MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
“Igor Sikorsky Kyiv Polytechnic Institute”

APPROVE
Academic Council
of "Igor Sikorsky Kyiv Polytechnic Institute"
(Meeting protocol No.10 from December 13, 2021)
Head of Academic Council
Mykhailo ILCHENKO

Engineering of Intelligent Electrotechnical and Mechatronic Complexes

EDUCATIONAL PROFESSIONAL PROGRAM

second (master's) level of higher education

specialty	**141 Electric Power Engineering, Electrotechnics and Electromechanics**
field of knowledge	**14 Electrical Engineering**
qualification	**Master of Electric Power Engineering and Electromechanics**

Put into effect by the Rector's Order Igor Sikorsky Kyiv Polytechnic Institute
from February 15, 2022
No. HOH/75/2022

Kyiv – 2022

PREAMBLE

DEVELOPED by a working group:

Chairman of the working group

Rosen Victor, Doctor of Technical Sciences, Professor of the Department Automation of Electrical and Mechatronic Complexes

Members of the working group:

Meyta Oleksandr, Candidate of Engineering Sciences (Ph.D.),
Associate Professor at the Department of
Automation of Electrical and Mechatronic Complexes
Mazurenko Leonid, Doctor of Technical Sciences,
Head of the Department of Electromechanical Systems
of the Institute of Electrodynamics of the Academy of Sciences of Ukraine
Bosak Alla, Candidate of Engineering Sciences (Ph.D.),
Associate Professor at the Department of
Automation of Electrical and Mechatronic Complexes
Polishchuk Valentina, Senior Lecturer at the Department of
Automation of Electrical and Mechatronic Complexes
Horobets Andriy, student at the Department of
Automation of Electrical and Mechatronic Complexes

Head of the Department of Automation of
Electrical and Mechatronic Complexes
Boychenko Sergiy, Doctor of Technical Sciences, Professor

AGREED:

Scientific and methodical commission of Igor Sikorsky Kyiv Polytechnic Institute on specialty 141 «Electric Power Engineering, Electrotechnics and Electromechanics»
Head of Scientific and Methodological Commission on Specialty
Oleksandr YANDULSKYI
(Meeting protocol No. 4 of December 6, 2021)

Methodical council of Igor Sikorsky Kyiv Polytechnic Institute
Chairman of the Methodological Council
Anatoliy MELNYCHENKO
(Meeting protocol No. 2 of December 9, 2021)

CONSIDERED:

According to the results of public discussion

- remarks and suggestions of stakeholders;
- graduates and students of higher education who are studying in educational and professional fields the Engineering of intelligent electrotechnical and mechatronic complexes program specialties 141 Power engineering, electrical engineering and electromechanics;
- industry specialists:

«Acciona Global Energy Ukraine» LLC, General Director O. V. Bosak,
Institute of Electrodynamics of the National Academy of Sciences of Ukraine, head of department of electromechanical systems, Mazurenko L.I.
«SV Altera Kyiv» LLC, General Director V.V. Tkachenko,
«Enersys Ukraine» LLC, General Director A.V. Sakhanenkov.

- specialists of the educational and methodical department of Igor Sikorskyi KPI;
- scientific and pedagogical staff of the Department of Automation of Electrical Engineering and mechatronic complexes.

According to the results of the monitoring of the educational and professional program Engineering intelligent electrotechnical and mechatronic complexes of the second (master's) level of higher education in the specialty 141 Power Engineering, electrical engineering and electromechanics, approved by the decision of the Academic Council dated 03.15.21., protocol No. 3, taking into account the suggestions of participants in the educational process, graduates, employers and other external stakeholders, it was updated, namely:

- changes introduced by Order of the Ministry of Economy No. 810-21 of October 25 are taken into account 2021 in the classifier of professions ДК 003:2010;

It is recommended when developing catalogs of selective components for forming individual trajectory to enter training educational components that are associated with practical professional activity.

The revision of the educational program was carried out in compliance with the order of the rector of Igor Sikorsky Kyiv Polytechnic Institute No. НОН/248/2021 dated October 22, 2021 "On updating the educational programs of Igor Sikorsky Kyiv Polytechnic Institute".

Educational and professional program "Engineering of intellectual electrical engineering and mechatronic complexes" was considered at the meeting of the automation department of electrotechnical and mechatronic complexes protocol No. 5 dated November 24, 2021.

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1. PROFILE OF THE EDUCATIONAL PROGRAM

1 – General information	
Full name of the Higher Education Institution and Institute /Faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Educational and Research Institute of Energy Saving and Energy Management
Higher education degree and title of qualification at original language	Degree – Master Qualification - Master of Electric Power Engineering, Electrotechnics and Electromechanics
The official name of the educational program	Engineering of intelligent electrical and mechatronic complexes
Type of diploma and volume of educational program	Master's degree, single, 90 credits, term of study 1 year, 4 months
Availability of accreditation	Accredited for the first time
Level of National Qualifications Framework	NQF of Ukraine - level 7 QF-EHEA – the second cycle EQF-LLL – Level 7
Prerequisites	Having a bachelor's degree
Language (s) of teaching	Ukrainian / English
Term of the educational program	Accredited for the first time
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/ section «Educational programs» https://aemk.kpi.ua/ section «Preparation of masters»
2 – The purpose of the educational program	
The purpose of the educational program is the fundamental training of specialists capable of solving specialized tasks and practical problems in the field of electric power, electrical engineering and electromechanics, which involve the development and improvement of intelligent control systems for electrotechnical and mechatronic complexes based on modern modeling technologies, control methods in complex systems using modern software.	
3 – Characteristics of the educational program	
Subject area	Objects of study and activity: - electrical and electromechanical services of enterprises, scientific and design institutions;

	- enterprises of the electric power industry, including the fuel and energy complex; - production, transmission, distribution and conversion of electric energy at power plants, electric networks and systems and their engineering; - electrotechnical equipment, electromechanical and switching equipment, electromechanical, electrotechnical complexes, and intelligent control systems. The purpose of education: training of specialists capable of constructing, designing, operating, providing culture of safety, performing installation, commissioning, and repair, creating new equipment and implementation the latest technologies, carrying out research and teaching. Theoretical content of the subject area: basic concepts of the theory of electric, electromagnetic circuits and technical mechanics, modeling, optimization and analysis of modes of operation of power plants, networks and systems, electric machines, electric drives, electrotechnical and mechatronic systems and complexes. Methods, techniques and technologies: analytical methods of calculation of electrical circuits, power supply systems, electrical machines and devices, intelligent control systems for electrical, electromechanical and mechatronic systems, electrical loads using specialized laboratory equipment, personal computers, microprocessors and programmable logic systems. Tools and equipment: control and measuring devices, electrical and electronic devices, microcontrollers, computers.
Orientation EP	Educational and professional
The main focus of the EP	The program is based on well-known scientific principles, taking into account the current state of development of power energy, electrical engineering, electromechanics and mechatronics, focuses on current specializations, within which further professional and scientific activities are possible. Keywords: electrotechnical, electromechanical and mechatronic systems and complexes, devices and equipment, control systems, intelligent automation systems, engineering.
Features of EP	It is possible to use a mixed form of education.
4 – Eligibility of graduates for employment and further education	
Suitability for employment	According to the classifier of professions ДК003: 2010 (in the current edition) graduates can perform the following types of professional work: 2143.2 Relay protection and electrical automation engineer 2143.2 Service engineer of energy enterprise lines 2143.2 Engineer of the converting complex 2143.2 Electrical engineer in the power sector 2143.2 Power engineer 2143.2 Design engineer (electrical engineering) Professional certification is possible
Further education	Continuation of education at the third (educational and scientific) level of higher education and / or acquisition of additional qualifications in

	the system of adult education.	
5 – Teaching and evaluation		
Teaching and learning	- involvement of specialists from other educational institutions in teaching disciplines; - conducting internships for students in the industry; - participation of higher education applicants in student research circles; - possibility to teach separate courses in English.	
Evaluation	Evaluation of students' knowledge is carried out in accordance with the "Regulations on the system of assessment of learning outcomes at Igor Sikorsky Kyiv Polytechnic Institute" for all types of classroom and extracurricular work (current, calendar, semester control); oral and written exams, assessments, practice reports, defense of qualification work.	
6 – Program competencies		
Integral competence	Ability to solve complex problems and problems during professional activities in the field of power engineering, electrical engineering, electromechanics and mechatronics or in the learning process involving research and / or innovation.	
General competencies (GC)	GC1	Ability to abstract thinking, analysis, and synthesis.
	GC2	Ability to search process and analyze information from various sources.
	GC3	Ability to use information and communication technologies.
	GC4	Ability to apply knowledge in practical situations.
	GC5	Ability to use a foreign language to carry out scientific and technical activities
	GC6	Ability to make informed decisions.
	GC7	Ability to learn and master modern knowledge.
	GC8	Ability to identify and assess risks.
	GC9	Ability to work independently and in a team.
	GC10	Ability to identify feedback and adjust actions based on it
Professional competencies (PC)	PC1	Ability to apply the acquired theoretical knowledge, scientific and technical methods to solve scientific and technical problems and problems of power engineering, electrical engineering and electromechanics.
	PC2	Ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems of power engineering, electrical engineering and electromechanics.
	PC3	Ability to plan, organize and carry out research in the field of power engineering, electrical engineering and electromechanics.
	PC4	Ability to develop and implement measures to improve the reliability, efficiency and safety in the design and operation of equipment and facilities of electricity, electrical engineering and

		electromechanics.
	PC5	Ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics.
	PC6	Ability to demonstrate knowledge and understanding of mathematical principles and methods required for using in power engineering, electrical engineering and electromechanics.
	PC7	Ability to demonstrate awareness of intellectual property and contracts in power engineering, electrical engineering and electromechanics.
	PC8	Ability to research and identify problems and identify constraints, including those related to nature protection, sustainable development, health and safety and risk assessments in electricity, electrical engineering and electromechanics.
	PC9	Ability to understand and take into account social, environmental, ethical, economic and commercial considerations that affect the implementation of technical solutions in power engineering, electrical engineering and electromechanics.
	PC10	Ability to manage by projects and evaluate their results.
	PC11	Ability to evaluate indicators of reliability and efficiency of operation of electric power, electrotechnical and electromechanical objects and systems.
	PC12	Ability to develop plans and projects to ensure the achievement of a specific goal, taking into account all aspects of the problem, including the production, operation, maintenance and disposal of equipment for power, electrical and electromechanical systems.
	PC13	Ability to demonstrate awareness and ability to use regulations, norms, rules, and standards in power engineering, electrical engineering and electromechanics.
	PC14	Ability to use methods of valuation of intellectual property rights for their further commercialization, including for the sale of licenses and technology transfer.
	PC15	Ability to publish the results of their research in scientific journals.
	PC16	Ability to formulate technical requirements for developed products and technologies, to determine technical conditions of operation and maintenance of new equipment, to make technical tasks for research and development, to allocate key technological parameters of developments and to define their target or normative values in the field of engineering.
	PC17	Ability to develop tools, methods and techniques of science and technology aimed at automation of existing and creating new automatic and automated technologies and industries.

	PC18	Ability to create universal most effective algorithms for modeling processes in electrical systems and carry out their research.
	PC19	Ability to optimize technological processes and build block diagrams of automated control systems.
	PC20	Ability based on the analysis of static and dynamic loads, mode characteristics to calculate and develop optimum designs of the equipment and operational modes of simple and complicated electromechanical complexes with use of modern computer methods of mathematical modeling.
	PC21	Ability to create new effective methods and techniques for designing, manufacturing, diagnosing, and repairing energy-intensive electrical equipment.

7 – Program learning outcomes

PLO1. Know and understand the main types of intellectual property law and methods of its protection, methodological and legislative bases of creation of intellectual property objects.
PLO2. Know and understand the main provisions of regulatory documents governing innovation in Ukraine.
PLO3. Know the list of major open international banks of electronic resources to support educational, research and innovation activities.
PLO4. Know the basic principles of sustainable development of society, taking into account the social, technological, economic and environmental aspects of human activity.
PLO5. Know a foreign language at a level that provides free discussion with foreign scientists on current scientific and technical problems of power engineering, electrical engineering and electromechanics and the opportunity to speak at foreign conferences and symposiums.
PLO6. Know and understand current standards, regulations and rules according to which Ukraine operates in the field of electricity, electrical engineering and electromechanics.
PLO7. Know and understand the rules of safe operation of electrical, electrical and electromechanical equipment.
PLO8. Know the main provisions of the Energy Strategy of Ukraine and the principles of energy security.
PLO9. Know the main effective methods and approaches aimed at improving energy efficiency and reliability of electrical, electrical and electromechanical equipment and related complexes and systems.
PLO10. Know the basic principles of the latest approaches and modern methods of research in the field of power engineering, electrical engineering and electromechanics.
PLO11. To reproduce processes in electric power, electrotechnical and electromechanical systems at computer model.
PLO12. Master new versions or new software, which designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems.
PLO13. Reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, operational efficiency and resource life.
PLO14. Apply the technique of intelligent control in the study and design of relevant complexes and systems.
PLO15. Apply methods of engineering activities in the field of modern electrical systems.
PLO16. Synthesize systems for automatic control of various objects based on the theory of fuzzy logic and using the theory of artificial neural networks.
PLO17. Create universal most effective algorithms for modeling the processes of electrical complexes and carry out research of it using modern equipment with modern software.

PLO18. Create intelligent-adaptive systems of automated control and monitoring of technical condition by electromechanical equipment based on using of programmable logic controllers.
PLO19. Knowledge of the composition and sequence of development of innovative projects.
PLO20. Knowledge, understanding and practical application of experimental theory, methods of experiment planning, evaluation of experimental results, methods of analysis of experimental data and creation of mathematical models based on it, including using of new methods based on modern information technologies.
PLO21. Perform physical and mathematical modeling, static and dynamic analysis of structures and mechanisms, materials and processes at the design stage using modern computer systems.
PLO22. Choose the element base of electromechanical and mechatronic systems, complete electric and hydraulic drives, control, protection, automation of power supply systems of machines and installations, production sites and enterprises.
PLO23. Create intelligent-adaptive systems of automated control and monitoring of technical condition by electromechanical equipment based on the use of programmable logic controllers and on-board computers.
PLO24. Calculate forces, stress-strain state, velocities, moments, power, static and dynamic properties, electromechanical equipment, perform power and hydraulic calculations of hydraulic drive elements, electric drives, linear and nonlinear elements, electric and magnetic circuits.
PLO25. Fluently communicate orally and in writing in state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics.
PLO26. Identify problems and identify constraints related to problems of environment protection, sustainable development, health and safety and risk assessments in the fields of electricity, electrical engineering and electromechanics.

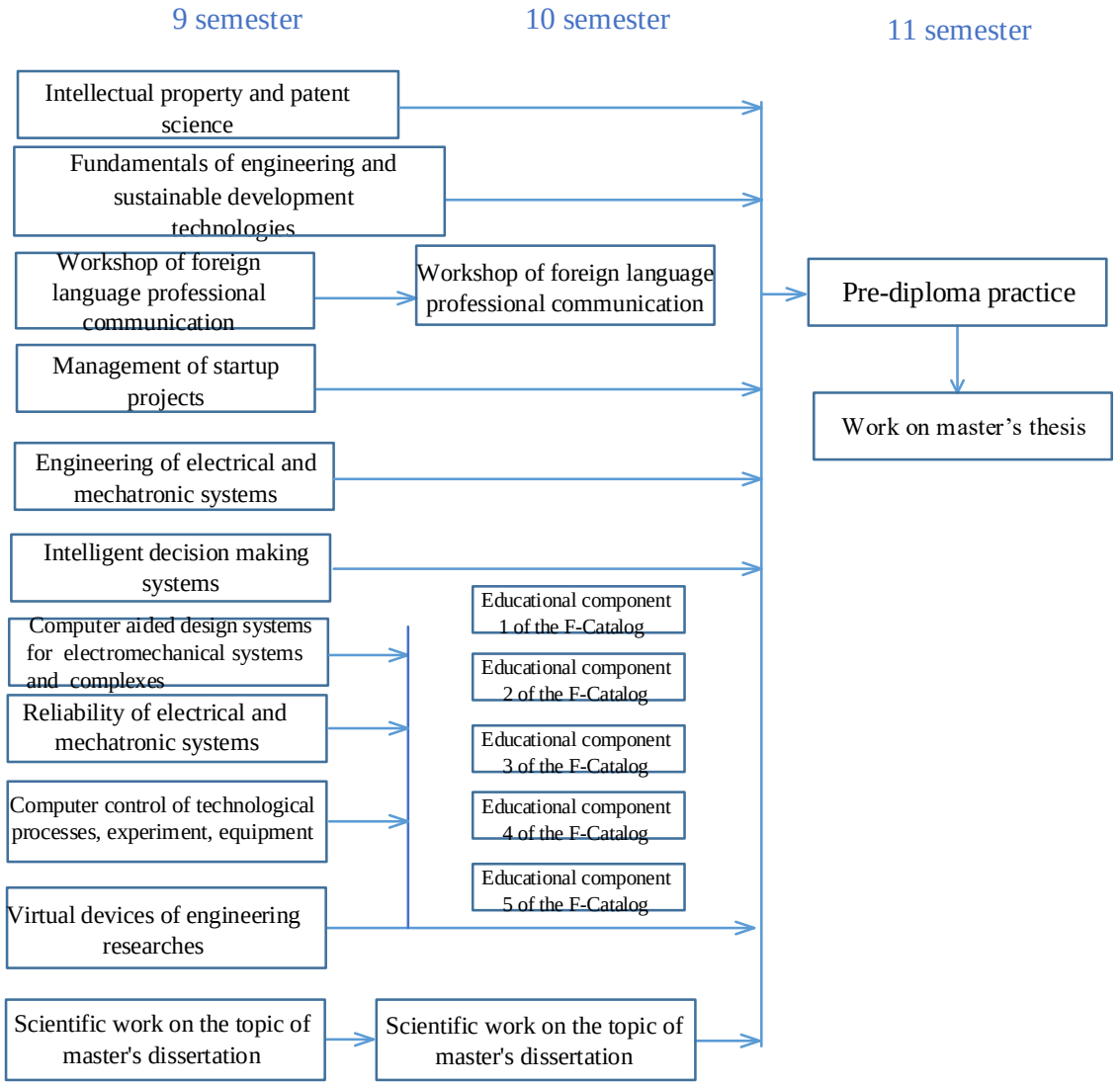
8 – Resource support for the implementation of the program	
Personnel support	In accordance with the personnel requirements for ensuring the implementation of educational activities for the appropriate level, approved by the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015, No. 1187 (as amended by the resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347). The implementation of the program involves the involvement of practicing professionals, industry experts, representatives of employers and other stakeholders in the educational process.
Material and technical support	In accordance with the technological requirements for material and technical support of educational activities of the appropriate level of HE, approved by the resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015, No.1187 (as amended by the resolution of the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347). During the training of specialists, the equipment of the department's laboratories and the technical capabilities of the enterprises where the applicants undergo practice, as well as modern software, are used.
Information and educational and methodological support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of HE, approved by the Cabinet of Ministers of Ukraine dated December 30, 2015, No. 1187 (as amended by the Cabinet of Ministers of Ukraine dated May 10, 2018, No. 347). When organizing and conducting the educational process, the resources of the scientific and technical library named after G.I. Denisenko KPI named after Igor Sikorsky Kyiv Polytechnic Institute (https://www.library.kpi.ua).

9 – Academic mobility	
National Credit Mobility	Possibility to conclude agreements on academic mobility, double graduation, etc.
International Credit Mobility	Possibility of concluding agreements on international academic mobility (Erasmus + K1), on double graduation, on long-term international projects that involve the inclusion of students, etc.
Training of foreign applicants for higher education	For foreign citizens, education is provided in English, and Ukrainian is studied as a foreign language

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code Discipline	Components of the educational program (academic disciplines, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
NORMATIVE educational components			
General training cycle			
GT1	Intellectual property and patent science	3	Test
GT2	Fundamentals of engineering and technology of sustainable development	3	Test
GT3	Workshop of foreign language professional communication	3	Test
GT4	Management of startup projects	3	Test
Vocational training cycle			
VT1	Engineering of electrical and mechatronic systems	5	Exam
VT2	Intelligent decision - making systems	4,5	Test
VT3	Computer aided design systems for electromechanical systems and complexes	4	Exam
VT4	Reliability of electrical and mechatronic systems	4	Exam
VT5	Computer control of technological processes, experiment, equipment	4,5	Test
VT6	Virtual devices of engineering researches	4	Test
Research (scientific) component			
VT7	Scientific work on the topic of master's dissertation	4	Test
VT8	Pre-diploma practice	14	Test
VT9	Work on a master's thesis	12	defense
SELECTIVE educational components			
Vocational training cycle (Optional subjects from Faculty catalogue)			
VO 1	Educational component 1 of the F-Catalog	5	Exam
VO 2	Educational component 2 of the F-Catalog	4	Test
VO 3	Educational component 3 of the F-Catalog	5	Exam
VO 4	Educational component 4 of the F-Catalog	4	Test
VO 5	Educational component 5 of the F-Catalog	5	Exam
The total volume of normative educational components:		67	
The total volume of selective educational components:		23	
TOTAL VOLUME OF THE EDUCATIONAL PROGRAM		**90**	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF FINAL CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Certification applicants a higher education professional program "Engineering of intelligent electrical and mechatronic systems" specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics " takes the form of a public defense of the qualification work and completed delivery of documents form for awarding him the degree of **Master of Electric Power Engineering, Electrotechnics and Electromechanics.**

Qualification work is checked for plagiarism and after the defense is placed in the repository of scientific and technical library University for free access. Graduation certification is open and public.

5. MATRIX OF COMPLIANCE OF PROGRAM COMPETENCIES WITH COMPONENTS OF THE EDUCATIONAL PROGRAM

	GT1	GT2	GT3	GT4	VT1	VT2	VT3	VT4	VT5	VT6	VT7	VT8	VT9
GC1							+	+		+			
GC2										+			+
GC3							+			+		+	+
GC4		+			+	+	+		+				
GC5			+				+	+		+			
GC6													+
GC7				+						+	+		
GC8												+	+
GC9												+	
GC10	+												
PC01								+					+
PC02							+			+		+	+
PC03												+	+
PC04		+						+					
PC05													
PC06							+	+					+
PC07	+												
PC08		+											
PC09					+								
PC10					+								+
PC11					+	+		+					
PC12													+
PC13							+	+					+
PC14	+												
PC15							+	+		+			+
PC16					+					+			
PC17					+	+	+		+				
PC18					+		+	+	+				
PC19						+			+				
PC20							+						
PC21							+						

6. MATRIX OF PROVIDING PROGRAM LEARNING OUTCOMES BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	GT1	GT2	GT3	GT4	VT1	VT2	VT3	VT4	VT5	VT6	VT7	VT8	VT9
PLO1	+									+			
PLO2		+											+
PLO3							+			+			+
PLO4		+											
PLO5			+				+	+					
PLO6							+			+			+
PLO7													+
PLO8							+	+		+	+		+
PLO9		+		+				+					
PLO10							+			+	+		+
PLO11							+		+				
PLO12							+		+	+			
PLO13								+					
PLO14						+							
PLO15					+								
PLO16					+								
PLO17						+	+		+	+			
PLO18					+		+			+			
PLO19					+	+				+			
PLO20					+					+			
PLO21								+					
PLO22					+								
PLO23						+							
PLO24							+						
PLO25							+	+		+			
PLO26										+			