, PWN, 2011.
- [2] Osowski S., K. Siwek, Daredevil M. Theory of circuits. Warsaw University of Technology, 2006.

SECONDARY LITERATURE

- [1] Piątek Z., P. Jablonski, Basic theory of electromagnetic field, WNT, 2010.
- [2] Bolkowski S., Brociek W., Rawa H., Theory of electrical circuits, Exercises, WNT 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electrotechnics
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W13	C1, C2	Lec1-Lec5	N1- N4
PEK_W02	K1MTR_W13	C2	Lec6-Lec11	N1 - N4
PEK_W03	K1MTR_W13	C3	LEc10-Lec11	N1- N4
PEK_U01	K1MTR_U13	C1, C2	CI1, CI2	N4
PEK_U02	K1MTR_U13	C1, C2	CI1-CI3	N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do programowania**

Name in English: **Introduction to programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR032251**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic problems of computer science (Information technology).
2. Abilities of handling computer with the operating system WINDOWS.
3. The student is able to think and act creatively

SUBJECT OBJECTIVES

- C1. Knowing and acquiring proficiency in use of principles of structural approach to creating algorithms.
- C2. Knowing of principles of programming in the C language
- C3. Mastering a skill of writing programs in the C language.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student has knowledge in the scope of structural programming.

PEK_W02 - The student knows fundamentals of the C programming language.

II. Relating to skills:

PEK_U01 - The student is able to make use of principles of structural programming.

PEK_U02 - The student is able to write a simple program in the C programming language.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	An introduction. Algorithms. Principles of creating flow charts	2
Lec2	Ideas of programming: the structural programming, object-oriented programming	2
Lec3	General characteristics of the C programming language. Writing simple programs. Programming calculation of expressions.	2
Lec4	Entering data into a program from the keyboard. Display of calculation results on the screen	2
Lec5	Programming change of the order of the performed calculation. Entering iterations into a program.	2
Lec6	A concept of standard library. Its utilization in a program.	2
Lec7	Test I.	2
Lec8	Extracting the repetitive parts in a program.	2
Lec9	Considering a set of data of the same type.	2
Lec10	Handling address of indicated place in computer memory.	2
Lec11	Declaration of own types. Considering a set of data of different types.	2
Lec12	Handling of text.	2
Lec13	Writing data into a mass storage of a computer.	2
Lec14	Practical principles of writing programs.	2
Lec15	Test II	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Flow charts for simple algorithms.	2
Lab2	Flow charts for more complex algorithms.	2
Lab3	Writing, compiling and running simple programs.	2
Lab4	Reading data from the keyboard. Display of numbers and strings on the screen.	2
Lab5	Writing programs with use of bifurcation of control and jumps.	2
Lab6	Programs utilizing loops.	2

Lab7	Utilization of directives and macrodefinitions.	2
Lab8	Programming with use of functions	2
Lab9	Recurrent functions.	2
Lab10	Programming table operations.	2
Lab11	Introduction of pointers into a program.	2
Lab12	Writing programs with use of data structures and unions.	2
Lab13	Programming more advanced operations on strings.	2
Lab14	Creating programs which read input data from files and write results into files	2
Lab15	Writing programs with various elements of the C programming language.	2
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - preparation for laboratory class
- N3. report preparation
- N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02	activity at the classes
F2	PEK_W01 PEK_W02	tests
$P = P=0.1 \cdot F1 + 0.9 \cdot F2$		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02	activity at the laboratory classes
F2	PEK_U01 PEK_U02	reports from the laboratory classes

$$P = P=0.3 \cdot F1 + 0.7 \cdot F2$$

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Wirth N., Algorithms + Data Structures = Programs. Prentice-Hall, PTR Upper Saddle River, NJ, USA 1978.
 [2] Kernighan B. W. , Ritchie D. M. , The C programming language. Prentice-Hall, Inc. Upper Saddle River, NJ, USA, 2011.
 [3] Sexton C. , C Programming Made Simple. Elsevier Science, Oxford, 2011.

SECONDARY LITERATURE

- [1] King K.N., C Programming: A Modern Approach, W. W. Norton & Company, 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to programming
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1, C2	Lec1	N1, N4
PEK_W02	K1MTR_W19	C2	Lec2, Lec3, Lec4, Lec5, Lec6, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14	N1, N4
PEK_U01	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, La9, Lab10, Lab11, Lab12, La13, Lab14, Lab15	N2, N3
PEK_U02	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materialoznawstwo II**

Name in English: **Materials Science II**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR033102**

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)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of advanced mathematics on a level permitting to understand mathematical problems in engineering sciences. Knowledge of the principles and laws of physics in the field of classical electrodynamics (electrostatics, electricity, electromagnetic waves, optics) and selected topics in solid state physics.
2. He can correctly and efficiently apply knowledge of mathematics for qualitative and quantitative analysis of mathematical problems related to the field of corresponding engineering studies. He can correctly and efficiently apply the previously acquired principles and laws of physics to the qualitative and quantitative analysis of physical problems as engineering.
3. He knows the possibilities of the further knowledge development and improvement of competences at work.

SUBJECT OBJECTIVES

- C1. Acquisition of theory-grounded knowledge about the properties of materials used in mechatronics, electrical engineering, electronics and optoelectronics
- C2. Understanding the importance of smart materials and nanomaterials in science and technology
- C3. Acquisition of skills related to research organization and materials diagnostics with carefully selected methods

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He/she has knowledge about the properties of conductive, semi-conductive, dielectric and magnetic materials. He/she understands the importance of smart materials and nanomaterials in science and technology.

PEK_W02 - He/she is able to describe the influence of external stresses on the physical characteristics of materials

PEK_W03 - He/she is able to appropriately select materials for specific applications.

II. Relating to skills:

PEK_U01 - He/she can independently determine the parameters of selected materials. He/she can make a critical analysis of the results obtained.

PEK_U02 - He/she can interpret the physical phenomena occurring during the materials examination and testing

PEK_U03 - He/she can use acquired and well chosen methods for the diagnostics of materials

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, literature, credit conditions. The electrical conductivity of metals. Wire, contact and thermoelectric materials	2
Lec2	Semiconductor materials. Varistors	2
Lec3	Dielectrics. Electrical conductivity, polarization, dielectric losses. Electric strength	2
Lec4	Inorganic insulating materials: ceramics, glass. Optical fibers.	2
Lec5	Insulating thermoplastic and thermoset materials. Composite materials	2
Lec6	The essence of magnetism. Basic properties. Soft and hard magnetic materials. Ferrites	2
Lec7	Electrets. Smart materials	2
Lec8	Nanomaterials	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Resistance measurements of solid and liquid dielectrics	3
Lab2	Determination of dielectric permittivity. Measurement of dielectric losses	3
Lab3	Dielectrics electric strength examination.	3
Lab4	Examination of magnetic properties of electrical steel sheets.	3
Lab5	Hall effect examination	3
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. self study - self studies and preparation for examination
- N3. self study - preparation for laboratory class
- N4. report preparation
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Short quiz before laboratory exercises
F2	PEK_U01, PEK_U02, PEK_U03	Report from the laboratory exercises
P = 0,5 F1 + 0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Newell J., Essentials of modern materials science and engineering, John Wiley and Sons, Inc. 2009[2] Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2011[3] Blicharski M., Wstęp do inżynierii materiałowej, Wydawnictwo AGH, Kraków, 2009[4] Rutkowski J. I inni, Podstawy inżynierii materiałowej – laboratorium, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005 [5] Lisowski M. - Pomiar rezystywności i przenikalności elektrycznej dielektryków stałych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2004[6] Hilczer B., Małecki J.- Elektrety i piezopolimery, PWN, Warszawa, 1992

SECONDARY LITERATURE

[1] Oleś A., Metody doświadczalne fizyki ciała stałego, WNT, Warszawa, 1998[2] Kolbiński K., Słowikowski J., Materiałoznawstwo elektrotechniczne, WNT, Warszawa, 1988[3] Recent papers covering usage of materials in engineering

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W02	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W03	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_U01	K1MTR_U03	C3.		N3., N4., N5.
PEK_U02	K1MTR_U03	C3.		N3., N4., N5.
PEK_U03	K1MTR_U03	C3.		N3., N4., N5.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Instalacje elektryczne i układy zasilania**

Name in English: **Electrical installations and supply systems**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR033231**

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	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. In the scope of knowledge:

1. Student has the knowledge in the scope basics of the physics, particularly he understands the action of to get warm with electrical current and the mechanisms of heat transmission.

2. Student has the knowledge in the scope basics of the electrotechnics, he knows the basics elements electrical circuits, he knows the basics dimensions which characterize the electrical circuit, he knows to calculation of the simple electrical circuits.

2. In the scope of know-how:

1. Student knows the basics utilization of the computer.

3. In the scope of the competence:

1. Student conscious of the responsibility to assume his work.

2. Student conscious of the imminent of life and health in connexion with work by the electrical devices.

3. Student understands the need and knows possibility self-education, to improve the professional competences.

SUBJECT OBJECTIVES

- C1. Acquirement the knowledge of the secure work by the electrical devises.
- C2. The competently classification of the electrical low-voltage devices as well as the basics parameters of them.
- C3. Acquirement the knowledge of solutions of the tasks and problems useful in choice of the supply and devices in the circuit of the electrical installation.
- C4. Acquirement and record social competences which refer the readiness to the work in the team as well as independent, responsibility and honesty in the behaviour, consciousness of the results undertaken engineer's activity.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has the deeply and the verified knowledge in the scope of the construction and the appropriation of the individual part of the electrical installation.

PEK_W02 - Student has the deeply and the verified knowledge in the scope of the over-current and of the over-voltage protection in circuit of electrical installation. Student knows the basic parameters of the low-voltage switches.

PEK_W03 - Student knows the basic elements of the feeders cable of the direct current (DC) as well alternating current (AC) used in the scientific as well as the research laboratories. Student knows the parameters of them as well as he uses them.

II. Relating to skills:

PEK_U01 - Student is able to calculation of short-currents in the circuit of electrical installation in order to attain the choice of electrical apparatus as well as the test electrical shock protection.

PEK_U02 - Student is able to calculation of thermal effect as result flow the short-currents as well as the overload-currents in the wires and in the another elements of the electrical installation.

PEK_U03 - Student is able to choice the type of supply, parameters of circuit supply given another circuit in electrical installation as well as circuit in the laboratory.

III. Relating to social competences:

PEK_K01 - Student well establishment know-how co-operate in team by realization of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information about the subject of the devices and installations electrical. System of the supply in electrical energy of customers.	2
Lec2	Elements of the electrical installation. Calculate of short currents 3-phase and 1-phase in installations circuits in order to attain the choice of electrical apparatus.	2
Lec3	Switches and fuses of the low voltage – construction and basic characteristics. Power electrical wiring and the rules them selection. Insulation and over-voltage protection.	2
Lec4	Thermal effects of the flow the short-currents as well the overload-currents in electrical installations. The thermal characteristics. Protection of the thermal effects.	2

Lec5	Low-voltage switchgear. Basics of the planning as well the projecting of the electrical installation. Electrical shock protection.	2
Lec6	Power quality, reliability of the supply, reserve and un-interruption source of supply.	2
Lec7	Feeder cable of the direct current (DC) as well of the alternating current (AC). Feeder cable utilization in the laboratory. Basics parameters and rules of choice.	2
Lec8	Colloquium for the course.	1
		Total hours: 15
Form of classes – Classes		Number of hours
CI1	Introductory classes. Discussion of the subject scope and credit of the course. Initial information of the subject of the supply system in power electricity and in electrical installations.	2
CI2	Calculation of the short-currents in electrical installations in order to attain the choice of electrical apparatus.	2
CI3	Calculation of the thermal effect in the wires as well in another elements of electrical installation. Thermal characteristics at short-currents as well at overload-currents.	2
CI4	Calculation of the thermal effect at short-currents and protection against them in the electrical installations.	2
CI5	Calculation of thermal effect at overload-currents. Protection criterion of the wires against these effects.	2
CI6	Exemplary, basics the projecting calculation of electrical installations.	2
CI7	Choice of the feeder to given lab-circuit as well as to electrical installation.	2
CI8	Colloquium for the course.	1
		Total hours: 15

TEACHING TOOLS USED

- N1. calculation exercises
- N2. problem exercises
- N3. problem discussion
- N4. multimedia presentation
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01	Colloquium
F2	PEK-W02	Lec3, lec5, Colloquium

F3	PEK-W03	Lec6, Lec7, Colloquium
P = 0,5F1+0,5F2+0,8F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-K01	Participation in problematical discussions.
F2	PEK-U01	CI1, CI2, paper test
F3	PEK-U02	CI3, CI4, CI5, paper test
F4	PEK-U03	CI6, CI7, Colloquium
P = 0,4F1+0,6F2+0,8F3+0,8F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Markiewicz H., Urządzenia elektroenergetyczne, WNT, Warszawa, 2005.

Markiewicz H., Instalacje elektryczne, WNT, Warszawa, 2007.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical installations and supply systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK-W01	K1MTR_W10	C1, C2	Lec1, Lec2	N2, N4, N5
PEK-W02	K1MTR_W10	C2, C3	Lec3, Lec4, Lec5	N1, N2, N4, N5
PEK-W03	K1MTR_W10	C2, C3	Lec5, Lec6, Lec7	N1, N2, N3, N4, N5
PEK-U01	K1MTR_U01, K1MTR_U02	C1, C3	CI1, CI2	N1, N2, N3, N4, N5

PEK-U02	K1MTR_U03, K1MTR_U04	C1, C3	CI3, CI4, CI5	N1, N2, N3, N4, N5
PEK-U03	K1MTR_U05	C1, C2, C3	CI6, CI7	N1, N2, N3, N4, N5
PEK-K01	K1MTR_K01	C4	CI1 - CI7	N2, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w Matlabie**

Name in English: **Programming in Matlab**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR033251**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of programming in C language.
2. Basic knowledge of mechatronics.
3. Student can think creatively.

SUBJECT OBJECTIVES

- C1. To assimilate knowledge to create Matlab programs to solve mechatronic tasks.
- C2. To become skillful at the creation of the function reading and writing the external files.
- C3. To be able to present the computation results as graphics using library programs.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can use matrix and array operations for solving mechatronic tasks.

PEK_U02 - Student can write the Matlab program containing the functions of reading input data and writing computation results and present them graphically.

PEK_U03 - Student can write the program which solve the simple mechatronic task using Matlab library.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Using Matlab for mechatronic calculations - basic matrix operations.	2
Lab2	Matlab instructions - if, switch, for, while, break, return.	2
Lab3	Import and export of data from disc to memory.	2
Lab4	Rules to create Matlab scripts for solving the linear equation set.	2
Lab5	Rules to create Matlab functions for solving the linear electric circuit.	2
Lab6	Rules used for graphical object programming.	2
Lab7	Creating graphics in Matlab using the example transients in basic electric circuits.	2
Lab8	Graphical user interface design for supporting the solution of square equation.	2
Lab9	Cooperation with external files - input and output functions for the solution of square equation.	2
Lab10	Creating the functions for solving the nonlinear mechatronic equations.	2
Lab11	The application of Matlab library functions to minimize the costs of energy generation.	2
Lab12	The application of Matlab library functions to solve differential equations describing the transient states in electric circuit.	2
Lab13	Harmonics analysis of time transients of voltages and currents.	2
Lab14	Statistical and graphical analysis of measurement data imported from external files.	2
Lab15	Final test.	2
		Total hours: 30

TEACHING TOOLS USED

- N1. self study - preparation for laboratory class
 N2. Final test.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	report of laboratory exercises
F2	PEK_U01-PEK_U03	test
P = 0.6F1+0.4F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Mrozek B., Mrozek Z., Matlab and Simulink. User handbook. Hellion 2010. /in polish/

Brzózka J., Dorobczyński L., Programming in Matlab. MIKOM 1998. /in polish/

SECONDARY LITERATURE

Sobierajski M., Łabuzek M., Programming in Matlab for electricians. Wyd. PWr 2005. /in polish/

Stachurski M., Numerical methods in Matlab. MIKOM 2003./in polish/

Regel W., Symbolic nad numeric calculations in Matlab. MIKOM 2004./in polish/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming in Matlab
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MTR_U19	C1,C2,C3	Lab1-Lab14	N1,N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**

Name in English: **Fundamentals of control engineering**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR034002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2

Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED

- N1. informative lecture
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	
F2	PEK_W01-PEK_W03	
P = 0,1F1+0,9F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of control engineering
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W17	C1		N1
PEK_W02	K1MTR_W17	C2, C3		N1, N2, N3
PEK_W03	K1MTR_W17	C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obiektowe**

Name in English: **Object Oriented Programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR034102**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		4
Lab2		4
Lab3		4
Lab4		4
Lab5		4
Lab6		4
Lab7		4
Lab8		2
		Total hours: 30

TEACHING TOOLS USED

N1.
N2. tutorials
N3.
N4.
N5.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_U01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Object Oriented Programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19, K1MTR_U35	C1		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia elektryczna**

Name in English: **Electrical metrology**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR034103**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Is able to identify and describe physical phenomena connected with electrical matter.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

- C1. Learn electrical measurement methods and techniques.
- C2. Learn operation principles, properties and application possibilities of analog and digital measurement instruments and systems for electrical and non-electrical measurements.
- C3. Learn rules of utilization measurements instruments and systems for electrical quantities measurements.
- C4. Gaining practical skills of measurements uncertainty analysis and results elaboration.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has knowledge of measurements methods and techniques of electrical quantities and is able to choose proper one for the task.

PEK_W02 - Knows principles of operation, properties and potential of analog and digital measurement instruments and systems for electrical and non-electrical measurements.

PEK_W03 - Knows rules of operation of measurements instruments and systems for electrical measurements.

II. Relating to skills:

PEK_U01 - Is able to use proper methods and instruments for measurements of basic electrical quantities.

PEK_U02 - Is able to estimate measurements uncertainty and elaborate measurement results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure, principles of operation and properties of measurement instruments for electrical quantities. Rules of selecting measurements instruments in measurements processes. Analog instruments and converters and their properties.	2
Lec2	Digital instruments and A/D converters. Role of microprocessors in digital instruments. Metrological properties of digital multimeters. Measurements of DC voltage and current.	2
Lec3	Measurement of AC voltage and current. Parameters of variable in time electrical signal. Methods for measurements of sinusoidal voltage and current. Analog and digital voltmeters and ammeters and their properties.	2
Lec4	Resistance, impedance, inductance and capacitance measurements. Bridge and digital measurements methods and instruments for resistance measurements. Measurements of impedance components. Functional and metrological properties of impedance and impedance components measurements instruments.	2
Lec5	Single-phase and three-phase power measurements. Analog and digital wattmeter. Digital electrical grid parameters meters.	2
Lec6	Analog and digital oscilloscope. Principle of operation and structure of analog and digital oscilloscope. Multichannel oscilloscope. Functional and metrological properties of oscilloscope. Oscilloscopic measurements.	2
Lec7	Measurements systems and their configuration. Elements of measurement system: measurements cards and data acquisition cards, signal conditioners, multiplexers. Data transfer, interfaces – types and properties. Virtual instruments – structure and application.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2

Lab2	DC voltage and current measurements with analog and digital instruments.	2
Lab3	AC voltage and power measurements	2
Lab4	Resistance measurements with analog and digital instruments.	2
Lab5	Impedance and capacitance measurements.	2
Lab6	Oscilloscopic measurements	2
Lab7	Time for missed classes	2
Lab8	Individual tests	1
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. laboratory experiment
- N3. self study - preparation for laboratory class
- N4. report preparation
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Oral and written test. Laboratory report. Final mark: middle with marks laboratory practices.
P = średnia z uzyskanych ocen cząstkowych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical metrology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U03	C1 - C3		N2 - N5
PEK_U02	K1MTR_U03	C4		N3 - N5
PEK_W01	K1MTR_W03	C1		N1, N5
PEK_W02	K1MTR_W03	C2		N1, N5
PEK_W03	K1MTR_W03	C3		N1, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy sieci komputerowych**

Name in English: **Components of computer networks**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR034104**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of computer support.
It has a basic knowledge of functional systems.
It has a basic knowledge of computer programming.
It has a basic knowledge of information retrieval.
2. Is able to recognise key hardware and software parameters of personal computers
Is able to write computer programmes based on given algorithm
3. Is able to think and action in a creative and enterprising manner.

SUBJECT OBJECTIVES

- C1. Has basic knowledge about computer communication and data exchange for engineering purposes
- C2. Identifies basic design guidelines for building local computer networks
- C3. Preparing to solve problems in the project team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It has a basic knowledge of computer communication and exchange of information in the activities of engineering

PEK_W02 - It has an elementary knowledge of modeling and programming network events

PEK_W03 - Knows the basic principles for the design of local area networks

II. Relating to skills:

PEK_U01 - Able to obtain the information from the literature and other sources in the field of communication connections compilation

PEK_U02 - He can use the built-in operating systems and communication procedures through elementary programming in C / C ++

PEK_U03 - Knows how to use available through a computer network resources processes and data servers

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The objectives and tasks of the networks in the activities of engineering. Multitasking and concurrency processes in modern computer systems. Sharing of information resources.	3
Lec2	Network topologies and to compare the physical layer Ethernet and Token Ring. Network frames. Logical structure of the network (LAN) and urban (MAN) and public (WAN) and separated (Corporate). Network protocols: IP, TCP, UDP. ISO model. Advantages and disadvantages of encapsulation and data decapsulator.	3
Lec3	Selected elements of the local network communication technology, Wi-Fi, Bluetooth, USB, RS232, RS485, GPIB. Dedicated applications for engineers: Matlab, LabVIEW. Programming interfaces and communications applications design principles.	3
Lec4	Communication in a client-server system. File servers and processes. Examples Programming Pascal, C / C ++ data in an Ethernet local area networks. Programming Fundamentals network communication TCP / IP and UDP / IP in C / C or Pascal and VBA.	3
Lec5	Terminal work and its importance in the management of distributed systems. Built-in communication procedures in selected network operating systems Linux and Windows (Winsock).	2
Lec6	Final test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	SSH terminal work sessions on networked systems. Commands Linux the information systems (Unix). Network file system and directories. SFTP secure data transmission.	2
Lab2	Shell Programming - shell variables. Process Control.	2

Lab3	Development of elementary procedures for network C on the basis of predetermined communication algorithm.	2
Lab4	Elementary programming procedures in C network based on the algorithm specified communication - monitoring and identification of network events.	2
Lab5	Elementary programming procedures in C network based on the algorithm specified communication - within the process control laboratory and project groups.	3
Lab6	Laboratory project client-server model. Programming in C client server of the steering tasks of teaching - Working in teams laboratory and design.	3
Lab7	Laboratory assessment.	1
		Total hours: 15

TEACHING TOOLS USED

- N1. problem lecture
- N2. multimedia presentation
- N3. self study - preparation for laboratory class
- N4. tutorials
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Self-study distance -test partial Educational platform: http://eportal.eny.pwr.wroc.pl
F2	PEK_W01, PEK_W02, PEK_W03	Final test (final) in the presence of conducting classes in the computer lab. Educational platform: http://eportal.eny.pwr.wroc.pl
P = 0,15*F1+0,85*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02,PEK_U03	The development of electronic sub-reports Educational platform: http://eportal.eny.pwr.wroc.pl

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Przewodnik po sieciach lokalnych, Greg Nunemacher, MIKOM (wydanie dowolne)
- [2] Programowanie zastosowań sieciowych w systemie Unix, W.Richaed Stevens,WNT '95
- [3] Platforma edukacyjna: <http://eportal.eny.pwr.wroc.pl>
- [4] Netografia

SECONDARY LITERATURE

- [1] Nowoczesne sieci miejskie, J.Jaworski, R.Morawski, J.Olędzki, WNT (wydanie dowolne)
- [2] TCP/IP. Administracja sieci, Craig Hunt, OW READ ME (wydanie dowolne)
- [3] JAVA Kompendium programisty, Helion, (wydanie dowolne)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Components of computer networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza) PEK_W02 PEK_W03	K1MTR_W19, K1MTR_W20	C1,C2	Lec1,Lec2,Lec3,Lec4,Lec5	N1,N2,N4
PEK_U01 (umiejętności) PEK_U02	K1MTR_U19, K1MTR_U20	C1,C2,C3	Lab1,Lab2,Lab3,Lab4,Lab5,Lab6	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obiektowe w Matlabie**

Name in English: **MATLAB Object Oriented Programming**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR034251**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of computer science, linear programming
2. Is familiar with Matlab software, can write, test and run own programs in Matlab
3. Student can think and act creatively. Student is able to work alone.

SUBJECT OBJECTIVES

- C1. Getting to know the principles of object-oriented programming
- C2. Acquiring the skills to use Matlab to write programs implementing mechanisms of object-oriented programming, and to solve engineering problems using these mechanisms

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is able to do practical algorithmization of any engineering task

PEK_U02 - Can apply object-oriented programming paradigm to solve practical engineering problems

PEK_U03 - Knows and applies the principles of good programming style. Is able to test, debug, document the code of the program

III. Relating to social competences:

PEK_K01 - Can competently, independently, making a multi-criteria analysis, work out the engineering task

PEK_K02 - Understand the need for regular and individual work to learn the course material

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Objects, classes, methods, attributes, structures, constructors, destructors	2
Lab2	Method overloading	2
Lab3	Inheritance, derived classes	2
Lab4	Operators, operator overloading	2
Lab5	I/O operations	2
Lab6	Double linked list	2
Lab7	Polymorphism and virtual functions	2
Lab8	Matlab Class Wizard	4
Lab9	Templates	2
Lab10	The implementation of cellular automata algorithms such as Life, Mistermind, etc.	6
Lab11	Testing, debugging and documenting of the program	2
Lab12	Final evaluation. Reserve term	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory

N2. individual work - writing the program and documenting

N3. preparation of the report

N4. tutoring

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	activity in classes, participation in problem discussions, reports (program code, documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Meyer B., Programowanie zorientowane obiektowo, Helion 2005, 2008
 Register A.H., A Guide to MATLAB Object-Oriented Programming, Chapman & Hall/CRC, 2007
 Mrozek B., Mrozek Z., Matlab i Simulink. Poradnik użytkownika. Helion 2010.
 Brzóška J., Dorobczyński L., Programowanie w Matlabie. MIKOM 1998.

SECONDARY LITERATURE

N.M. Josuttis, C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion 2003
 Chomicz P., Uliasz R., Programowanie w języku C i C++. Poradnik programisty. Wydawnictwo. PLJ, Warszawa, 1992
 Liberty J., C++ dla każdego, Helion 2002
 Prata S., Szkoła Programowania. Język C++, Helion 2006
 Pratap R., Matlab 7 dla naukowców i inżynierów. MIKOM, Warszawa 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MATLAB Object Oriented Programming
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U1 - PEK_U3	K1MTR_U19, K1MTR_U35	C1-C2	La1 - La12	N1, N2, N3, N4
PEK_K1 - PEK_K2	K1MTR_K01	C1-C2	La1 - La12	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**

Name in English: **Fundamentals of control engineering**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR035002**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		1
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
		Total hours: 15

TEACHING TOOLS USED

- N1. self study - preparation for laboratory class
- N2. tutorials
- N3. laboratory experiment
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U01, PEK_K01	
P = 0,5F1+0,5F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of control engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U17	C1		N3, N4
PEK_K01	K1MTR_K03	C1		N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory - właściwości i zastosowania**

Name in English: **Sensors – properties and applications**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR035103**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of physics, mathematical analysis, basics of metrology and electrical metrology, mechanics, electrotechnics.
2. Is able to identify and describe physical phenomena connected with mechanics and electrotechnics.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

- C1. Learn physical basics of classic and intelligent sensors. Learn most important parameters of sensors, and their use in mechatronics, automatics and measurement systems.
- C2. Ability to select and use sensors for measurements of different physical quantities, and use of sensors in measurement, monitoring and control systems.
- C3. Ability to examine basic sensor characteristics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has basic knowledge of properties, functioning and structure of sensors and sensors systems, intelligent sensors and microsensors.

PEK_W02 - Has basic knowledge of sensors application for different physical quantities measurements.

PEK_W03 - Has basic knowledge of sensors application in measurement, monitoring and control systems.

II. Relating to skills:

PEK_U01 - Is able to select and use proper sensor for different physical quantities measurements

PEK_U02 - Is able to use sensors in measurement, monitoring and control systems.

PEK_U03 - Is able to examine basic sensor characteristics.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classical and intelligent sensors in mechatronics, automatics and measurement systems. Measurement and double-state (switching) sensors. Static and dynamic properties.	2
Lec2	Passive and active temperature sensors (resistive, capacitive, thermoelectric, quartz resonance).	2
Lec3	Fiber optic and pyrometric temperature sensors.	2
Lec4	Mechanical quantities sensors. Tensiometers – properties and applications. Displacement, linear and rotational speed sensors.	2
Lec5	Vibration sensors. Optical motion sensors and their application in anti-theft systems.	2
Lec6	Pressure and flow sensors. Gas sensors, humidity sensors.	2
Lec7	Electric and magnetic field sensors. Illumination sensors.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2
Lab2	Investigation of static and dynamic properties of contact temperature sensors and their practical application	4
Lab3	Surface temperature measurements with contactless optical methods: pyrometric, thermovision camera. Measurements of air humidity.	4
Lab4	Investigation of properties of tensiometers and their practical applications (i.e. pressure measurements).	4
Lab5	Investigation of properties of inductive displacement sensors and layer thickness sensor. Inductive sensors for metal detection. Measurements of rotational speed.	4

Lab6	Optical distance measurements. Capacitive sensors and their application (i.e. liquid level sensors). Properties of intelligent motion sensors.	4
Lab7	Light sensitive sensors, illumination measurements.	4
Lab8	Missed classes time.	4
		Total hours: 30

TEACHING TOOLS USED		
N1. traditional lecture with the use of transparencies and slides		
N2. laboratory experiment		
N3. self study - preparation for laboratory class		
N4. self study - self studies and preparation for examination		
N5. report preparation		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	Oral and written test. Laboratory report.
P = F1		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors – properties and applications
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1		N1
PEK_U01 - PEK_U03	K1MTR_U15	C2, C3		N2 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Energoelektronika**

Name in English: **Power Electronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR035201**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

- N1. laboratory experiment
- N2. self study - preparation for laboratory class
- N3. traditional lecture with the use of transparencies and slides
- N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03.	
P = 1*F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U01, PEK_U02, PEK_U03	
F3	PEK_U02, PEK_U03	
P = 0,25*F1+0,25*F2+0,5*F3		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
<u>SECONDARY LITERATURE</u>		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Power Electronics AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_W02	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_W03	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_U01	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.
PEK_U02	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.

PEK_U03	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.
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SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy techniki sterowania**

Name in English: **Elements of control engineering**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR035212**

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)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should know notations used in control system theory, to know types of control systems and characteristics of control system elements.
2. Student should have the basic knowledge of control systems.
3. Student should know how to analyze simple control systems and arrange and rearrange block diagrams of control systems.

SUBJECT OBJECTIVES

- C1. Skill in stability analysis of linear and nonlinear control systems.
- C2. Skill in designing of control algorithms for models of various type control plants.
- C3. Skill in solving linear-quadratic problems.
- C4. Skill in formulating and solving optimal control problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - A student gets the knowledge of feedforward and feedback control systems design.

PEK_W02 - A student gets the knowledge of optimal control systems design.

PEK_W03 - A student gets the knowledge of probabilistic plant control systems design.

II. Relating to skills:

PEK_U01 - A student can analyze stability of linear and non-linear control systems.

PEK_U02 - A student can design control algorithms for static and dynamic plants.

PEK_U03 - A student can find a solution for linear-quadratic optimal control problem.

III. Relating to social competences:

PEK_K01 - A student can act independently working on a complex engineering project.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Models of continuous system. Models of discrete system.	1
Lec2	Open-loop control system design methods. Feedback control system design methods.	2
Lec3	Controllability. Observability. Lyapunov stability.	2
Lec4	Global stability. Linear-quadratic optimal control problem.	2
Lec5	Deterministic optimal control.	2
Lec6	Dynamic programming. Optimal control of continuous systems.	2
Lec7	Bellman's equation. Time-optimal control.	2
Lec8	Estimation of an unknown parameter measured under disturbances. Minimal risk method.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction.	1
Lab2	Open-loop control system design methods.	2
Lab3	Feedback control system design methods.	2
Lab4	State observers.	2
Lab5	Feedback control systems based on state observers.	3
Lab6	Time-optimal control with limited magnitude of control signal.	3
Lab7	Complement classes.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
 N2. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	activity
F2	PEK_U01, PEK_U02, PEK_U03	reports
P = 0.3*F1+0.7*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bubnicki Z., Teoria i algorytmy sterowania, PWN, Warszawa 2002.[2] Kaczorek T., Teoria układów regulacji automatycznej, WNT, Warszawa 1977.[3] Kaczorek T., Teoria sterowania, T.1. Układy liniowe ciągłe i dyskretne, PWN, Warszawa 1977.[4] Kaczorek T., Teoria sterowania, T.2. Układy nieliniowe, procesy stochastyczne. oraz optymalizacja statyczna i dynamiczna, PWN, Warszawa 1981.[5] Kaczorek T., Teoria sterowania i systemów. wyd.2 popr., PWN, Warszawa 1996.

SECONDARY LITERATURE

[1] Philippe de Larminat, Yves Thomas., Automatyka-układy liniowe. T. I, II, III.[2] Zbiór zadań i problemów z teorii sterowania. pod red. Zdzisława Bubnickiego, Oficyna Wyd. PWr, Wrocław 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements of control engineering
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W17	C1	WY1-WY3	N1
PEK_W02	K1MTR_W17	C2	WY4-WY6	N1
PEK_W03	K1MTR_W17	C3, C4	WY7-WY8	N1
PEK_U01	K1MTR_U17	C1	La2 - La3, La7	N2
PEK_U02	K1MTR_U17	C2	La4, La7	N2
PEK_U03	K1MTR_U17	C3, C4	La5-La7	N2
PEK K01	K1MTR_K01			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo w elektrotechnice**

Name in English: **Safety in electrical engineering**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR035241**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic principles of electrical engineering and construction of the installation and power grids. Basic knowledge of the construction and operation of the electrical equipment and apparatus.
2. Basic ability to connect the measurement circuits and to use the electrical quantities meters.
3. Ability to cooperate in a team.

SUBJECT OBJECTIVES

- C1. Knowledge of operation rules of electric shock protection systems used in low-voltage installations.
- C2. Knowledge of effectiveness criteria of electric shock protection systems in low-voltage installations.
- C3. Knowledge of principles of low-voltage electrical installations testing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has knowledge of the effects of electrical current on the human body.

PEK_W02 - Student has knowledge of the protective systems and protective measures used in low-voltage installations and knows the criteria of their effectiveness.

PEK_W03 - Student has knowledge of the principles of working on low-voltage electrical equipment, especially of the principles of testing of low-voltage electrical installations.

II. Relating to skills:

PEK_U01 - Student is able to perform the verification measurements in low-voltage electrical installations.

PEK_U02 - Student is able to evaluate the results of measurements and make a report for verification.

III. Relating to social competences:

PEK_K01 - Student can effectively cooperate in a team performing electrical verification tests.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and designations in protection against electric shock. The impact of electric current on human beings.	2
Lec2	Principles for design and construction of low-voltage electrical installations.	2
Lec3	Low-voltage networks systems.	2
Lec4	Classes of protection of electrical equipment. Degrees of protection provided by enclosures. The criteria of protection against electric shock.	2
Lec5	Basic protection measures used in low-voltage installations.	2
Lec6	Fault protection measures used in low-voltage installations.	2
Lec7	The principles of safe work organization on electrical equipment. Principles of testing of electrical installations.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Presentation of safety rules and guidelines in the laboratory. Establish the requirements for crediting. General introduction to the stand of laboratory.	2
Lab2	Resuscitating of persons shocked by electric current.	2
Lab3	Measurement of insulation resistance and electric strength test of electrical installation and electrical equipment.	2
Lab4	Examination of protection by automatic disconnection of supply with overcurrent devices.	2
Lab5	Examination of protection by automatic disconnection of supply with residual current devices.	2
Lab6	Measurement of earth electrode resistance and the resistivity of soil.	2
Lab7	Measurement of insulation resistance of floors and walls. Measurement of touch voltage.	2

Lab8	Additional term. Laboratory crediting.	1
		Total hours: 15

TEACHING TOOLS USED

- N1. informative lecture
- N2. traditional lecture with the use of transparencies and slides
- N3. self study - preparation for laboratory class
- N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	presence at lectures
F2	PEK_W01, PEK_W02, PEK_W03	final test

$P = 0,2 \cdot F1 + 0,8 \cdot F2$

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	activity in the laboratory
F2	PEK_U02	report

$P = 0,25 \cdot F1 + 0,75 \cdot F2$

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Markiewicz H.: Bezpieczeństwo w elektroenergetyce: zagadnienia wybrane. WNT, Warszawa 2009

SECONDARY LITERATURE

1. PN-IEC 60364 Instalacje elektryczne w obiektach budowlanych (norma wieloarkuszowa)
2. PN-HD 60364 Instalacje elektryczne niskiego napięcia (norma wieloarkuszowa)
3. Ustawa Prawo budowlane wraz z rozporządzeniami wykonawczymi

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety in electrical engineering
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W27	C1, C2	Lec1	N1, N2
PEK_W02	K1MTR_W27	C1, C2	Lec2-Lec6	N1, N2
PEK_W03	K1MTR_W27	C3	Lec7	N1, N2
PEK_U01	K1MTR_U31	C2, C3	Lab2-Lab7	N3, N4
PEK_U02	K1MTR_U31	C3	Lab2-Lab7	N3, N4
PEK_K01	K1MTR_K13	C3	Lab2-Lab7	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy elektryczne**

Name in English: **Electrical Drives**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **MCR035301**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of physics, especially electrodynamics and electromagnetism.
2. Has basic knowledge in the field of electrotechnics, including basics of DC and AC circuits theory.
3. Can properly and effectively apply the knowledge on the differential and integral calculus of single variable function for qualitative and quantitative analysis of mathematical problems connected with studying field of engineering.

SUBJECT OBJECTIVES

- C1. Familiarizing students with the basic steady-state and dynamical performances of electrical drives.
- C2. Familiarizing students with the basic converter-fed DC and AC motor drives, with speed control methods of mechatronic drives (including servodrives).
- C3. Perfecting skills for measuring, data acquisition and elaboration of test results, their interpretation and analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has knowledge on basic elements of converter-fed drive, its operation regimes, can define and describe them. Can explain the principles of the operation and steady-state characteristics of the basic electrical and loading machines.

PEK_W02 - Can characterize and describe the basic methods used for speed control of the DC and AC motor drives.

PEK_W03 - Can characterize and describe the basic control structures of the DC and AC motor drives in open and closed-loop structures, including methods and structures for vector controlled servodrives.

II. Relating to skills:

PEK_U01 - Can calculate basic values characterizing operation of the DC and AC motors

PEK_U02 - Can choose the basic measurements equipment for electrical motors applied in chosen drive systems.

PEK_U03 - Can realize the experimental tests of chosen controlled electrical drives in laboratory set-up including their static and dynamical characteristics and analyse obtained results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Electrical drive system - basic definition, components. Steady state characteristics of different types of motors and loading machines, regions of operation.	2
Lec2	Motion equation of electrical drive system, static and dynamic states, stable steady-state operation conditions. Influence of different types of mechanical connections to equation of motion.	2
Lec3	DC motor drive systems: construction and operation principle of DC motor with separate excitation, its mathematical model, dynamical performances. Converters supplying the DC motor.	2
Lec4	DC motor drive systems: speed control, breaking methods.	2
Lec5	Cascade structure of the speed and torque control of the DC motor. Controller adjustment methods, transient performances.	2
Lec6	Induction motor (IM) drive systems: principle of IM operation, its steady-state characteristics. Basic static converters supplying AC motors.	2
Lec7	Induction motor drive systems: speed control, breaking methods.	2
Lec8	Basics of frequency speed control method - scalar control: control rule, structure, performances.	2
Lec9	Basics of vector control principle of the IM speed and torque - main idea, control structure, dynamical performances, applications.	2
Lec10	Direct torque control method for the induction motor - main idea, control structure, dynamical performances, applications.	2
Lec11	Brushless DC and AC permanent magnet motors; construction, principle of operation, basic methods for torque and speed control.	2

Lec12	Vector control method of the PMSM torque and speed - structures, dynamical performances.	2
Lec13	Basic requirements and parameters of servodrives. Electrical motors used in servodrives; permanent magnet DC and AC motors, step motors; main parameters and requirements.	2
Lec14	Design of servodrives with DC and AC motors - structures, analogies and differences depending on driving motor. Design rules for position controller, parameter adjustment, dynamics optimization.	2
Lec15	Development trends in electrical drive systems.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction - general description of laboratory set-ups, measurement equipment and measuring methods. Forming of characteristics of the DC motor with separate excitation in different operation modes.	3
Lab2	Testing of the DC motor drive system supplied from the bidirectional controlled rectifier.	3
Lab3	Starting systems for squirrel-cage and slip-ring induction motors.	3
Lab4	Testing of the induction motor drive supplied from the voltage inverter -scalar control.	3
Lab5	Simulation tests of the cascade control structure of the DC drive system, with the stiff and elastic connection.	3
Lab6	Experimental tests of the cascade control structure of the DC drive system, with the stiff and elastic connection, in digital realization (with digital processor).	3
Lab7	Simulation tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab8	Experimental tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab9	Simulation tests of the voltage-inverter-fed PMSM motor drive system - vector control method.	3
Lab10	Experimental tests of the voltage-inverter-fed PMSM motor drive system - vector control method. Crediting with grade.	3
		Total hours: 30

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. tutorials
- N3. self study - self studies and preparation for examination
- N4. self study - preparation for laboratory class
- N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	short tests, written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Evaluation of short tests before laboratory exercises.
F2	PEK_U02, PEK_U03	Activity in the exercises and discussion.
F3	PEK_U01, PEK_U02, PEK_U03	Evaluation of the written works and laboratory reports.
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE		
<u>PRIMARY LITERATURE</u>		
W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990		
Krishnan R., Electric Motor Drives – modeling, analysis and control, Prentice Hall, 2001		
<u>SECONDARY LITERATURE</u>		
Automatic Control of Converter-fed Drives, Elsevier, 1994		

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Electrical Drives AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10	C1		N1, N2, N3
PEK_W02	K1MTR_W10	C1, C2		N1, N2, N3
PEK_W03	K1MTR_W10	C1, C2		N1, N2, N3

PEK_U01	K1MTR_U02	C2, C3		N4, N5
PEK_U02	K1MTR_U10	C2, C3		N4, N5
PEK_U03	K1MTR_U10	C2, C3		N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie systemów rozproszonych na bazie sterowników PLC**

Name in English: **Programming of distributed control systems based on PLC**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR035303**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the theory of logic circuits.
2. He can develop a control algorithm of the selected industrial process.

SUBJECT OBJECTIVES

- C1. Familiarize students with the structure of the distributed control systems of automation.
- C2. The acquisition of basic knowledge of popular communication networks used in industrial automation.
- C3. The acquisition skills programming of the automation devices in distributed control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It is able to characterize the structure of distributed automation systems.

PEK_W02 - It is able list and describe the basic communication networks used in distributed control systems.

II. Relating to skills:

PEK_U01 - He can connect and configure a distributed control system using popular industrial communication networks.

PEK_U02 - It is able to program controllers and industrial automation equipment to realize the selected industrial process.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Automation in the modern manufacturing plant. Structures of the industrial control systems.	2
Lec2	Structure and programming of OMRON CJ1M PLC. The CX-One software.	2
Lec3	Communication systems for industrial automation. ISO OSI Reference Model. Principles of data exchange in popular industrial networks.	2
Lec4	Communication in distributed automation systems using OMRON PLCs.	2
Lec5	Application of RS-232 and RS-485 interface for data exchange between automation devices. Communication using PC-Link network.	2
Lec6	Visualization of industrial processes - programming HMI terminals.	2
Lec7	Visualization of industrial processes - the Cx-Supervisor SCADA software.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the Rules and Regulations of internal safety lab. Establish rules for passing. General familiarization with laboratory equipment. Discussion of the laboratory exercises.	2
Lab2	Introduction to the CX-One software. Configuration and programming OMRON CJ1M controller.	2
Lab3	Getting to know the function libraries of the CX-Programmer software.	2
Lab4	Programming of serial ports. The exchange of data between controllers with PC-Link network.	2
Lab5	The use of communication modules PRM21 for data exchange using PROFIBUS network. Operation of the distributed I/O station GRT1-PRT.	1
Lab6	The use of communication modules DRM21 for data exchange using DeviceNet network. Operation of the distributed I/O station GRT1-DRT.	1
Lab7	Programming of control systems of selected models of advanced industrial processes.	4

Lab8	Giving reports, summary and pass the lab.	1
		Total hours: 15

TEACHING TOOLS USED		
<p>N1. multimedia presentation N2. laboratory experiment N3. report preparation N4. self study - preparation for laboratory class N5. informative lecture</p>		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01 PEK-W02	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-U01 PEK-U02	Rating of reports of completed projects.
F2	PEK-U01 PEK-U02	Assessment of prepare for laboratory exercises.
F3	PEK-U01 PEK-U02	Activity in laboratory classes.
P = 0,4*F1 + 0,3*F2 + 0,3*F3		

PRIMARY AND SECONDARY LITERATURE		
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PRIMARY LITERATURE

- [1] Kasprzyk J., Programowanie sterowników przemysłowych, WNT
[2] Pawlak M., Sterowniki Programowalne, e-skrypt, ed. Politechnika Wroclawska, Wroclaw 2010, available in Dolnośląska Biblioteka Cyfrowa,

SECONDARY LITERATURE

- [1] Flaga S., Programowanie sterowników PLC w języku drabinkowym, BTC, Legionowo 2010
[2] Weigmann J., Kilian G., Decentralization with PROFIBUS-DP, Publicis MCD Verlag, Erlangen 2000
[3] Solnik W., Zajda Z., Komputerowe sieci przemysłowe Profibus DP i MPI, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004.
[4] Laboratory instruction set, supplementary materials for the lecture, a set of technical documentation of PLCs.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming of distributed control systems based on PLC
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W17, K1MTR_W33	C1	Lec1 Lec2 Lec3 Lec4	N1 N5
PEK_W02	K1MTR_W10, K1MTR_W17, K1MTR_W33	C2	Lec3-Lec7	N1 N5
PEK_U01	K1MTR_U15, K1MTR_U20, K1MTR_U36	C2, C3	Lab2-Lab7	N1, N2, N3, N4
PEK_U02	K1MTR_U15, K1MTR_U20, K1MTR_U36	C2, C3	Lab2-Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiały aktywne**

Name in English: **Active materials**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036102**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. KNOWLEDGE

1. Has a basic knowledge in physics, chemistry and materials science.
2. Has a basic knowledge in the field of metrology, including evaluation of the uncertainty of measurements.

2. SKILLS

1. Can apply knowledge of physics, chemistry and materials science to qualitative and quantitative analysis of the physical aspects of engineering problems.
2. Can estimate the uncertainty of measurements of electrical and non-electrical quantities made in laboratory conditions.

3. OTHER COMPETENCES

1. Understands the need to study the chosen field of study.
2. Understands the need for continuous life-long learning to master professional, social and competences.

SUBJECT OBJECTIVES

- C1. To familiarize the student with the types, properties and applications of active and intelligent materials.
 C2. To familiarize the student with the latest world trends and achievements in research on active and intelligent materials.
 C3. To gain practical skills and knowledge of experimental characterization of selected properties of active and intelligent materials .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Being able to explain the concept of active and intelligent materials, name and characterize their types in detail.

PEK_W02 - Is able to provide and explain the physical phenomena responsible for the operation and functions of active and intelligent materials.

PEK_W03 - Is able to provide examples of application of active and intelligent materials in mechatronic systems and transducers.

II. Relating to skills:

PEK_U01 - Can experimentally determine the selected properties of active and intelligent materials.

PEK_U02 - Is able to interpret the results of experimental work carried out in the field of active and intelligent materials.

PEK_U03 - Can, on the basis of the obtained results and their conclusions, assess whether active material or a transducer using such material complies with the requirements of mechatronic system.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction: requirements and how to pass. Active , smart, multifunctional materials- basic concepts. An overview of the kinds of active materials. Color-changing materials. Electrochromic materials. E-paper.	2
Lec2	Light-emitting materials. Chemo-and electroluminescence.	2
Lec3	Shape-changing materials. Magneto- and electrostrictive materials, piezomaterials. Artificial muscles. Electroactive polymers.	2
Lec4	Electrothermal and thermoresponsive materials . Thermochromic materials. The viscosity-changing materials. Ferrofluids and materials displaying electroreology-related phenomena.	2
Lec5	Self-assembling and self-repairing materials. Biomaterials as matrices. Microcapsules.	2
Lec6	Materials sensitive to changes in pH. Polymer gels. Superhydrophobic, oleophobic and self-cleaning materials.	2
Lec7	MEMS and NEMS structures. Biomimetic materials.	2
Lec8	Final test.	1

		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction: requirements and how to pass. Overview of individual lab exercises. Health and safety training.	1
Lab2	Experimental characterization of electroactive polymer.	3
Lab3	Experimental characterization of piezoelectric material.	3
Lab4	Experimental characterization of electroluminescent material.	3
Lab5	Experimental characterization of electrothermal and thermoresponsive material.	3
Lab6	Extra laboratory exercise. Credition.	2
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. case study
- N3. laboratory experiment
- N4. report preparation
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	short written tests, oral questioning
F2	PEK_U01-PEK_U03	reports of all scheduled and carried out lab exercises
P = 0,5*F1+0,5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Brian Culshaw, Smart structures and materials, Boston ; London : Artech House, cop. 1996
 [2] Smart materials / ed. by Mel Schwartz, Boca Raton: CRC Press, Taylor & Francis Group, 2009
 [3] Nanoengineering of structural, functional, and smart materials / ed. by Mark J. Schulz, Ajit D. Kelkar, and Mannur J. Sundaresan, Boca Raton, CRC Press, 2006.

SECONDARY LITERATURE

- [1] Smart polymers: applications in biotechnology and biomedicine / ed. by Igor Galaev, Bo Mattiasson. 2nd ed., Boca Raton: CRC Press; 2008
 [2] Theory and phenomena of metamaterials / ed. by Filippo Capolino, Boca Raton: CRC Press / Taylor & Francis Group, 2009
 [3] Jerzy Wiciak, Wybrane zagadnienia redukcji drgań i dźwięków strukturalnych (Selected aspects of structural vibrations and sounds reduction), Kraków AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Active materials
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W02	K1MTR_MAP_W02, K1MTR_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W03	K1MTR_MAP_U02	C1, C2	Lab1-Lab6	N1, N2, N5
PEK_U01	K1MTR_MAP_U02, K1MTR_U03, K1MTR_U24	C3	Lab1-Lab6	N3, N4, N5
PEK_U02	K1MTR_MAP_U02, K1MTR_U02, K1MTR_U22	C3	Lab1-Lab6	N3, N4, N5
PEK_U03	K1MTR_MAP_U02	C3	Lab1-Lab6	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interdyscyplinarny projekt zespołowy**

Name in English: **Interdisciplinary team project**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036103, MCR036231, MCR036302**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of informatics and electronics.

SUBJECT OBJECTIVES

C1. Acquisition of practical knowledge and skills for implementation and using of optimization algorithm for processes and devices design.

C2. Acquisition of practical knowledge and skills for design and realization of simple mechanisms based on programmable devices.

C3. Acquisition and fixing the social competences related to creative thinking.

C4. Acquisition and fixing the social competences related to cooperation in group.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can use proper optimization and statistics methods for optimization of industrial systems.

PEK_U02 - Is able to choose and program (using high level programming languages) configurable devices used for calculation of algorithms used in industrial applications.

III. Relating to social competences:

PEK_K01 - Is able to cooperation and work in team and correctly present results of researches.

PEK_K02 - Is able to creative and enterprising thinking.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction-presentation of the form of classes and realized projects. Division into groups.	4
Proj2	Selection of methods used for realization of tasks, with particular emphasis on the possibility of applying methods of rapid prototyping and cost reduction.	2
Proj3	Presentation of the prepared concepts relating to realization of individual tasks.	4
Proj4	Consultations of projects. Discussion about individual work and cooperative problem solving.	6
Proj5	Presentation of the subsequent stages of work (speech using multimedia tools).	4
Proj6	Consultations of projects. Discussion about results presentation.	6
Proj7	Presentation of final results of projects (speech using multimedia tools and show of the real model). Discussion between all participants of the course.	4
		Total hours: 30

TEACHING TOOLS USED

- N1. self study - preparation for project class
- N2. multimedia presentation
- N3. project presentation
- N4. problem discussion
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02	Assessment of presentations
F2	PEK_K01 PEK_K02	Activity
F3	PEK_U01 PEK_U02 PEK_K01 PEK_K02	Assessment of final results
$P = 0,3 \cdot F1 + 0,3 \cdot F2 + 0,4 \cdot F3$		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Kardaś M., Mikrokontrolery AVR Język C podstawy programowania, Atmel, 2011.
- [2] Doliński J., Mikrokontrolery AVR w praktyce, BTC, 2004.
- [3] Grębosz J., Symfonia C ++ Standard, Editions 2000 Kraków, 2008.
- [4] Kowalski A.H., Procesory DSP dla praktyków, Wydawnictwo: BTC, Legionowo, 2011.
- [5] Michalewicz Z., Algorytmy + Struktury danych = programy ewolucyjne, Wydawnictwa Naukowo Techniczne, 2003.
- [6] Anderson R., Cervo D., Arduino dla zaawansowanych, Helion, 2014.

SECONDARY LITERATURE

- [1] Ganczarski J., Owczarek M., C++. Wykorzystaj potęgę aplikacji graficznych, Helion, 2008.
- [2] Wieczorek H., Eagle, pierwsze kroki, BTC, 2007.
- [3] Eckel B., Thinking in C++, Helion, 2002.
- [4] Kowalski A.H., Procesory DSP w przykładach, Wydawnictwo: BTC, Legionowo, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Interdisciplinary team project** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U04, K1MTR_U30	C1	Proj1-Proj7	N1-N5
PEK_U02	K1MTR_U04, K1MTR_U30	C2	Proj1-Proj7	N1-N5
PEK_K01	K1MTR_K03, K1MTR_K06	C3,C4	Proj1-Proj7	N1-N5
PEK_K02	K1MTR_K03, K1MTR_K06	C3,C4	Proj1-Proj7	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w pomiarach**

Name in English: **Microsystems in measurements**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036104**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		1
Lec8		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		2
Lab5		2
Lab6		2
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. tutorials
- N3. self study - preparation for laboratory class
- N4. laboratory experiment
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_WO1, PEK_WO2, PEK_WO3	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02, PEK_U03	
F3	PEK_U01, PEK_U02, PEK_U03	
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in measurements
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W16	C1		N1, N2
PEK_W02	K1MTR_W16	C1		N1, N2
PEK_W03	K1MTR_W16	C1		N1, N2
PEK_U01	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U02	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U03	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w sterowaniu**

Name in English: **Microsystems in control**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036105**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		6
Lec3		2
Lec4		3
Lec5		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

- N1. traditional lecture with the use of transparencies and slides
- N2. tutorials
- N3. self study - preparation for laboratory class
- N4. laboratory experiment
- N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02, PEK_U03	
F3	PEK_U01, PEK_U02, PEK_U03	
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1		N1, N2
PEK_W02	K1MTR_W21	C1		N1, N2
PEK_W03	K1MTR_W21	C1		N1, N2
PEK_U01	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U02	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U03	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Cyfrowe przetwarzanie sygnałów**

Name in English: **Digital signal processing**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036106**

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		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical knowledge of Laplace and Fourier transforms
2. Basic ability to programming in C and Matlab

SUBJECT OBJECTIVES

- C1. Understanding and applying issues of digital signal processing
- C2. Description and analysis digital systems in time and frequency domain
- C3. Project and implementation of simple digital systems
- C4. Effective working in groups, focused on creativity and collaboration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He has ordered knowledge of digital signal processing including: sampling theory, mathematical description and analysis of discrete systems in the time domain and frequency

II. Relating to skills:

PEK_U01 - Able to be used mathematical tools in programming environments for the description and analysis of digital signal processing problems

PEK_U02 - Able to design and implement the correct algorithms for digital signal processor

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, program, bibliography, conditions for course crediting, basic definitions and examples, discrete signals (mathematical model of discrete signal, the signal spectrum, aliasing)	2
Lec2	Discrete-time systems, LTI systems properties, models of systems, difference equations, convolution, impulse response, block diagrams, state space, systems classification, analog-to-digital conversion, periodic sampling, examples, sampling theorem, sampling of band pass signals.	2
Lec3	The z-transform, introduction, definition of the z-transform, relationship between the z-transform and the Laplace transform, basic properties. The inverse z-transform, methods and examples, partial fraction expansion, contour integration, region of convergence, solved problems.	2
Lec4	Using z-transform, transform analysis of systems, solving difference equations, system function, stability and causality. The discrete Fourier transform (DFT), introduction, definition and properties of the DFT, examples, relationship between the z-transform and the DFT. The inverse discrete Fourier transform (IDFT), overlapping effect, windows methods, and frequency resolution.	2
Lec5	Digital filters, introduction, notations, structures for FIR and IIR systems, the zero-pole method for filter design, filter specifications and classification, examples of filters.	2
Lec6	FIR filters, linear phase FIR design using windows, properties, design procedures, examples. IIR filters, introduction, structures for IIR filters, IIR filters design, impulse-invariant transformation, bilinear transformation.	2
Lec7	The Fast Fourier Transform, relationship between the FFT and the DFT, FFT algorithm, introductions, examples, radix-2 decimation-in-time FFT.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory organization, conditions for course crediting, group division.	1
Lab2	Signal processor programming - introduction (Signal Processor)	2

Lab3	Analog-to-digital conversion (Matlab)	2
Lab4	Generation of signals, real-time processing (Signal processor)	2
Lab5	Spectral analysis, FFT (Signal Processor)	2
Lab6	Digital filters (Matlab)	2
Lab7	Digital filters (Signal Processor)	2
Lab8	Corrections and evaluation of the course	2
		Total hours: 15

TEACHING TOOLS USED		
<p>N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation</p>		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	oral answers
F2	PEK_U02	laboratory reports
P = 0.2*F1+0.8*F2		

PRIMARY AND SECONDARY LITERATURE		
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PRIMARY LITERATURE

T. P. Zielinski „Cyfrowe przetwarzanie sygnałów”, 2005
A. V. Oppenheim, R. W. Schaffer „Cyfrowe przetwarzanie sygnałów“ 1989
R. G. Lyons „Wprowadzenie do cyfrowego przetwarzania sygnałów” 1999

SECONDARY LITERATURE

G. Marven, G. Ewers „Zarys cyfrowego przetwarzania sygnałów” 1999
W. Brodziewicz, K. Jaszczak „Cyfrowe przetwarzanie sygnałów” 1987
R. Gabel, R. Roberts „Sygnały i systemy liniowe” 1978
K. Steiglitz „Wstęp do systemów dyskretnych” 1977

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Digital signal processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1, C2	Le1-8	N1
PEK_U01	K1MTR_U21	C3	La1-8	N2,N3,N4
PEK_U02	K1MTR_U22	C3	La1-8	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie systemów**

Name in English: **System modelling**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036202**

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		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED	
<p>N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. report preparation</p>	

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
F2	PEK_W01, PEK_W02, PEK_W03	
P = 0,1F1+0,9F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	
F2	PEK_U01, PEK_U02, PEK_U03	
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
System modelling
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W04, K1MTR_MAP_W05	C1 - C3		N1
PEK_W02	K1MTR_MAP_W04, K1MTR_MAP_W05	C1 - C3		N1
PEK_W03	K1MTR_MAP_W04, K1MTR_MAP_W05	C1 - C3		N1
PEK_U01	K1MTR_MAP_U05	C2, C3		N2, N3
PEK_U02	K1MTR_MAP_U05	C2, C3		N2, N3
PEK_U03	K1MTR_MAP_U04	C2, C3		N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Prototypowanie systemów sterowania**

Name in English: **Control Systems Prototyping**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036203**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory

Number of hours

Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for laboratory class N2. laboratory experiment N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02, PEK_U03	
F3	PEK_U01 - PEK_U03	
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
<u>SECONDARY LITERATURE</u>

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT Control Systems Prototyping AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Mechatronics				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_U01	K1MTR_U19	C1 - C3		N1 - N3
PEK_U02	K1MTR_U19	C1 - C3		N1 - N3
PEK_U03	K1MTR_U19	C1 - C3		N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie MES w mechatronice**

Name in English: **FEM modelling in mechatronics**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR036303**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge about differential calculus.
2. Student has basic knowledge about electrodynamics (electrostatics, electric current, magnetostatics, magnetic induction, electromagnetic waves)
3. Student is able to utilize theory of electromagnetic field to assess physical quantities.

SUBJECT OBJECTIVES

- C1. Description of electromagnetic phenomena in electrical machines and devices.
- C2. Introduction to universal method of computation of field (by finite element method) as a tool to evaluate induction, force and power loss parameters.
- C3. Introduction to field analysis and designing of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student is able to utilize commercial software to field and circuit-field computation.

PEK_U02 - Student is able to design 2-D field and circuit-field model of electrical machines and devices.

PEK_U03 - Student is able to assess results of computations of electromagnetic field.

III. Relating to social competences:

PEK_K01 - Student is able to cooperate in a teamwork for various roles.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Basic terms of electrodynamics and definitions of physical quantities.	2
Lab2	Principles of software to compute fields by finite element method. Training of simple software to compute electromagnetic fields (QuickField and FEMM).	2
Lab3	Construction of field model of electromagnetic device (QuickField and FEMM).	2
Lab4	Geometry construction of simple electrical device and material parameters of its elements.	2
Lab5	Mesh generation. Investigation of mesh quality on the computation results.	2
Lab6	Computation of magnetic field distribution on simple models of electrical devices.	2
Lab7	Analysis of numerical computation results. Methods of results presentation.	2
Lab8	Analysis of field computation results. Integral quantities computation (induction, force, torque).	2
Lab9	Planar-parallel model of device supplied by DC current.	2
Lab10	Planar-parallel model of device with permanent magnet.	2
Lab11	Field axial-symmetrical model of electric device supplied by permanent magnets or DC current.	2
Lab12	Computation of magnetic field distribution and electromagnet parameters.	2
Lab13	Computation of magnetic field distribution and DC current actuator parameters.	2
Lab14	Computation of magnetic field distribution and permanent magnet synchronous machine torque. Teamwork.	2
Lab15	Grades.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Turowski J., Obliczenia elektromagnetyczne elementów maszyn i urządzeń elektrycznych, WNT, Warszawa 1982

SECONDARY LITERATURE

Bianchi N., Electrical machine analysis using finite elements, CRC Taylor&Francis, Boca Raton, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM modelling in mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U01	C3		N1
PEK_U02	K1MTR_U13	C3		N1
PEK_U03	K1MTR_U02	C3		N1
PEK_K01	K1MTR_K03	C3		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**

Name in English: **Diploma seminar**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037028**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
Sem2		2
Sem3		2
Sem4		6
Sem5		10
Sem6		6
Sem7		2
		Total hours: 30

TEACHING TOOLS USED

- N1. informative lecture
- N2. self study - self studies and preparation for examination
- N3. report preparation
- N4. problem discussion
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**

Name in English: **Diploma seminar**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037038**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
Sem2		2
Sem3		2
Sem4		6
Sem5		10
Sem6		6
Sem7		2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture N2. N3. N4. N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
<u>SECONDARY LITERATURE</u>

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie cienkwarstwowe**

Name in English: **Thin-layer technologies**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037102**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the foundations of physics .
2. Has a basic knowledge of the materials science engineering

SUBJECT OBJECTIVES

- C1. Understanding the physical basis of the generation and measurement of the vacuum.
- C2. Understanding the technology of thin films .
- C3. Knowledge of contemporary developments in the field of electrical materials technology .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows basics of vacuum technology

PEK_W02 - Has a basic knowledge of the technology of thin films .

PEK_W03 - Has a basic knowledge of contemporary developments in the field of electrical materials technology .

II. Relating to skills:

PEK_U01 - Is able to select the right technology for obtaining layers of given chemical and physical parameters .

PEK_U02 - Is able to select the appropriate layer for specific applications in industry.

PEK_U03 - Is able to use vacuum techniques in thin film technologies .

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Acquainted with the subject , the requirements and the test requirements. Basic laws , definitions and concepts of thin-film techniques .	2
Lec2	Electrodeposition of layers	4
Lec3	Fundamentals of vacuum technology and vacuum measurement methods	4
Lec4	Chemical vapour deposition	6
Lec5	Physical vapour deposition	8
Lec6	Plasma methods of obtaining carbon layers .	2
Lec7	Methods of test for the basic parameters of the layers.	2
Lec8	Technologies for substrates preparation.	1
Lec9	Final test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Vacuum evaporation	3
Lab2	The use of electron beam	3
Lab3	Preparation of carbon coatings by magnetron sputtering	3
Lab4	Preparation of high melting layers by magnetron sputtering .	3
Lab5	Plasma polymerisation	3
Lab6	Polymerization in the plasma at a frequency of 26 MHz .	3
Lab7	Reactive processes - obtaining oxide layers	3
Lab8	The study of electrical properties of thin films	3
Lab9	Spectrophotometric study of the chemical composition of the plasma.	3
Lab10	Additional classes	3
		Total hours: 30

TEACHING TOOLS USED

- N1. problem lecture
- N2. multimedia presentation
- N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = 0,4F1+0,3F2+0,3F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_UO1	test, lab report
F2	PEK_UO2	test, lab report
F3	PEK_UO3	test, lab report
P = 0,4F1+0,3F2+0,3F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Kordus A., Plazma w technice, Wydawnictwo Uczelniane Politechniki Poznańskiej, Poznań, 1973[2] Burakowski T., Wierzchoń T., Inżynieria powierzchni, WNT, Warszawa 1995[3] Miernik K., Działanie i budowa magnetronowych urządzeń rozpylających, Radom 1999[4] Tracton A. A., Coating materials and surface coatings, CRC Press 2006

SECONDARY LITERATURE

[1] Posadowski W.M.: Niekonwencjonalne Układy magnetronowe do próżniowego nanoszenia cienkich warstw, Oficyna wydawnicza Politechniki Wrocławskiej, Wrocław 2001[2] Grill A., Cold plasma in materials fabrication, IEEE PRESS 1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thin-layer technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W07, K1MTR_W02	C1	Wy1, Wy3	N1, N2
PEK_W02	K1MTR_MAP_W07, K1MTR_W18	C2, C3	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_W03	K1MTR_MAP_W07, K1MTR_W18	C2,	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_U01	K1MTR_U02	C1,	La1	N3
PEK_U02	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3
PEK_U03	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**

Name in English: **Numerical methods**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037202**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge about mathematical analysis and linear algebra
Has basic knowledge about developing algorithms and computer programming
2. Is able to write computer C programmes based on given algorithm
3. Recognises the need of continuous education, developing professional, personal and social competences and it able to define opportunities to do so

SUBJECT OBJECTIVES

- C1. Introduction to selected numerical computational techniques for engineering purposes
- C2. Preparation for problem solving in a design team
- C3. Introduction to methods of algorithmization of computational procedures, monitoring and controlling of technological processes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is able to source information about selecting numerical methods and procedures necessary to solve elementary engineering problems, from literature, databases and other sources

PEK_U02 - Is able to draft documentation describing execution of an engineering task and prepare a text discussing its results

III. Relating to social competences:

PEK_K01 - Is able to think and action in a creative and enterprising manner.

PEK_K02 - Is able to evaluate design team performance and perform a critical analysis.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Conversion and standardisation of floating-point numbers.	2
Proj2	Summation of infinite alternating trigonometric numerical series using the method of partial sum averaging as modified by Gill-Moler (G-M)	2
Proj3	Solving the Dirichlet electrostatic problem for two-dimensional geometrical areas (examples: Laplace's and Poisson's equation)	2
Proj4	Students in groups of two select a single project problem concerning application of computational techniques in engineering problems. Each project consists of the following stages: theoretical breakdown, algorithmization and programming, launching and testing the end-user application, preparing documentation. Project problems are different every year and are not repeated.	9
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

N2. self study - preparation for project class

N3. tutorials

N4. case study

N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01,PEK_U02	
F2	PEK_U01,PEK_U02 PEK_K01,PEK_K02	
P = 0.15F1+0.85F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Metody numeryczne, G.Dahlquist, A.Bjork, PWN (wydanie dowolne)
- [2] Przegląd metod i algorytmów numerycznych - cz.1 i 2, J.i M. Jankowscy, WNT
- [3] Wstęp do programowania systematycznego, N.Wirth, WNT (wydanie dowolne)
- [4] Platforma edukacyjna: <http://eportal.eny.pwr.wroc.pl>
- [5] Netografia

SECONDARY LITERATURE

- [1] Algorytmy + struktury danych..., N. Wirth, WNT (wydanie dowolne)
- [2] Macierze w automatyce i elektrotechnice, T.Kaczorek, WNT (wydanie dowolne)
- [3] Handbook of mathematical functions, M. Abramowitz, I.Stegun, Washington 1964,
(Wydanie rosyjskie dostępne w czytelni Biblioteki Głównej PWr)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 PEK_U02	K1MTR_U01	C1,C2,C3	Pr1,Pr2,Pr3,Pr4	N1,N2,N3,N4,N5
PEK_K01 PEK_K02	K1MTR_K04, K1MTR_K06	C1,C2,C3	Pr4	N1,N2,N3,N4,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyka w budynku**

Name in English: **Building automation**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037231**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. In the scope of knowledge:
 - 1.1. Student has a basic knowledge concerning the electrical installations of municipal buildings.
2. In the scope of know-how:
 - 2.1. Student knows how to use basic computer hardware and software.
 - 2.2. Student can obtain information from literature, databases and other sources.
3. In the scope of the competence:
 - 3.1. Student understands the need of continuous education and knows possibilities of improving professional, personal and social competencies.

SUBJECT OBJECTIVES

- C1. Acquiring general knowledge regarding the planning of electrical installations in municipal buildings and getting to know of basic principles of the functioning and organization of building automation and security systems as a part of intelligent building.
- C2. Acquiring knowledge in the field of topology, physical and logical structure of chosen solutions of intelligent installation systems and security systems.
- C3. Getting to know of basic software tools used for configuration of selected building automation systems.
- C4. Acquiring detailed knowledge and skills in planning and designing simple arrangements of intelligent installations and security systems in chosen building automation systems with using products of various manufacturers.
- C5. Getting to know broad principles of design of electrical installations in municipal buildings.
- C6. Acquiring and strengthening social competencies concerning the selfdependence, responsibility and reliability in the proceedings, awareness of effects of engineering actions taken.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows the fundamental assumptions of the building automation and the system technology of intelligent installations and security systems in the building.

PEK_W02 - Student has a general knowledge in the field of the construction and operation of selected intelligent installation systems and security systems in the building.

PEK_W03 - Student has a detailed knowledge in the field of the construction and operation of selected intelligent installation systems and security systems in the building.

II. Relating to skills:

PEK_U01 - Student can design and select the elements of a traditional electrical installation in municipal buildings.

PEK_U02 - Student can design and select the elements of an intelligent installation in chosen buildings automation systems.

PEK_U03 - Student can design and select the elements of a security system installation in chosen buildings automation systems.

III. Relating to social competences:

PEK_K01 - Student is able to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course and presentation of credit conditions. Preliminary information about the building automation, system technology of intelligent installation and security systems in the buildings. Basic definitions and classifications.	2
Lec2	General presentation of the intelligent installations systems. Basic divisions and classifications.	2

Lec3	General characteristics of the KNX system. Topology of the KNX system and division of the system components. The logical structure of the KNX system. Examples of applications and practical implementation of selected control functions.	2
Lec4	General characteristics of the LCN system. The internal structure of the module, system components, system topology. Division and types of system devices. The logical structure of the LCN system. Examples of applications and practical implementation of selected control functions.	2
Lec5	Security of the intelligent buildings. Automatic control systems in buildings - the types and classifications, basic tasks and functions. General characteristics of the fire detection and fire alarm system. Types of devices and examples of implementation.	2
Lec6	General characteristics of the intruder and hold-up alarm system. Types of devices and topology of the system. Examples of implementation. General characteristics of the access control system. Types of devices and system topology. Examples of implementation.	2
Lec7	General characteristics of the closed-circuit television system. Types of devices and topology of the system. Examples of implementation. General characteristics of the alarm and evacuation sound system, types of devices. Integration and cooperation of the automation systems in the building.	2
Lec8	Final colloquium.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to the course. Presentation of the course credit conditions. Distribution of project tasks and discussion of their scope. Planning the electrical installation and determining of the power demand requirements in the selected buildings. Sizing and equipping the electrical installations in municipal buildings.	3
Proj2	Sizing and equipping the electrical installations in municipal buildings. Selection of cables, wires and protection devices in the distribution network and in chosen electrical installation circuits. Guidelines concerning equipping the intelligent electrical installations.	3
Proj3	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj4	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj5	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj6	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems. The content and principles for the preparation of technical project documentation in the field of conventional and intelligent electrical installations.	3
Proj7	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3

Proj8	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj9	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj10	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems. The content and principles for the preparation of technical project documentation in the field of electrical installations of security systems.	3
		Total hours: 30

TEACHING TOOLS USED

- N1. information lecture with use of audio-visual techniques
- N2. multimedia presentation
- N3. problem discussion
- N4. software tools to design and programming the intelligent installations
- N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Discussion
F2	PEK_U01, PEK_U02, PEK_U03	Evaluation of the project preparation
F3	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Project defence
P = 0,2F1 + 0,3F2 + 0,5F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Markiewicz H., Instalacje elektryczne, WNT, current edition;
 [2] Niezabitowska E. (red.), Budynek inteligentny. Tom II. Podstawowe systemy bezpieczeństwa w budynkach inteligentnych, Wydawnictwo Politechniki Śląskiej, current edition;

SECONDARY LITERATURE

- [1] Klajn A., Bielówka M., Instalacja elektryczna w systemie KNX/EIB, Informacje o Normach i Przepisach Elektrycznych – Miesięcznik Stowarzyszenia Elektryków Polskich, Podręcznik dla Elektryków – Zeszyt 10, Warszawa 2006;
 [2] Selected websites of the manufacturers of building automation systems, according to the Supervisor's recommendation;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Building automation
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W06	C1	Lec1, Lec2, Lec5, Lec7, Lec8	N1, N3, N5
PEK_W02	K1MTR_MAP_W06	C2	Lec2 - Lec8	N1, N3, N5
PEK_W03	K1MTR_MAP_W06	C2, C3	Lec3 - Lec8	N1, N3, N4, N5
PEK_U01	K1MTR_MAP_U06	C5	Proj1, Proj2, Proj6	N2, N3, N5
PEK_U02	K1MTR_MAP_U06	C3, C4	Proj2 - Proj6	N2, N3, N4, N5
PEK_U03	K1MTR_MAP_U06	C4	Proj7 - Proj10	N2, N3, N5
PEK_K01	K1MTR_K06	C6	Proj1 - Proj10	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**

Name in English: **Diploma seminar**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **optional**

Subject code: **MCR037301, 7201, 7103**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS points in required range

SUBJECT OBJECTIVES

- C1. Gaining ability to present own qualifications, knowledge, skills and social competences.
- C2. Straightening the ability to think critically and work in team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is able to think critically and work in team.

III. Relating to social competences:

PEK_K01 - Introduction, general information about Master's thesis and master's examination.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, general information about Master's thesis and master's examination.	2
Sem2	Rules of proper technical and scientific paper preparation.	2
Sem3	Rules of proper multimedia presentation preparation, especially for master's examination.	2
Sem4	Review of current knowledge, aim and scope of individual diploma thesis – students presentations.	6
Sem5	Reports from progress in realization of students work – students presentation.	10
Sem6	Multimedia presentation of students prepared for diploma examination – students presentation.	6
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

- N1. Informative lecture
- N2.
- N3.
- N4.
- N5. Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_K01	The appreciation of skill of solving in range of qualifying work the technical problems and their multimedia introduction as well as the leadership of discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**

Name in English: **Block of Sports Activities**

Main field of study (if applicable): **Mechatronics**

Level and form of studies: **I level, full-time**

Kind of subject: **obligatory**

Subject code: **WFW000000BK**

Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
Group of courses					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Sports Activities
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_K01	K1MTR_K03, K1MTR_K11, K1MTR_K14	wg kart opracowanych przez SWF.		wg kart opracowanych przez SWF.

SUBJECT SUPERVISOR

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