

4. The Program Goals and learning outcomes of the higher educational program “Cryogenic Engineering and Technology”

	Program Goals				
Learning outcomes	G1	G2	G3	G4	G5
CC.1.					+
CC.2.	+	+			+
CC.3.				+	+
CC.4.	+	+		+	
CC.5.				+	+
CC.6.					+
CC.7.	+				
CC.8.	+				
CC.9.			+		
CC.10.			+		
CC.11.			+		+
CC.12.			+		
CC.13.			+		
PC.1.		+			
PC.2.		+			
PC.3.	+				
PC.4.		+	+		
PC.5.		+			+
PC.6.			+		
PC.7.		+			
PC.8.					+
PC.9.					+
PC.10.			+	+	
PC.11.			+	+	
PC.12.			+		
PC.13.			+		
PC.14.			+		
PC.15.	+			+	
PC.16.			+		
PC.17.					+
PC.18.	+		+		
PC.19.		+			
PC.20.		+	+		
PC.21.				+	
PC.22.					+
PC.23.			+		
PC.24.		+			

5. Credit value of the results in groups of the program "Cryogenic Engineering and Technology" competencies

Russian state educational standart	Professional competences	General cultural competences
Credit value	95	25

6. "Cryogenic Engineering and Technology" structure of modules

№	code	Name of subject / module	credits	prerequisites
	CD	General Science		
	CD	<i>Basic part</i>		
1	CD01	Foreign Language	5	
2	CD02	Science and Technology History and Philosophy	2	
	CD	<i>Variative part</i>		
3	CD03	Strategic and innovation management	4	
4	CD04	Similarity and mathematical modeling methods	4	
5	CD05	Special foreign language seminar	3	CD01
6	CD06	Selectable discipline №1 (for example, "Planning, processing and analysis of the experiment")	3	
7	CD07	Selectable discipline №2 (for example, "Computer technologies in science and education")	4	
	PD	Professional subjects		
	PD	<i>Basic part</i>		
	PD	General Science		
8	PD01	Cryogenic systems special chapters of the thermodynamics	3	
9	PD02	Cryogenic systems and plants actual problems	2	
10	PD03	Gas and fluid computational dynamics, heat and mass transfer	3	PD01
11	PD04	Cryogenic machines, apparatus and plants analysis is and design	4	PD03
	CD	<i>Variative part</i>		
12	PD05	Modern Superconducting Devices	4	CD04, PD01, PD03

13	PD06	Cryogenic systems mathematical modeling	2	CD04
14	PD07	Emergency Protection	2	
15	PD08	Cryogenic systems	3	PD01
16	PD09	Selectable discipline №1 (for example, "Cryogenic technology for processing waste")	3	
17	PD10	Selectable discipline №2 (for example, "Nano-and micro Cryogenic engineering")	3	
18	PD11	Selectable discipline №3 (for example, "Cryogenic Transport Systems")	3	
19	PD12	Selectable discipline №4 (for example, "Cryovacuum engineering")	3	
	PR	Practice	2	
20	PR01	Industrial Practice	2	
21	PR02	Scientific and Industrial Practice	4	PD04
22	PR03	Research Practice	4	PD03, PR02
23	PR04	Educational Practices	2	
24	RW01	Research work	28	PR03
25	SC01	Final state certification (Master's thesis defense)	20	

7. Credit distribution of learning outcomes of higher education programs "Cryogenic Engineering and Technology"

Module	CD01	CD02	CD03	CD04	CD05	CD06	CD07	PD01	PD02
Credits	5	2	4	4	3	3	4	3	2
CC.1.	1	1							
CC.2.			1			1		1	
CC.3.	3				1				
CC.5.				1			1		
CC.6.	1								
CC.7.			2						
CC.8.					1				
CC.12.									1
PC.1.								1	
PC.2.				2					
PC.3.					1				1
PC.4.				1				1	
PC.5.							2		
PC.6.							1		
PC.7.						2			
PC.8.		1							

PC.14.			1						
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Module	PD03	PD04	PD05	PD06	PD07	PD08	PD09	PD10	PD11
Credits	3	4	4	2	2	3	3	3	3
CC.5.	1								
CC.9.			1						
CC.10.						1			
CC.11.							1		
CC.13.		1							
PC.3.			1			1			
PC.4.	1								
PC.6.				1					
PC.10.	1	1					1		
PC.11.				1		1		1	
PC.12.					2				
PC.13.									2
PC.14.								1	1
PC.16.		1					1	1	
PC.17.			1						
PC.19.		1	1						

Module	PD12	PR01	PR02	PR03	PR04	RW01	SC 01
Credits	3	2	4	4	2	28	20
CC.1.						1	
CC.2.						1	
CC.6.			1				
PC.1.						1	
PC.2.	1					1	1
PC.3.						1	1
PC.4.							2
PC.5.	1					1	1
PC.6.						2	1
PC.7.						3	2
PC.8.					1		
PC.9.		1			1	2	
PC.10.	1					2	2
PC.11.				1			1
PC.14.		1					1
PC.15.			1				
PC.16.						3	

PC.17.						2	
PC.18.			1				1
PC.19.			1			3	1
PC.20.			1				2
PC.21.				1		2	2
PC.22.						2	
PC.23.				1		1	1
PC.24.				1			1

8. Credit distribution on the learning outcomes for higher education program, "Cryogenic Engineering and Technology"

Learning outcomes	CC.1	CC.2	CC.3	CC.4	CC.5	CC.6	CC.7	CC.8	CC.9
Credits	4	6	5	1	5	2	2	1	1

Learning outcomes	CC.10	CC.11	CC.12	CC.13	PC.1	PC.2	PC.3	PC.4	PC.5
Credits	1	1	2	1	2	5	5	5	5

Learning outcomes	PC.6	PC.7	PC.8	PC.9	PC.10	PC.11	PC.12	PC.13	PC.14
Credits	5	7	2	4	8	5	2	2	5

Learning outcomes	PC.15	PC.16	PC.17	PC.18	PC.19	PC.20	PC.21	PC.22	PC.23
Credits	1	6	3	2	6	3	5	2	3

Learning outcomes	PC.24
Credits	2

9. Comparison of "Cryogenic Engineering and Technology" master curriculum general cultural Learning Outcomes with the relevant Learning Outcomes of the European Master curriculum

		First Cycle Transferable Skills (fulfil all the Transferable Skill requirements of a FC graduate at the more demanding level of SC)	Additional for Second Cycle Transferable Skills
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	Total								
			– function effectively as an individual and as a member of a team	– use diverse methods to communicate effectively with the engineering community and with society at large	– demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice	– demonstrate an awareness of project management and business practices, such as risk and change management, and understand their limitations	– recognise the need for, and have the ability to engage in independent, life-long learning	– function effectively as leader of a team that may be composed of different disciplines and levels	– work and communicate effectively in national and international contexts
To improve and develop own intellectual and cultural level; own culture of thinking; to have the ability to generalize, analysis, information perception, goal setting and choice of ways to achieve it (CC.1);	1						✓		
independently to learn new methods of research in a changing scientific and scientific-production profile of their professional activities; to strive for self-development, enhance their skills and competences to critically assess the advantages and disadvantages(CC.2);	2	✓					✓		
Free to use of Russian and foreign languages as a means of business communication, correspondence and documents, to prepare presentations, make reports, write articles and research reports including a foreign languages (CC.3);	2		✓						✓
To use in practice the skills in the organization of research and design operations in the management team, to use regulatory instruments in their work (CC.4);	2				✓			✓	
independently to acquire with the help of information and telecommunications technologies and to use in the practice of new knowledge and skills, including in new areas of knowledge not directly related to the scope of activities (CC.5);	1						✓		
To be able to logically true, reasoned and clear to build oral and written speech, be ready to cooperate with	4	✓	✓	✓	✓	✓			

colleagues and teamwork; exercise creative initiative, including in situations of risk, to find the organizational and managerial solutions to unusual situations and to be prepared to bear for them responsibility (CC.6);								
To use the basic terms and methods of social, humanitarian and economic sciences in addressing social and professional tasks and to be able to analyze socially significant problems and processes to realize the social importance of their future profession, to have a high motivation to carry out professional activities (CC.7);	1			✓				
To respect and to protect the historical heritage and cultural traditions of Russia, to understand the social and cultural differences and peculiarities of other countries to use in their personal and professional life ethical and legal norms governing interpersonal relationships and attitudes towards society, environment, basic laws and norms of social conduct, rights and freedoms of man and citizen (CC.8);	2		✓	✓				
To have the basic knowledge and techniques to protect production personnel and the public from the possible consequences of accidents and natural disasters (CC.9);	1			✓				
<u>To</u> have safety culture and risk-thinking (CC.10),	2			✓	✓			
To have the motivation and ability for self-improving safety culture (CC.11);	2			✓		✓		
ability to recognize, critically to evaluate and to analyze the contribution of their subject area to address environmental and security problems (CC.12);	1			✓				
ability to use this knowledge to a reasoned justification of their decisions in security terms (CC.13).	1			✓				

Total:	22	2	3	9	2	4	1	1
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10. Comparison of “Cryogenic Engineering and Technology” master curriculum professional Learning Outcomes with the relevant Learning Outcomes of the European Master curriculum

	Total	Knowledge and Understanding	Engineering Analysis	Engineering Design	Investigations	Engineering Practice
To identify the nature of scientific and technical problems arising in professional activities course, to involve the appropriate solutions for their physical and mathematical tools, computational methods and computer technology (PC.1);	2	✓	✓			
Critically to analyze the current problems of cryogenic engineering tailored to the needs of industry, modern science and world developments in techniques and technologies, to set goals and develop a program of study to choose an adequate techniques and methods for the solution of theoretical, applied and experimental problems, analyze, interpret, represent and apply the results (PC.2)	1		✓			
Critically to analyze the current problems of cryogenic engineering tailored to industry needs, modern science and world developments in techniques and technologies, to set goals and develop a program of study to choose an adequate techniques and methods for the solution of theoretical, applied and experimental problems; to analyze, to interpret, to represent and to apply the results (PC.3);	3	✓	✓		✓	
independently to develop and to apply modern theories of physical and mathematical and computational methods, new systems of computer mathematics and computer-assisted design and computer engineering to effectively address the professional challenges (PC.4);	2		✓			✓
independently to carry out scientific research in the field of cryogenic engineering for various industries, fuel and energy systems, transport and construction, to solve complex scientific and technical tasks, which for its study will require the development and application of mathematical and computer models of software systems multidisciplinary analysis (world-class CAE-systems) (PC.5);	3	✓	✓	✓		
Independently to acquire modern programming languages and to develop original software packages and to use them to carry out thermal analysis of machines and equipment, as well as the dynamics and strength, stability, reliability, and for specialized tasks-term cryogenic technology(PC.6);	1		✓			
to acquire new modern techniques and tools for experimental thermo physical studies, as well as on the dynamics and strength, stability, reliability, low-temperature friction and wear of machinery, plant and equipment; to process, to analyze and to summarize the results of the experiments (PC.7);	2		✓		✓	
To participate directly in the educational and methodical work of departments and other branches of the profile areas, to participate in the development of educational modules and learning courses (PC.8);	0					
To conduct training sessions, labs, computer workshops; to participate in the organization of scientific research to undergraduates and students, to be able to teach in schools and colleges (PC.9);	0					
To develop and to optimize advanced scientific technologies in various fields of application cryogenic engineering with regard to economic and environmental requirements (PC.10);	2		✓			✓

To self-adapt and to implement modern high-tech computer technology cryogenic engineering with elements of multidisciplinary analysis to solve complex scientific and technological objectives for a new generation of cryogenic machines, installations, machinery, equipment, devices and equipment (PC.11);	2		✓	✓		
To formulate engineering tasks of reference and to apply computer-aided design software systems (CAD-system) for design maximum productivity low-temperature machines and plants, taking into account strength, durability, reliability and durability; to prepare the necessary technical documentation (PC.12);	2		✓	✓		
To design a cryogenic machines and plants according requirements of their maximum productivity, as well as strength, stability, durability and safety, reliability and durability of machines components and its parts (PC.13);	2		✓			✓
to develop a feasibility study of projected cryogenic machines and plants, to make the technical documentation for projects, their components and assembly units (PC.14);	2		✓			✓
To have techniques and methods of work with the staff; to have assessing the quality and effectiveness of work methods, to assess the costs and results of operations research and production team (PC.15);	1					✓
To find rational solutions to create competitive products to according to requirements of their best performance of strength, stiffness, stability, longevity, durability, quality, cost, safety (PC.16);	2	✓				✓
To be ready for continuous improvement of professional activities, decisions and developments in improving security direction (PC.17);	1					✓
To have a full range of legal and normative acts in security sphere related to the mind and the object of professional activity (PC.18);	1					✓
To innovative approaches to development, deployment and commercialization of new technologies (PC.19);	2		✓			✓
To develop plans and programs for organization of innovation research and production team, to develop a feasibility study of scientific and technical projects innovative sections (PC.20);	2		✓			✓
To develop and to implement projects for the integration of university, academic and industry research to commercialization and deployment of innovative developments in high-tech industrial companies, research institutes (PC.21);	2		✓			✓
to participate in organizing and conducting of innovative educational process (PC.22);	1		✓			
To consult engineers, designers and other workers in industrial and research and production firms in the modern cryogenic engineering achievements for high-tech computer technology introduction (PC.23);	1					✓
to conduct scientific and technical examination of the theoretical and experimental work in the field of cryogenic engineering, performed by third-party organizations (PK.24).	1					✓
Total	38	4	16	3	2	13