MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

APPROVED BY

Rector of NTU "KhPI"

_____ Y. Sokol

«____»_____2019

EDUCATIONALLY- PROFESSIONAL PROGRAM "ELECTRONICS"

The second (Magister) Level

by specialty**: 171 «Electronics»**

Knowledge field title **17 «Electronics and Telecommunications»**

Qualification**: Magister of Electronics**

APPROVED BY

Academic of Scientific Council

Chairman of the Scientific Council

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Protocol №_____ of

«____» _____2019

Kharkiv 2019

PREAMBLE

Developed on the basis of the project of the higher education standard by the project team from the specialty 171 "Electronics" Institute of the educational and scientific of power engineering, electronics and electromechanics of the National Technical University "Kharkiv Polytechnic Institute" consisting of:

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APPROVAL PAGE

Educationally- scientific program "ELECTRONICS"

Higher education degree	**Second (Magister) Level**
Branch of knowledge	**17 Electronics and telecommunications**
Specialty	**171 Electronics**
Specialization	**171-01 Industrial Electronics,** **171-02 Biomedical Electronics**
Qualification	**Magister of Electronics**

APPROVED
The support group
for the specialty 171

Head of the group
_____ R.S. Tomashevskyi
November 30, 2018

RECOMMENDED
Methodical Council of NTU "KhPI"
Deputy Chairman of the methodical council
_____ R.P Mygushchenko
November 30, 2018.

APPROVED AND PROVIDED

By order of the rector of the National Technical University "Kharkiv Polytechnic Institute" from "____" _____ № _____.

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1. Profile of the educational program by specialty 171 "Electronics

1 – General Information	
Full name of higher educational institution and structural unit	National Technical University "Kharkiv Polytechnic Institute" Institute of Educational and Scientific of Power Engineering, Electronics and Electromechanics Department of Industrial and Biomedical Electronics
Higher education and the name of the qualification in the language of the original	Ступінь вищої освіти – магістр Освітня кваліфікація – магістр з електроніки Кваліфікація в дипломі – магістр з електроніки
The official name of the educational program	Educationally - professional program of the Second (Magister) Level of "Electronics" higher education level
Type of diploma and volume of educational program	Magister r's degree, unitary, 120 ECTS credits,1.9 years
Availability of Accreditation	- Certificate of Accreditation: Series: НД No 2192147 dated September 6, 2017 Ministry of Education and Science of Ukraine; Validity: until July 1, 2023
Cycle / Degree	NQF of Ukraine - 8th degree FQ-EHEA is the first cycle, EQF-LLL - degree 7 (Magister)
Prerequisites	Complete general secondary education or secondary specialized education. Entrance exam for specialty and foreign language. The remaining requirements are determined by the rules of admission for educational-Professional Master's Program.
Language (s) of teaching	Ukrainian
Validity of educational programsи	According to the validity period of the certificate of accreditation
Internet address of the permanent description of the educational program	http://www.kpi.kharkov.ua/ukr/ http://www.kpi.kharkov.ua/ukr/faculty/e/
2 – The purpose of the educational program	
Acquiring theoretical and practical knowledge and skills, skills and other competencies for successful professional activity: use of technologies, materials and devices of electronic equipment; designing, manufacturing, restoration and modernization of electronic equipment based on the use of modern circuit design solutions, as well as preparing students for further employment in the chosen specialty in the subject area Electronics, development of programs of the following levels (Doctor of Philosophy) for researchers. The achievement of the stated goal is based on the principles of continuity and individualization of learning, the fundamental and integral provision of knowledge, practical orientation and awareness of the place of the received competencies, symbiosis of scientific and systemic approaches, etc.	

Characteristics of the educational program	
Subject area (branch of knowledge, specialty, specialization (if any**))**	Knowledge field title: 17 «Electronics and Telecommunications» Specialty title: 171 "Electronics" Specializations: Block 01 "Industrial Electronics" Block 02 "Biomedical Electronics"
Orientation of the educational program	The main advantage of the magister's degree program is the combination of a high level of specialist training in the field of electronics and telecommunications with the specialization of science and technology and professional training in the field of industrial and biomedical electronics with the possibility of acquiring the necessary research skills for a scientific career.
The main focus of the educational program and specialization	Special education in the field of electronics and telecommunications on the specialty "Electronics" under the program "Electronics". Key words: software tools of electronics; microcontroller devices; devices and systems of power electronics and converters; systems and devices for transformation, protection, processing, transmission of information and regulatory systems.
Features of the program	The educational and professional program of masters training is designed for applicants of higher education who seek to become specialists in the field of engineering and scientific activities of industrial and biomedical electronics. During the period of study in a magistracy student must take part in a scientific conference and have scientific publications.
4 – Eligibility of graduates to employment and further training	
Suitability for employment	Employment at enterprises and companies in electronics and telecommunications, electrical, electrical and electromechanical industries, as well as in branch scientific, design and design organizations and institutions. Professional opportunities of graduates (according to the Classifier of professions DK 003: 2010). The main area of employment corresponds to codes 122, 123, 214, 231, 232, 311 and 313 of the current version of the National Classifier of Ukraine.
Further training	Studying at the third (higher education) educational level (level 8 of the NQF, the third cycle of FQ-EHEA and EQF-LLL8 level 8) and continuing education abroad to obtain a doctorate in philosophy.
5 – Teaching and Assessment	
Teaching and learning	Lectures, laboratory and practical classes, scientific and practical workshops, implementation of training and real projects (project training), problem-oriented learning and in-service training, student-centered learning, dual training, distance and mixed learning, self-study and self-study, practice, preparation of qualifying work.
Assessment	Current and final control of knowledge (surveys, control and individual tasks, testing, etc.), credits and exams (oral and written), protection of educational projects with the presentation, public defense of qualification work. Rating system of assessment, oral and written examinations, testing. The evaluation system involves the use of an international system of ECTS (with grades A, B, C, D, E, F), the national system (rated "excellent", "good", "satisfactory" and "unsatisfactory"), as well as 100-point HEI systems with established conformity system.

6 – Program competencies	
Integral competence	Ability to solve complex specialized tasks and problems, to solve practical problems during professional activity in the field of electronics and telecommunications or in the process of study, which involves the use of research and / or innovation in electronics and telecommunications, and characterized by complexity and uncertainty of conditions and requirements.
General Competence (GC))	**GC 1.** Ability to think, analyze and synthesize. **GC 2.** Ability to search, process and analyze information from different sources. **GC 3**. Ability to use information and communication technologies. **GC 4.** Ability to apply knowledge in practical situations. **GC 5**. Ability to use a foreign language for carrying out scientific and technical activities. **GC 6**. Ability to make informed decisions. **GC 7**. Ability to learn and master modern knowledge. **GC 8**. Ability to detect and assess risks. **GC 9**. Ability to produce new ideas, show creativity, ability to think systematically. **GC 10.** Ability to work independently and in a team, the ability to communicate with colleagues in the field of research and development. **GC 11**. Ability to detect feedback and adjust their actions with their consideration. **GC 12**. Ability to assess and maintain the quality of work performed. **GC 13**. Ability to demonstrate awareness of intellectual property issues in the field of electronics and telecommunications**.**
Professional competence of the specialty (PC)	**PC 1**. Ability to apply the obtained theoretical knowledge, scientific and technical methods and corresponding software for solving scientific and technical problems and carry out scientific research in the field of electronics and telecommunications. **PC 2.** Ability to apply existing and develop new methods, techniques, technologies and procedures for solving engineering tasks, including designing and exploitation of industrial and biomedical electronics objects. **PC 3.** Ability to apply analytical methods of analysis, mathematical modeling and perform physical, mathematical and computational experiments for the solution of engineering tasks and in conducting research. **PC 4.** Ability to apply information and communication technologies and programming skills to solve typical tasks of engineering activities in electronics and telecommunications. **PC 5.** Ability to understand and take into account social, environmental, ethical, economic and commercial considerations that influence the implementation of technical solutions in industrial and biomedical electronics. **PC 6.** Ability to manage projects and critically evaluate their results. **PC 7.** Ability to develop a technical task for the creation of industrial and biomedical devices, systems and complexes. **PC 8**. Ability to use information technologies, methods of intellectualization and visualization, artificial intelligence, cloud computing and supercomputer computing for research and analysis of processes in electronic systems. **PC 9.** Ability to apply designing and modeling methods for the devel-

	opment of modern devices for industrial biomedical electronics and other types of electronic systems. **PC 10.** Ability to develop design and scientific and technical projects of electronic devices using the means of automatic design, software packages of CAD. **PC 11.** Ability to use the acquired knowledge and skills for carrying out scientific research of the corresponding level. **PC 12.** The ability to prepare and publish the results of their research in scientific journals.
7 – Program learning outcomes	
Program results of training in a specialty (defined by the standard of higher education specialty	**PRT 1.** To argue and protect developed design and scientific and technical solutions before the customer, conduct reasoned professional and scientific discussion. **PRT 2.** Combine the application of modern methods for the development of low-waste, energy-saving and environmentally friendly technologies that ensure the safety of people's lives and their protection against the possible consequences of accidents, disasters and natural disasters, apply methods of rational use of raw materials, energy and other types of resources. **PRT 3.** To take part in maintaining the qualification of the collective on the world level of scientific and engineering achievements in the field of development and operation of electronic systems. **PRT 4.** To initiate and implement organizational and technical measures to ensure proper working conditions, safety precautions, prevention of occupational injuries and occupational diseases, and organize and monitor compliance with the environmental safety standards of works performed. **PRT 5.** To practice informational and scientific search, use databases and knowledge, critically interpret and interpret results, draw conclusions and form research directions taking into account domestic and foreign experience. **PRT 6.** Coordinate the work of the teams of performers in the field of research, design, development, analysis, calculation, modeling, production and testing of electronic devices and systems. **PRT 7.** Manage projects of international scientific cooperation and academic mobility with writing scientific papers, preparing scientific reports, approbation and implementation of research results, disseminating information about research results at international conferences, seminars, etc. **PRT 8.** To organize the acquired knowledge for the formulation and solution of engineering and scientific problems, the selection and use of appropriate analytical methods of calculation when designing and researching electronic devices. **PRT 9.** To determine the directions of modernization of technological aspects of production, introduction of the latest information and communication technologies. **PRT 10.** To build a system of organization of document circulation, preparation of technical, design, technological, metrological and organizational and management documentation, reporting, verification of compliance with current norms and standards of record keeping, implementation of a quality management system at the enterprise. **PRT 11.** To choose the optimal research methods, to modify, adapt and develop new methods and to formulate a method of processing results in electronic systems.

	PRT 12. To analyze technical and economic indicators, reliability, ergonomics, patent purity, market needs, investment climate and compliance of design decisions, scientific and research developments in electronic devices with the norms of Ukrainian legislation regarding intellectual property. **PRT 13.** To study processes in electronic systems using means of automation of engineering calculations, planning and conducting of scientific experiments with the processing and analysis of results. **PRT 14.** Summarize the modern scientific knowledge and apply it for solving scientific and technical problems, assessing the possibility of bringing the solutions obtained to the level of competitive development, implementation of results in business projects in the field of electronics and telecommunications. **PRT 15.** Follow principles of wide-scale introduction of modern information technologies, means of communication, methods of increasing the energy and economic efficiency of development, production and operation of electronic systems. **PRT 16.** To organize and manage research, innovation and investment activities, business projects and production processes taking into account technical, technological and economic factors. **PRT 17.** Apply design and modeling methods to develop and implement projects and engineering solutions in the field of electronics. **PRT 18.** To be able to design industrial electronics devices using a modern element base and make calculations for analysis of transient and steady modes of operation of devices. **PRT 19.** To be able to simulate processes in electronic systems and to carry out experimental research with processing and analysis of results using automation of engineering calculations and modern information and computer technologies. **PRT 20.** To be able to develop design and scientific and technical projects of electronic devices and devices using software packages of CAD with verification of conformity to standards, specifications and other normative documents. **PRT 21.** To be able to apply modern resource and energy-saving, information and communication technologies for the creation of industrial electronics devices. **PRT 22.** To be able to create software and mathematical support for simulation, calculation and optimization of electronic systems, microcontroller systems, systems of transformation and data transmission using modern software packages of IDE. **PRT 23.** To be able to use modern scientific knowledge for construction **PRT 24.** To be able to use mechanisms of human interaction with electronic equipment for obtaining reliable information about the patient's condition and formation of the corresponding influence. **PRT 25.** To be able to construct and carry out experimental studies of the quantities of different physical nature for obtaining reliable data, and to correctly interpret the results with the use of modern information and computer technologic

8 – Ресурсне забезпечення реалізації програми	
Staffing	All the scientific and pedagogical staff providing the educational-professional program in accordance with the qualification correspond to the profile and the direction of the disciplines being taught, have the

	necessary experience of teaching work and experience of practical work. In the process of organizing the learning process, professionals with experience in research / management / innovation / creative work and / or work in the specialty are involved. 100% of the teachers who provide educational activities in English have certificates in accordance with the European language education guidelines (at level B2) or qualification documents related to the use of a foreign language.
Material and technical support	Material and technical support allows you to fully provide the educational process throughout the training cycle for the educational program. The condition of the premises is certified by sanitary and technical passports, which correspond to the existing normative acts.
Information and methodological support	Information support is provided by textbooks, study aids, etc. and electronic resources (the library is provided with at least five titles of national and foreign professional periodical professional editions of the corresponding or related profile, including in electronic form). Methodical support is realized by obligatory accompaniment of educational activity with the corresponding educational and methodological materials for each educational discipline of the curriculum.

9 – Academic mobility	
National Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and higher educational institutions of Ukraine
International Credit Mobility	On the basis of bilateral agreements between the National Technical University "Kharkiv Polytechnic Institute" and the Otto-von-Guericke University of Magdeburg (Germany), the DAAD program, which involves the training and exchange of students in the fields of "Electrical engineering" and "Machine-building", is being implemented. Under this program, students have the opportunity to attend language courses, take industrial practice and study in the magistracy. Under the Erasmus + program, programs are implemented with the University of Applied Sciences Würzburg-Schweinfurt and the Warsaw Polytechnic University.
Training foreign applicants for higher education	According to the license of NTU "KhPI" foreigners and / or stateless persons can study for the educational program. Curricula for this contingent have expanded language training in the Ukrainian language. In order to create conditions for international academic mobility, the institution of higher education has the right to decide on the teaching of one / several / all disciplines in English and / or other foreign languages, while providing students with higher education the appropriate discipline in the state language. For the teaching of academic disciplines in foreign (English), separate groups are formed for foreign citizens, stateless persons who wish to obtain higher education for the funds of individuals or legal entities, or develop individual programs. At the same time, the program of higher education establishments provides study of such persons of the state language as a separate educational discipline.

2. List of components of the educational-professional program

2.1. List of EP components

Key	Components of the educational program (disciplines, projects / work, practice, qualification work)	Credits ECTS	Final control forms
1	2	3	4
Compulsory components of the Educational Program			
GT 1	Intellectual Property	3	Test
GT 2	Organization of production and marketing	3	Test
GT 3	Safety of work and professional activity	3	Test
GT 4	Philosophical problems of modern scientific knowledge	3	Test
GT 5	Foreign language in professional direction	4	Test
PT 1	Modern methods of mathematical and computer modeling Part.1	5	Exam
PT 2	Basics of the scientific research	3	Test
PT 3	Fundamentals of construction of specialized information systems	4	Exam
PT 4	Systems and devices for data transmission	5	Exam
PT 5	Modern methods of mathematical and computer modeling Part.2	6	Exam
PT 6	Modern trends in electronics development	5	Exam
GT 6	Pre-diploma practice	11	
GT 7	Attestation (diploma project)	19	
Total volume of mandatory components:		**74**	
Selective components of the Educational Program			
Block of disciplines 01 «Industrial electronics»			
OB 1.1.	Digital signal processing	5	Exam
OB 1.2.	Power transforming systems	5	Exam
OB 1.3.	Programming of embedded systems	3	Test
OB 1.4.	Special issues of power electronics	4	Exam
OB 1.5.	Electronic control systems	4	Exam
OB 1.6.	Energy saving in power supply systems with semiconductor transducers	4	Exam
OB 1.7	Real-time systems	4	Test
	Total:	**28**	
Block of disciplines 02 «Biomedical electronics»			
OB 2.1.	Programming of microcontroller systems	4	Exam
OB 2.2.	The theory of automatic regulation	5	Exam
OB 2.3.	Pathological physiology	3	Test
OB 2.4.	Quality management system in medical instrumentation	4	Exam
OB 2.5.	Electronic instruments for radiation diagnostics	4	Exam
OB 2.6.	Methods of laboratory diagnostics	4	Exam
OB 2.7.	Mathematical methods of processing medical signals	4	Test
	Total:	**28**	

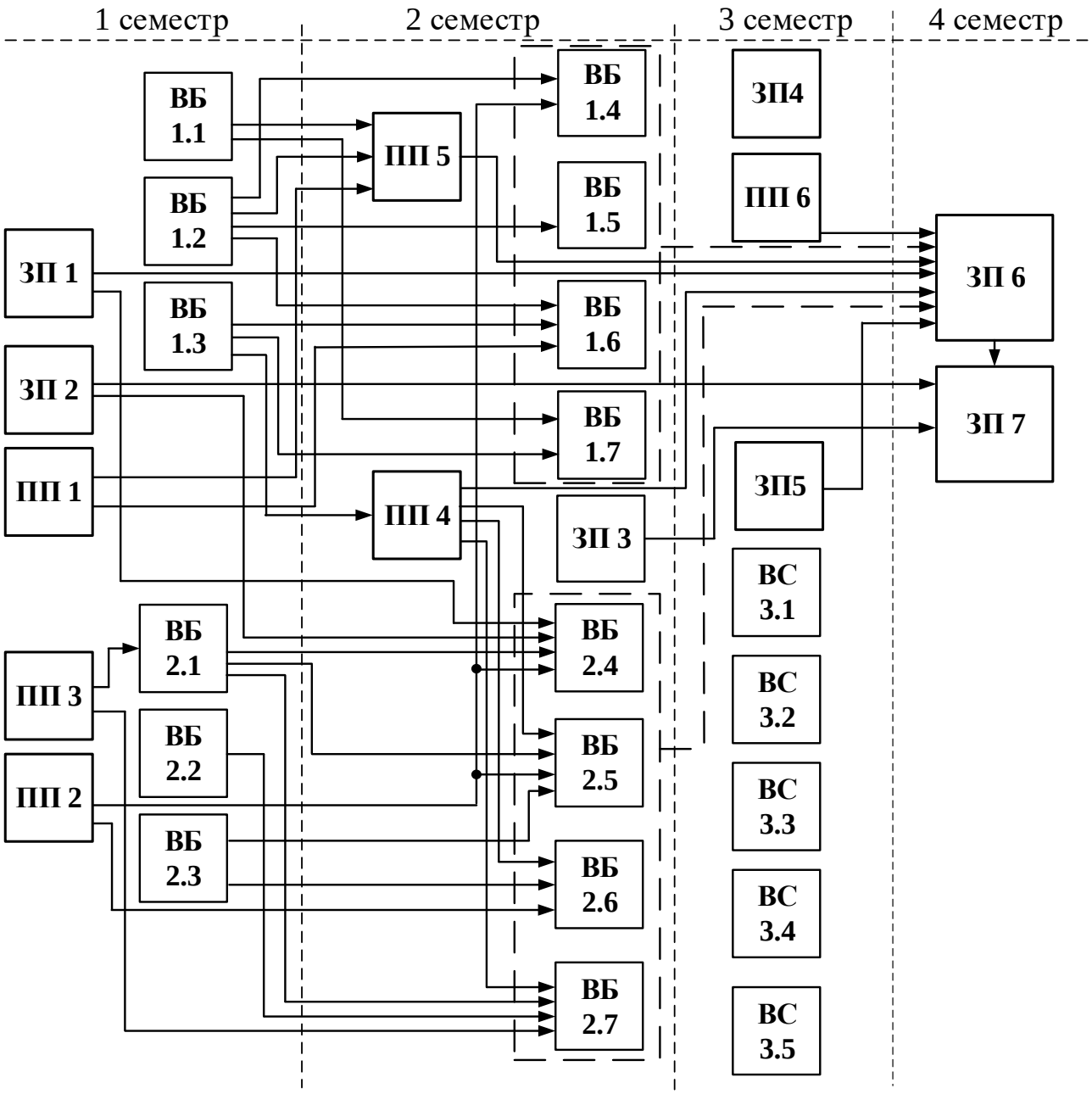
1	2	3	4
Block of disciplines of free choice			
OS 3.1	Discipline of the psychological direction	3	Test
OS 3.2	Discipline of the jurisprudence direction	3	Test
OS 3.3	Discipline of professionally oriented training 1	4	Exam
OS 3.4.	Discipline of professionally oriented training 2	4	Exam
OS 3.5.	Discipline of professionally oriented training 3	4	Test
	Total:	**18**	
Total volume of Required components:		**46**	
TOTAL VOLUME OF EDUCATIONAL PROGRAM		**120**	

2.2. Structural-logical scheme

2.3 Distribution of the content of the educational program into groups of components and training cycles

№	Training cycle	Volume of study load of the applicant of higher education (ECTS credits /%)		
		Required components of the educational and professional program	Optional components of the educational-professional program	Total for the whole period of study
1	General training	46 / 38,3	-	**46 / 38,3**
2	Professional training	28 / 23,4	-	**28 / 23,4**
3	Optional disciplines	-	46 / 38,3	**46 / 38,3**
Total for the whole period of study		**74 / 61,7**	46 / 38,3	**90 / 100**

Structural-logical scheme



ЗП-GT
ПП-PT
ВБ-OB
ВС- OS

3. Form of certification of applicants for higher education

Certification of graduates of the educational program of specialty 171 **"Electronics**" is carried out in the form of defense of the qualification master's work and ends with the issuing of the document of the established sample on awarding a bachelor's degree with qualification: "**Master of Electronics"** in specialties "**Industrial Electronics"** and **"Biomedical Electronics".** The certification is carried out openly and publicly.

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

Qualifying work should be tested for plagiarism using software and hardware.

A qualification work must be placed in a depository of a higher education institution or an appropriate structural subdivision.

4.The matrix of compliance of program competences with the components of the educational program

	GT 1	GT 2	GT 3	GT 4	GT 5	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	GT 6	GT 7	OB 1.1	OB 1.2	OB 1.3	OB 1.4	OB 1.5	OB 1.6	OB 1.7	OB 2.1	OB 2.2	OB 2.3	OB 2.4	OB 2.5	OB 2.6	OB 2.7	OB 3.1	OB 3.2
GC 1							●				●		●				●			●									
GC 2											●	●	●		●				●				●						
GC 3						●		●		●		●	●	●		●				●	●	●			●	●	●		●
GC 4						●				●			●					●					●						
GC 5				●					●				●			●					●								
GC 6				●								●	●					●											
GC 7						●			●	●			●		●											●			
GC 8			●										●									●	●						
GC 9											●		●				●		●										
GC 10		●	●										●											●					●
GC 11							●					●	●					●				●							
GC 12		●											●											●					
GC 13	●												●																
PT 1								●	●			●	●								●								
PT2						●				●			●									●	●						
PT 3						●	●			●			●	●								●	●						
PT 4									●	●		●	●													●		●	●
PT 5	●	●	●										●												●	●			
PT 6												●	●																

	GT 1	GT 2	GT 3	GT 4	GT 5	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	GT 6	GT 7	OB 1.1	OB 1.2	OB 1.3	OB 1.4	OB 1.5	OB 1.6	OB 1.7	OB 2.1	OB 2.2	OB 2.3	OB 2.4	OB 2.5	OB 2.6	OB 2.7	OB 3.1	OB 3.2
PT 7								●							●										●	●	●		●
PT 8								●	●																●				
PT 9						●				●		●																	
PT 10						●				●		●																●	
PT 11							●					●	●										●						
PT 12					●							●											●						

5. The Matrix of Providing Program Learning Outcomes (PLOs) by the relevant components of the curriculum

	GT 1	GT 2	GT 3	GT 4	GT 5	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	GT 6	GT 7	OB 1.1	OB 1.2	OB 1.3	OB 1.4	OB 1.5	OB 1.6	OB 1.7	OB 2.1	OB 2.2	OB 2.3	OB 2.4	OB 2.5	OB 2.6	OB 2.7	OB 3.1	OB 3.2
PRT 1				●								●	●											●					
PRT 2			●										●						●										
PRT 3							●						●						●					●					
PRT 4			●										●																●
PRT 5				●	●						●		●		●								●				●		
PRT 6													●											●					●
PRT 7	●				●		●						●															●	●
PRT 8						●						●	●		●										●	●			
PRT 9								●	●			●	●	●		●				●	●	●							
PRT 10		●				●							●																●
PRT 11						●	●			●			●	●				●				●	●		●	●	●		
PRT 12	●	●									●		●											●					
PRT 13								●				●	●				●	●				●							
PRT 14		●									●		●				●							●					
PRT 15								●	●				●			●				●	●								
PRT 16	●	●		●	●								●											●					

	GT 1	GT 2	GT 3	GT 4	GT 5	PT 1	PT 2	PT 3	PT 4	PT 5	PT 6	GT 6	GT 7	OB 1.1	OB 1.2	OB 1.3	OB 1.4	OB 1.5	OB 1.6	OB 1.7	OB 2.1	OB 2.2	OB 2.3	OB 2.4	OB 2.5	OB 2.6	OB 2.7	OB 3.1	OB 3.2
PRT 17						●				●		●	●								●								
PRT 18													●		●		●	●											
PRT 19													●		●				●						●	●		●	
PRT 20						●				●		●	●																
PRT 21											●	●	●						●										
PRT 22							●	●				●	●	●		●				●	●	●			●		●	●	
PRT 23								●	●			●	●	●		●				●	●	●							
PRT 24												●	●										●		●	●			
PRT 25												●	●										●		●	●			