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.8 from December 12, 2022)
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, Electrotechnics and Electromechanics**

Put into effect by the Rector's
Order Igor Sikorsky Kyiv Polytechnic
Institute
from May 17, 2023
No. HOH/165/2023

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 Electrotechnical and Mechatronic Complexes

Members of the working group:

Meyta Oleksandr, Candidate of Engineering Sciences (Ph.D.),
Associate Professor at the Department of
Automation of Electrotechnical 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 Electrotechnical and Mechatronic Complexes
Polishchuk Valentina, Senior Lecturer at the Department of
Automation of Electrotechnical and Mechatronic Complexes
Horobets Andriy, student at the Department of
Automation of Electrotechnical and Mechatronic Complexes

Head of the Department of Automation of
Electrotechnical 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. 2 of November 24, 2022)

Methodical council of Igor Sikorsky Kyiv Polytechnic Institute

Chairman of the Methodological Council

Anatoliy MELNYCHENKO

(Meeting protocol No. 3 of December 1, 2022)

CONSIDERED:

Based on the results of public discussion
- comments and suggestions of stakeholders;
- graduates and applicants for higher education studying in the educational and professional program Engineering of Intelligent Electrical and Mechatronic Complexes in the specialty 141 Electric Power Engineering, Electrical Engineering and Electromechanics;
- industry specialists:

SE "Institute "UkrNIIproekt", General Director Krut O.A.,
Institute of Electrodynamics of the National Academy of Sciences of Ukraine, Head of the Department of Transistor Converters, Yurchenko O.M.,
Enersys Ukraine LLC, General Director Sakhanenkov A.V.,
NPC UKRENERGO, Director of Market Operations M.V. Vyshnevsky

- specialists of the educational and methodological department of Igor Sikorsky Kyiv Polytechnic Institute;
- scientific and pedagogical staff of the Department of Automation of Electrical and Mechatronic Complexes.

According to the results of the monitoring of the educational and professional program "Engineering of Intelligent Electrical and Mechatronic Complexes" of the second (master's) level of higher education in the specialty 141 Electric Power Engineering, Electrical Engineering and Electromechanics, approved by the decision of the Academic Council of Igor Sikorsky Kyiv Polytechnic Institute. Minutes No. 10 dated 13.12.21, considering the proposals of participants in the educational process, graduates, employers and other external stakeholders, it was updated, namely:

- the changes made by the Order of the Ministry of Economy No. 810-21 of October 25, 2021, to the classifier of professions DK 003: 2010 are taken into account;

It is recommended to introduce educational components related to practical professional activity in the development of catalogs of elective components for the formation of an individual learning trajectory.

The revision of the educational program was carried out in pursuance of the order of the rector of Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky No. NON/282/2022 dated 04.10.2022 "On updating the educational programs of Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky".

The educational and professional program "Engineering of Intelligent Electrical and Mechatronic Complexes" was considered at a meeting of the Department of Automation of Electrical and Mechatronic Complexes, Minutes No. 6 dated November 23, 2022.

CONTENT

1. EDUCATIONAL PROGRAM PROFILE

1 – General information	
Full name of the HEI 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 in the original language	Master's Degree Qualification – master's degree in Electric Power Engineering, Electrical Engineering and Electromechanics
Official name of the Office of the President	Engineering of Intelligent Electrical and Mechatronic Complexes
Type of diploma and scope of EP	Master's degree, single, 90 credits, term of study 1 year 4 months
Availability of accreditation	Accredited for the first time
VO Cycle/Level	NQF of Ukraine – Level 7 QF-EHEA – Second Cycle EQF-LLL – Level 7
Prerequisites	Availability of a bachelor's degree
Language(s) of instruction	Ukrainian
Validity of the OP	Accredited for the first time
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/ section "Educational programs" https://auek.kpi.ua/ section "master's Training"
2 – Purpose of the educational program	
The purpose of the educational program is to fundamentally train specialists capable of solving engineering problems in the field of development and improvement of intelligent electrical and mechatronic systems using modern software and the latest technological equipment.	
3 – Characteristics of the educational program	
Subject Area	*Objects of study and activity:* - electrotechnical 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 electrical energy at power plants, in electrical networks and systems and their engineering; - electrical equipment, electromechanical and switching equipment, electromechanical, electrotechnical complexes and intelligent control systems. *The purpose* of the training is to train specialists capable of constructing, designing, operating, ensuring a safety culture, performing installation, adjustment and repair, creating new equipment and introducing the latest technologies, conducting research and teaching. *Theoretical content of the subject area*: basic concepts of the theory of electrical, electromagnetic circuits and technical mechanics, modeling, optimization and analysis of operating modes of power plants, networks and systems, electrical machines, electric drives, electrical and mechatronic systems and complexes. *Methods, techniques and technologies:* analytical methods for calculating 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 complexes. *Tools and equipment*: instrumentation, electrical and electronic devices, microcontrollers, Computers.
Orientation of the OP	Educational and professional
The main focus of the OP	The program is based on well-known scientific provisions, considering the current state of development of energy, electrical engineering, electromechanics and mechatronics, focuses on current specializations, within which further professional and scientific activities are possible. The program is aimed at the formation of such competencies of higher education applicants that make their comprehensive professional, scientific, intellectual, and social development possible in the field of electrical engineering, engineering of intelligent electrical and mechatronic complexes. Keywords: electrotechnical and electromechanical systems and complexes, devices and equipment, control systems, intelligent automation systems, engineering.
Features of the OP	Involvement of scientists and practitioners of industry institutions and enterprises in teaching. Availability of certificate programs "Engineering and Automation of Fuel and Energy Systems and Bioenergy Technologies", "Engineering and Automation of Hydrogen Energy Systems and Technologies". Possibility of studying in a dual form of education.
4 – Graduates' suitability for employment and further study	
Employability	According to the Classifier of Professions DK003:2010 (in the current version), graduates can perform the following types of professional work: 2143.2 Relay Protection and Electrical Automation Engineer 2143.2 Power Enterprise Line Service Engineer 2143.2 Converter complex engineer 2143.2 Electrical Engineer in the Energy Sector 2143.2 Power engineer 2143.2 Design Engineer (Electrical Engineering) Professional Certification Possible
Further education	Continuation of studies at the third (educational and scientific) level of higher education and/or acquisition of additional qualifications in the adult education system.
5 – Teaching and Assessment	
Teaching & Learning	Student-centered learning, task-oriented learning through practice. All participants in the process are provided with timely accessible and understandable information on the goals, content and program learning outcomes, the procedure, and criteria for assessment within individual educational components. The general style of learning is creatively oriented. The educational process is carried out based on acmeological, axiological, systemic, competence-based, personality-oriented approach. A creative learning style is used, stimulating creativity

	in cognitive activity and initiative, learning through practice. Teaching methods: communicative-cognitive, problem-based, heuristic (partially exploratory), discussion. Teaching is carried out in the form of lectures, seminars, practical classes, laboratory classes; term papers and projects; calculation, calculation and graphic, home tests, essays, blended learning technology, practices and excursions, implementation of a diploma project, independent work with the possibility of consulting by a teacher, individual classes, the use of information and communication technologies (e-learning, online lectures).	
Evaluation	Assessment of students' knowledge is carried out in accordance with the "Regulations on the system of assessment of learning outcomes in Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky" for all types of classrooms and extracurricular work (current, calendar, semester control); oral and written exams, tests, practice reports, defense of qualification work.	
6 – Programmatic Competencies		
Integral Competence	Ability to solve complex problems and tasks during professional activities in the field of electric power, electrical engineering and electromechanics or in the process of studying, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.	
General Competencies (GC)	K01	Ability to search, process and analyze information from various sources.
	K02	Ability to use information and communication technologies.
	K03	Ability to apply knowledge in practical situations.
	K04	Ability to use a foreign language to carry out scientific and technical activities.
	K05	Ability to make informed decisions.
	K06	Ability to learn and master up-to-date knowledge.
	K07	Ability to identify and assess risks.
	K08	Ability to work autonomously and in a team.
	K09	Ability to identify feedback and adjust your actions taking them into account.
	K10	Ability to communicate with representatives of other professional groups of different levels.
Professional Competencies (FC)	K11	Ability to apply existing and develop new methods, techniques, technologies, and procedures to solve engineering problems of electric power, electrical engineering and electromechanics.
	K12	Ability to develop and implement measures to improve reliability, efficiency and safety in the design and operation of equipment and facilities of electric power, electrical engineering and electromechanics.
	K13	Ability to carry out the analysis of technical and economic indicators and examination of design solutions in the field of electric power, electrical engineering and electromechanics.
	K14	Ability to demonstrate knowledge and understanding of the mathematical principles and methods required for use

		in the electric power, electrical engineering, and electromechanics industries.
	K15	Ability to understand and consider social, environmental, ethical, economic, and commercial considerations affecting the implementation of technical solutions in the electric power, electrical engineering and electromechanics industries.
	Q16	Ability to manage projects and evaluate their results.
	Q17	Ability to develop plans and projects to ensure the achievement of a specific goal, considering all aspects of the problem to be solved, including the production, operation, maintenance and disposal of equipment of electric power, electrical and electromechanical complexes.
	Q18	Ability to demonstrate awareness and ability to use regulations, norms, rules and standards in the electric power industry, electrical engineering and electromechanics.
	Q19	Ability to use software for computer modeling, computer-aided design, computer-aided manufacturing, and computer-aided development or design of elements of electric power, electrotechnical, and electromechanical systems.
	K20	Ability to demonstrate awareness of intellectual property and contract issues in the electric power, electrical engineering and electromechanics industries.
	K21	Ability to formulate technical requirements for developed products and technologies, determine the technical conditions for the operation and maintenance of new equipment, draw up technical specifications for research and development, identify key technological parameters of developments and determine their target or normative values in the field of engineering.
	K22	Ability to develop means, ways and methods of science and technology aimed at automation of existing and creation of new automated and automatic technologies and productions.
	K23	Ability to optimize technological processes and build structural diagrams of intelligent automated control systems.
	K24	Ability to calculate and develop optimal equipment designs and operating modes of simple and complex electromechanical complexes using modern computer methods of mathematical modeling based on the analysis of static and dynamic loads, regime characteristics

7 – Programmatic Learning Outcomes

PR01. To reproduce processes in electric power, electrotechnical and electromechanical systems in their computer modeling.
PR02. Outline an action plan to improve the reliability, operational safety and resource extension of electric power, electrical and electromechanical equipment and related complexes and systems.
PR03. Analyze processes in electric power, electrical and electromechanical equipment and related complexes and systems.

PR04. To reconstruct existing electrical networks, stations, and substations, electrotechnical and electromechanical complexes and systems in order to improve their reliability, operational efficiency and service life extension. PR05. Possess methods of mathematical and physical modeling of objects and processes in electric power, electrotechnical and electromechanical systems. PR06. Search for sources of resource support for additional training, scientific and innovative activities. PR07. Plan and implement scientific research and innovative projects in the field of electric power, electrical engineering and electromechanics. PR08. Consider the legal and economic aspects of research and innovation. PR09. Adhere to the principles and directions of the strategy for the development of Ukraine's energy security. PR10. To justify the choice of direction and methods of scientific research, considering modern problems in the field of electric power engineering, electrical engineering and electromechanics. PR11. Freely communicate orally and in writing in the state and foreign languages on modern scientific and technical problems of electric power engineering, electrical engineering and electromechanics. PR12. Demonstrate an understanding of regulations, norms, rules, and standards in the field of electric power, electrical engineering, and electromechanics. PR13. Identify the main factors and technical problems that may hinder the implementation of modern methods of control of electric power, electrical and electromechanical systems. PR14. Master new versions or new software designed for computer modeling of objects and processes in electric power, electrotechnical and electromechanical systems. PR15. Perform physical and mathematical modeling, static and dynamic analyses of structures, mechanisms, materials, and processes at the design stage, investigate the reliability of systems, using modern computer tools. PR16. Select the element base of electromechanical and mechatronic systems, complete electric and hydraulic drives, controls, protection, automation of power supply systems for machines and installations, production sites and enterprises. PR17. To create intellectually adaptive systems for automated control and control of the technical condition of electromechanical equipment based on the use of programmable logic controllers. PR18. Calculate forces, stress-strain state, velocities, moments, powers, static and dynamic properties of electromechanical equipment, perform power and hydraulic calculations of hydraulic drive elements, electric drives, linear and nonlinear elements, electric and magnetic circuits.

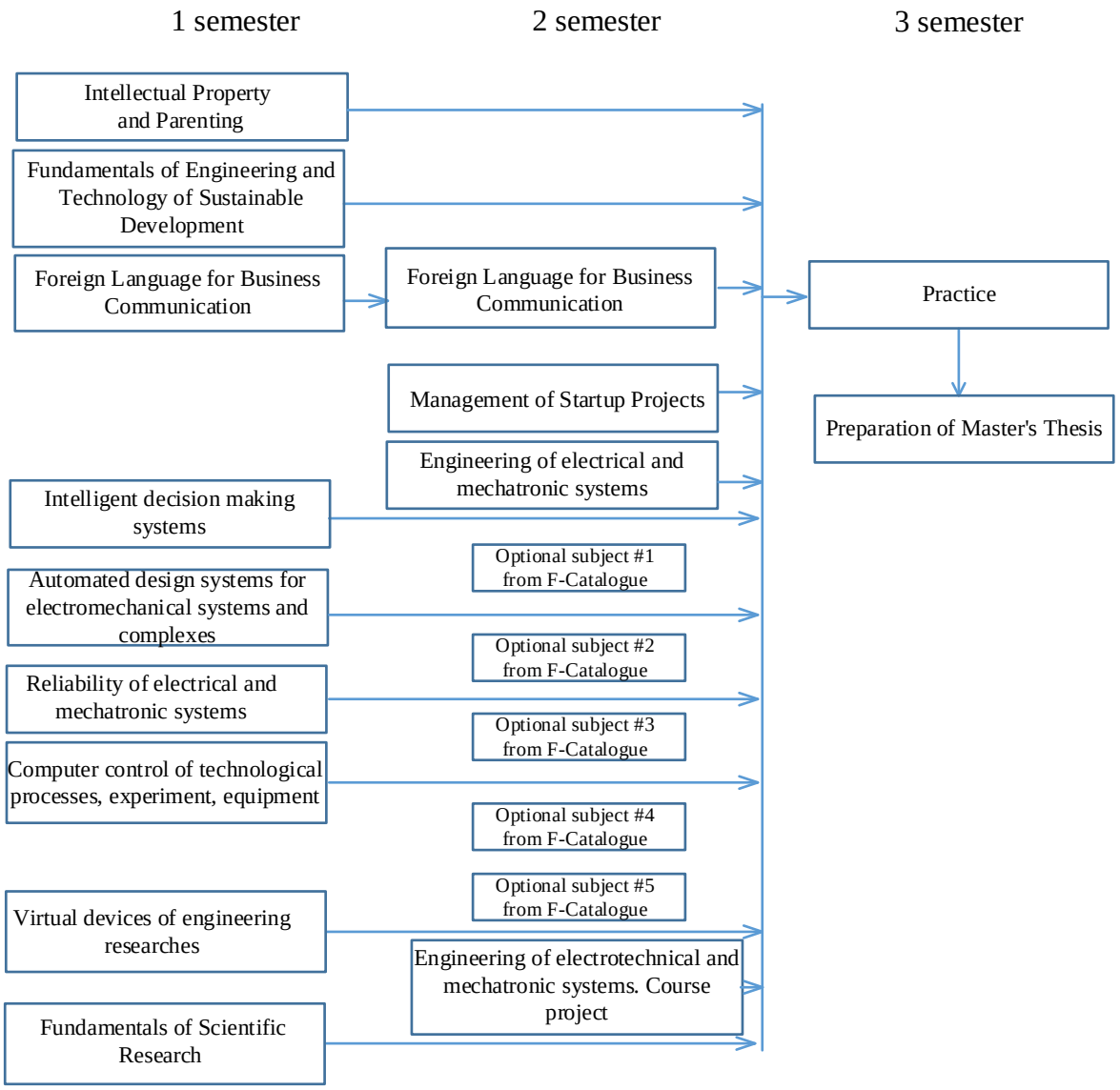
8 – Resourcing of program implementation	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the appropriate level, approved by the Resolution of the Cabinet of Ministers of Ukraine dated December 30, 2015, No. 1187 in the current version. The implementation of the program involves the involvement of practitioners, industry experts, representatives of employers and other stakeholders in the educational process.
Material and technical support	In accordance with the technological requirements for the 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 in the current version. In the training of specialists, the equipment of the department's laboratories and the technical capabilities of the enterprises where applicants are trained, as well as modern software, are used.
Informational, educational, and methodological support	In accordance with the technological requirements for educational, methodological and information 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 in the current version). In the organization and conduct of the educational process, the resources of the scientific and technical library are used. G.I. Denisenko KPI them. Igor Sikorsky (https://www.library.kpi.ua).
9 – Academic mobility	
National Credit Mobility	Possibility of concluding agreements on academic mobility, double diploma, etc.
International Credit Mobility	The possibility of concluding agreements on international academic mobility (Erasmus + K1), on double diplomas, on long-term international projects that involve the training of students, etc.
Training of foreign applicants for higher education	For foreign citizens, training is carried out in Ukrainian, and there is also the possibility of studying in English according to certain educational components.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

N/A Code	Components of the educational program (academic disciplines, practices, qualification work)	Number of credits	Form of final control
1	2	3	4
1. NORMATIVE educational components			
General Training Cycle			
ZO01	Intellectual Property and Parenting	3	Passed
ZO02	Fundamentals of Engineering and Technology of Sustainable Development	2	Passed
ZO03	Foreign Language for Business Communication	3	Passed
ZO04	Management of start-up projects	3	Passed
Vocational training cycle			
PO01	Engineering of Electrotechnical and Mechatronic Systems	5	Exam
PO02	Intelligent Decision-Making Systems	4,5	Passed
PO03	Automated design systems for electromechanical systems and complexes	4	Exam
PO04	Reliability of electrical and mechatronic systems	4	Exam
PO05	Computer Control of Technological Processes, Experiments, Equipment	5	Exam
PO06	Virtual devices of engineering research	4	Passed
PO07	Fundamentals of Scientific Research	2	Passed
PO08	Engineering of Electrotechnical and Mechatronic Systems. Course project	1,5	Passed
PO09	Practice	14	Passed
PO10	Preparation of master's Thesis	12	protection
Selective components of EP			
Vocational training cycle			
PV1	Optional subject #1 from F-Catalogue	5	Exam
PV2	Optional subject #2 from F-Catalogue	4	Passed
PV3	Optional subject #3 from F-Catalogue	5	Passed
PV4	Optional subject #4 from F-Catalogue	4	Passed
PV5	Optional subject #5 from F-Catalogue	5	Exam
The total amount **of mandatory components**:		67	
Total Sample Components:		23	
TOTAL SCOPE OF THE EDUCATIONAL PROGRAM:		**90**	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Certification of higher education applicants for the educational and professional program "Engineering of Intelligent Electrotechnical and Mechatronic Complexes" specialty 141 " Electric Power Engineering, Electrotechnics and Electromechanics" is carried out in the form of public defense of the qualification work and ends with the issuance of a standard document on awarding him a master's degree with the qualification: Master of Electric Power Engineering, Electrotechnics and Electromechanics, "Engineering of Intelligent Electrotechnical and Mechatronic Complexes".

The qualification work should provide for the solution of a complex specialized task or practical problem in the field of electric power, electrical engineering and/or electromechanics, which involves research and/or innovation and is characterized by uncertainty of conditions and requirements.

The qualification work is checked for plagiarism and, after defense, is placed in the repository of the Scientific and Technical Library of the University for free access.

The defense is carried out openly and publicly.

5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

	ZO01	ZO02	ZO03	ZO04	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10
K01	+	+		+								+	+	+
K02	+											+	+	+
K03				+								+	+	+
Q04			+											
Q05				+								+		
Q06	+	+	+	+										
Q07		+		+									+	+
Q08				+								+		
Q09		+		+										
Q10			+										+	+
Q11						+	+		+		+	+	+	+
Q12								+		+	+		+	+
Q13					+						+		+	+
Q14						+				+		+	+	+
Q15	+	+			+						+		+	+
Q16				+	+						+		+	+
Q17				+		+		+					+	+
Q18								+			+	+	+	+
Q19							+		+	+		+	+	+
Q20	+										+		+	+
Q21					+								+	+
Q22									+	+		+	+	+
Q23						+						+	+	+
Q24							+	+						

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

	ZO01	ZO02	ZO03	ZO04	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10
PR01					+		+			+		+	+	+
PR02					+			+					+	+
PR03					+	+				+		+	+	+
PR04								+					+	
PR05					+					+		+	+	+
PR06	+			+							+	+		+
PR07	+			+		+				+	+			+
PR08	+				+						+			+
PR09		+		+										+
PR10		+			+	+					+			
PR11			+										+	+
PR12	+			+									+	+
PR13		+				+							+	+
PR14							+		+				+	
PR15					+		+	+		+				+
PR16								+	+	+		+	+	+
PR17									+				+	+
PR18										+				+