Non-profit joint-stock company «Kazakh national research technical University named after K.I. Satbayev»
Mining and metallurgical Institute named after O. A. Baykonurov
Department of «Metallurgy and mineral processing»
Department of «Metallurgical processes, heat engineering and special materials technology»

Educational program
6B07203 - "METALLURGY AND MINERAL PROCESSING"

Bachelor of engineering and technology
in the field of metallurgy and mineral processing

based on the following specialties of the defunct classifier of specialties:
5B070900 - Metallurgy and 5B073700 - MineralpProcessing

1st edition
in accordance with the state standard of higher education 2018

Almaty 2021

The program is drawn up and signed by the parties:

From KazNRTU named after K.I. Satbayev

1. Head of the Department «MaMP» — Barmenshinova M.B.
2. Head of the Department «MPHEaTSM» — Chepushtanova T.A.
3. Director of the mining and metallurgical Institute named after O. A. Baykonurov — Rysbekov K.B.
4. Chairman of the TG of the departments «MaMP» and «MPHEaTSM», professor — Baimbetov B.S.

From the employer

1. First Deputy Executive Director of the DLE «AMaME» — Mukhanov T.M.
2. Head Of the Department of complex processing of technogenic raw materials of "Kazakhmys" LLP, Dr. Techn. sciences — Ospanov E.A.
3. Chief concentrator of "KAZ Minerals" LLP — Dzhetybayeva U.K.

Approved at the meeting of the Academic Council of the Kazakh national research technical University named after K. I. Satpayev. Protocol No. 3 of 25.06.2021.

Qualifications:

Level 6 of the National qualifications framework:
6B07 Engineering, manufacturing and construction industries
6B072 Manufacturing and processing industries (bachelor's degree)

Professional competence:

Management of technologies for processing processing, metallurgical production and metallurgical processes; control of technological processes in metallurgy and mineral processing; solving problems of energy and resource conservation, as well as environmental protection from man-made impacts of processing and metallurgical production.

Brief description of the program

Educational program "Metallurgy and minerals processing" is based on "metallurgy" and "mineral processing" and includes fundamental, scientific, engineering and professional training of bachelors in the field of metallurgy and enrichment in accordance with the development of science and technology, and the changing needs of the mining industry. A distinctive feature of the program is that the program gives the graduate adaptability to the production sector, due to the content in the educational program of 40% of General engineering disciplines. The graduate receives a fundamental set of General engineering disciplines, as well as a maximum set of specialized disciplines. The program provides an in-depth study of the theory of processing and metallurgical processes, metallurgical heat engineering, theory of furnaces, design and design of metallurgical aggregates, physical and chemical analysis methods, software for calculating physical and chemical processes, technological processes for obtaining high-quality powder, composite materials and coatings and increased consumer properties. Graduates have knowledge of the technology of metallurgical production of ferrous, non-ferrous, noble, radioactive, rare and other metals.

The mission of the educational program of specialties - 5B070900 - Metallurgy, 5B073700 - Mineral processing: preparation of bachelors-metallurgists and concentrators who know the mineral resource base, technologies for processing ore and man-made raw materials, production technology and consumption of metals, having fundamental training in physics, mathematics, chemistry, physical and chemical basics of technologies for processing and metallurgy, processing of metals and alloys, production of composite materials and nanomaterials. Providing students with knowledge, skills and abilities that allow them to analyze problems in the field of professional activity and find ways to solve them, solve engineering problems of designing technologies and equipment for plants and factories, conduct experimental research using information technologies and mathematical modeling.

Field of professional activity. Specialists who have graduated from the bachelor's degree perform production, technological and organizational work at industrial enterprises, as well as conduct research work on the enrichment of minerals, obtaining ferrous, non-ferrous, rare and radioactive metals, alloys and special materials; processing of metals and alloys; heat treatment of metals and alloys.

Objects of professional activity. The objects of professional activity of graduates are processing plants, enterprises of ferrous and non-ferrous metallurgy, chemical, mining and engineering industries, industry research and design institutes, factory laboratories, secondary professional and higher educational institutions.

The subjects of professional activity are technological processes of mining and metallurgical industry, processing of raw materials and production of metal products

with increased consumer properties, technologies for obtaining and processing metals and materials, studying the structure and properties, equipment for mining and metallurgical production, automatic control systems for metallurgical production and quality control of final products.

Economic activities: mining of iron ore by underground method; iron production; steel making; mining and milling non-metallic ores; open pit mining: the mining of iron ore, mining of non-ferrous metal ores; mining of solid minerals: mining ores, except iron; uranium mining: mining of uranium and thorium ores; casting of metals casting of light metals casting of other non-ferrous metals; enrichment of solid minerals: mining and refining of aluminium-containing raw materials, extraction and processing of copper ore, extraction and beneficiation of lead-zinc ore; coal processing: coal processing, lignite (brown coal) processing; non-ferrous metal production: aluminum production, lead, zinc and tin production, copper production; casting in single (sand-clay) forms: casting of light metals; coking casting: casting of other non-ferrous metals; injection molding: casting of light metals.

The education level code is 6B.

The code and name of the field of education is 6B07 Engineering, manufacturing and construction industries.

The code and name of the training area is 6B072 Manufacturing and processing industries.

The goals of the bachelor's degree program in the field of "metallurgy and mineral processing" are:

- formation of personnel for the innovative economy in metallurgy and mineral processing, covering modern energy-saving technologies, project activities, innovative solutions, entrepreneurship in the high-tech sphere of mineral processing.

- formation of General scientific, socio-personal, instrumental and professional competencies in accordance with state standards that allow graduates to successfully work in their chosen field of activity, contributing to their social mobility and stability in the labor market of mineral processing.

- providing knowledge, skills and abilities in the following types of professional activities: production and technological; organizational and managerial; research; project at the national and international levels.

– training of highly qualified personnel for engineering activities at processing and metallurgical enterprises, in a research organization or commercial structure, with the prospect of further professional growth.

- development of personal science-metric indicators of the student.

The objectives of the educational program are:

- formation of social and humanitarian education based on the laws of social and economic development of society, history, modern information technologies, state, foreign and Russian languages;

– mastering the knowledge of natural science, General technical and economic disciplines as the Foundation of professional education;

- formation of theoretical and practical knowledge on processing of ore raw materials, knowledge in technologies of production of ferrous and non-ferrous metals, as well as their alloys and various metal-containing products.

- formation of theoretical and practical knowledge in technologies for processing metallurgical waste and secondary raw materials.

- formation of theoretical and practical knowledge in the field of processing of critical raw materials and metals, innovative "green" technologies of the metallurgical sector, nanotechnologies in metallurgy.

The content of the educational program includes the following modules: General education, General engineering, engineering and professional modules.

The modern educational program allows you to specialize in:

- *mineral processing* - a set of processes of primary processing of mineral raw materials, as a result of which all valuable minerals are separated from the waste rock, as well as the mutual separation of valuable minerals. The products (concentrates) obtained as a result of enrichment must meet the technical and economic requirements of subsequent metallurgical processing in terms of their quality.

- *extractive metallurgy* - extractive metallurgy that extracts all known metals. The graduate has the ability to analyze raw materials and apply the best method of extracting metals; apply technologies of pyro -, hydro -, electrometallurgy; their knowledge and skills can affect the reduction of waste and environmental pollution; influence the optimal fuel consumption, the ability to perform technical, thermal, thermal power, metallurgical calculations; design workshops.

- *physical metallurgy* - a branch that provides skills and studies the physical state of metals, their properties, the effects of various media, stress and pressure; testing metals for compliance with quality and safety standards; perform various analytical, physical and chemical methods of analysis.

- *technological metallurgy* - an industry where metal parts are designed and controlled by the processes in which they are formed, the graduate has the skills of casting, forging, welding, rolling, etc.

Entry Requirements

• *Description of generally binding standard requirements for admission:* carried out according to the applications of an applicant who has completed in full secondary, specialized secondary education on a competitive basis in accordance with the points of a certificate issued according to the results of a single national test with a minimum score of at least 65 points.

• Special requirements for admission to the program, if any, including for

graduates of 12 summer schools, colleges of applied undergraduate programs, etc.

The presence of subject-specific and intersubjective competencies is ensured through the implementation of requirements for general education and knowledge of the basic and specialized cycles of academic disciplines, socio-ethical, economic and organizational-managerial, professional competencies.

Correction of subject-specific and intersubjective competencies is carried out in accordance with the findings of regular monitoring of the results of mastering educational programs, assessing the main trends in the development of the field of metallurgy and mineral processing.

Credit transfer rules for accelerated (shortened) education on the basis of 12-year secondary, secondary technical and higher education

Code	Competency Type	Competency Description	Competency Result	Responsible
GENERAL (It implies full training with possible additional depending on the level of knowledge)				
G1	Communicative	- Fluent monolingual oral, written and communicative skills - the ability to not fluent communication with a second language - The ability to use communicative communication in various situations - there are the basics of academic writing in the native language - diagnostic test for language level	Full 4-year training with the development of at least 240 academic loans (of which 120 contact classroom academic loans) with the possible transfer of loans in a second language where students have an advanced level. Language level is determined by a diagnostic test	Department of Kazakh and Russian, Department of English
G2	Math literacy	- Basic mathematical thinking at the communication level - the ability to solve situational problems on the basis of the mathematical apparatus of algebra and the beginnings of mathematical analysis - diagnostic test for mathematical literacy in algebra	Full 4-year training with the development of at least 240 academic loans (of which 120 contact classroom academic loans). With a positive diagnostic test, the level is Mathematics 1, with a negative - the level of Algebra and the beginning of the analysis	Department of Math
G3	Basic Literacy in Science	- a basic understanding of the scientific picture of the world with an understanding of the essence of the basic laws of science	Full 4-year training with the development of at least 240 academic loans (of which 120 contact classroom academic loans). If the diagnostic test is	Departments in the areas of natural sciences

		- understanding of basic hypotheses, laws, methods, formulation of conclusions and estimation of errors	positive, the level is Physics 1, General Chemistry, if negative, the level of the Beginning of Physics and the Basic Fundamentals of Chemistry	
SPECIFIC (implies reduced training by transferring loans, depending on the level of knowledge of competencies for graduates of 12-year schools, colleges, universities, including humanitarian and economic areas)				
S1	Communicative	- Fluent bilingual oral, written and communication skills - the ability to not fluent communication with a third language - writing skills of various styles and genres - skills of deep understanding and interpretation of one's own work of a certain level of complexity (essay) - basic aesthetic and theoretical literacy as a condition for full perception, interpretation of the original text	Full transfer of loans by language (Kazakh and Russian)	Department of Kazakh and Russian language
S2	Math literacy	- Special mathematical thinking using induction and deduction, generalization and concretization, analysis and synthesis, classification and systematization, abstraction and analogy - the ability to formulate, justify and prove the provisions - application of general mathematical concepts, formulas and extended spatial perception for mathematical problems - full understanding of the basics of mathematical analysis	Transfer of credits in the discipline Mathematics (Calculus) I	Department of Math
S3	Special literacy in natural sciences (Physics, Chemistry, Biology and Geography)	- A wide scientific perception of the world, involving a deep understanding of natural phenomena - critical perception for understanding the scientific phenomena of the world	Loan transfer on Physics I, General chemistry, General biology, Introduction to geology, Introduction to geodesy; Training practice, etc.	Departments in the areas of natural sciences

		- cognitive abilities to formulate a scientific understanding of the forms of existence of matter, its interaction and manifestations in nature		
S4	English	- readiness for further self-study in English in various fields of knowledge - willingness to gain experience in design and research using English	Transfer of English loans above academic to professional (up to 15 credits)	Department of English
S5	Computer skills	- Basic programming skills in one modern language - the use of software and applications for training in various disciplines -the presence of a global standard certificate of language level	Transfer of credits in the discipline Introduction to information and communication technologies, Information and communication technologies	Department of Software Engineering
S6	Social and humanitarian competencies and behavior	- understanding and awareness of the responsibility of every citizen for the development of the country and the world - Ability to discuss ethical and moral aspects in society, culture and science	Transfer of loans on the modern history of Kazakhstan (with the exception of the state exam)	Department of Social Sciences
		- Critical understanding and debate ability for debating on modern scientific hypotheses and theories	Relocation of loans in philosophy and other humanitarian disciplines	
PROFESSIONAL (involves reduced training by transferring loans, depending on the level of knowledge of competencies for graduates of colleges, AV schools, universities, including humanitarian and economic areas)				
P1	Professional competencies	- critical perception and a deep understanding of professional competencies at level 5 or 6 - Ability to discuss and debate on professional issues within the framework of the mastered program	Relocation of loans in basic professional disciplines, including the basics of mineral processing, ore preparation processes and equipment, the theory of metallurgical processes I-II, gravity methods of enrichment	Graduating department
P2	General engineering competencies	- basic engineering skills and knowledge, ability to solve engineering problems and problems	Relocation of credits in general engineering disciplines (Engineering graphics, descriptive	Graduating department

		- be able to use application packages for processing experimental data, solving systems of algebraic and differential equations	geometry, fundamentals of electrical engineering, fundamentals of thermodynamics)	
P3	Computer Engineering Competencies	- basic skills in the use of computer programs and software systems for solving general engineering problems	Relocation of credits in the following disciplines of computer graphics, CAD fundamentals, CAE fundamentals, etc.	Graduating department
P4	Engineering Competencies	- skills and abilities to use technical means and experimental devices for solving general engineering problems	Transfer of credits in academic disciplines of experimental direction: General chemistry, crystallography and Mineralogy, metallurgical engineering, metallurgy of heavy and light metals, metallurgy of secondary raw materials, heat power engineering of metallurgical processes, technology of metallurgical production, metallurgical heat engineering, flotation methods of enrichment, etc.	Graduating department
P5	Socio-economic competencies	- Critical understanding and cognitive ability to reason on contemporary social and economic issues - A basic understanding of the economic valuation of objects of study and the profitability of industry projects	Relocation of loans in socio-humanitarian and technical and economic disciplines to offset the elective cycle	Graduating department

The university may refuse to transfer credits if a low diagnostic level is confirmed or the final grades for completed disciplines were lower than A and B.

Requirements for completing studies and obtaining a diploma

• Description of generally binding standard requirements for graduating from a university and assigning an academic degree to a bachelor: mastering at least 240 academic credits of theoretical training and final diploma work

• Special requirements for graduation under this program:

- The student should have a general understanding of the topic of the thesis / research plans, and contact potential academic advisors one year before the expected

completion of studies;

- A review meeting is held one year prior to the expected completion of studies in order to get acquainted with potential scientific advisers and accelerate the students' choice of topics for their thesis (project);

- To collect the necessary data and study relevant tasks, techniques and procedures on the topic of the thesis, the student undergoes practical training;

- Upon completion of practical training, the student contacts the head in writing or verbally and reports on the results of work, but no more than a week after the start of the 4th year of study;

- Within 4 weeks after the start of study, the student and the leader should discuss and decide on the type (research, design or independent study) and the topic of the thesis. This is an extremely important discussion and decision, since further changes in the topic and type of work are impossible;

- The topic of the thesis (project) and the supervisor are assigned to a student or group of students no more than six weeks after the start of the final year of study and approved by order of the rector of a higher educational institution.

MAJOR CURRICULUM for 2021-2022 academic year admission

Educational program 6B07203 - "Metallurgy and mineral processing"

Group of Educational programs B071 - "Mining and extraction of minerals"

Full-time study | Study duration : 4 years | Academic degree: bachelor of engineering and technology

Year of study	Code	Name of discipline	Cycle	Totel Credits	Total hours	classroom volume of lec/lab/pr	IWS (including IWST), in hours	Code	pre-requisites	Code	Name of discipline	Cycle	Totel Credits	Total hours	classroom volume of lec/lab/pr	IWS (including IWST), in hours	Code	pre-requisites
	1 semester (fall 2021)									**2 semester (spring 2022)**								
1	LNG108	English	G	5	150	0/0/3	105		Diagnostic test	LNG108	English	G	5	150	0/0/3	105		
	LNG104	Kazakh (Russian) language	G	5	150	0/0/3	105		Diagnostic test	LNG104	Kazakh (Russian) language	G	5	150	0/0/3	105		
	HUM100	Contemporary History of Kazakhstan (state exam)	G	5	150	1/0/2	105		no	MET499	Basics of mineral processing	B	5	150	2/1/0	105		no
	PHY111	Physics I	B	5	150	1/1/1	105		no	PHY467	Engineering thermodynamics	B	5	150	1/0/2	105		
	MAT101	Mathematics I	B	5	150	1/0/2	105		no	MAT102	Mathematics II	B	5	150	1/0/2	105		MAT101
	GEN177	Engineering and Computer Graphics	B	5	150	1/0/2	105		no	HUM129	Culturology	G	2	60	1/0/0	45		no
	HUM128	Political science	G	2	60	1/0/0	45		no	CHE495	Chemistry	B	5	150	1/1/1	105		no
	MET501	Technological mineralogy	S	5	150	2/1/0	105		no	KFK102	Physical education II	G	2	60	0/0/2	30		KFK101
	KFK101	Physical education I	G	2	60	0/0/2	30		no		**Total:**		**34**		**21**			
	Total:			**39**		**24**												
	3 semester (fall 2022)									**4 semester (spring 2023)**								
2	CSE677	Information and communication technology (eng)	G	5	150	2/1/0	105		no	HUM124	Phylosophy	G	5	150	1/0/2	105		no
	MAT103	Mathematics III	B	5	150	1/0/2	105		MAT102	HUM122	Psychology	G	2	60	1/0/0	45		no
	HUM127	Sociology	G	2	60	1/0/0	45		no	MNG487	Fundamentals of Entrepreneurship, leadership and anti-corruption culture	G	3	90	1/0/1	60		no
	CHE127	Physical chemistry	B	5	150	2/1/0	105		CHE192	MET502	Processes of ore preparation and equipment	B	5	150	2/1/0	105		MET451
	MET500	General Metallurgy	S	5	150	2/0/1	105		MET163	MET596	Theory of metallurgical processes II	B	5	150	2/1/0	105		MET429
	MET619	Theory of metallurgical processes I	B	5	150	2/1/0	105		MET454	MET503	Metallurgy of heavy non-ferrous metals	B	5	150	2/1/0	105		CHE199
	KFK103	Physical education III	G	2	60	0/0/2	30		KFK102	MET505	Gravitational methods of enrichment	B	5	150	2/1/0	105		MET163
										KFK104	Physical education IV	G	2	60	0/0/2	30		KFK103
	Total:			**29**		**18**				**Total:**			**32**		**20**			
	5 semester (fall 2023)									**6 semester (spring 2024)**								
3	MET507	Flotation methods of dressing	B	5	150	2/1/0	105		MET175	MET622	Heat power engineering of metallurgical processes	B	5	150	2/0/1	105		
	MET509	Metallurgy of ferrous metals	B	5	150	2/0/1	105		MET429	MET621	Metallurgical Engineering (in English)	B	5	150	2/0/1	105		CHE199
	MET620	Metallurgical heat engineering	B	5	150	2/1/0	105		MET429	MET508	Metallurgy of secondary raw materials	B	5	150	2/1/0	105		MET429
	MET504	Metallurgy of light metals	B	5	150	2/1/0	105		CHE199	MET510	Metallurgy of precious metals	B	5	150	2/0/1	105		CHE199

	3302	Elective	S	5	150	1/0/2*	105		
	3303	Elective	S	5	150	1/0/2*	105		
	Total:			**30**		**18**			
4	**7 semester (fall 2024)**								
	CHE452	Ecology and Sustainable Development	G	2	60	1/0/0	45		
	CHE451	Life safety	G	2	60	1/0/0	45		no
	4307	Elective	S	5	150	1/0/2*	105		
	4308	Elective	S	5	150	1/0/2*	105		
	Total:			**14**		**8**			

	3304	Elective	S	5	150	1/0/2*	105		
	3305	Elective	S	5	150	1/0/2*	105		
	3306	Elective	S	5	150	1/0/2*	105		
	Total:			**35**		**21**			
	8 semester (spring 2025)								
	4309	Elective	S	5	150	1/0/2*	105		
	4310	Elective	S	5	150	1/0/2*	105		
	ECA001	*Preparation & writing of thesis (project)	FA	6					
	ECA103	Thesis (project) defence*	FA	6					
	Total:			**22**		**6**			

Year of study	**Code**	**Name of discipline**	**Cycle**	**Credits**	**Recommended semester**
Mandatory types of training with an assessment of P/NP					
1	AAP101	Educational Internship (B)	B	2	2
2	AAP109	Industrial internship I (S)	S	2	4
3-4	AAP114	Industrial internship II (S)	S	3	6
Additional types of training					
1	AAP107	Sports club sectional	G	0	5
2-3	AAP500	Military training	G	0	5

Total number of credits			
Cycle of disciplines	**Credits**		
	compul-sary	**elective**	**total**
Cycle of general disciplines (G)	58	0	**58**
Cycle of basic disciplines (B)	110	2	**112**
Cycle of special disciplines (S)	5	55	**60**
Total of theoretical study:	**173**	**57**	**230**
Final attestation (FA)	12	0	**12**
Total:	**185**	**57**	**242**

ELECTIVE subjects for recruitment to the 2021-2022 academic year

Educational program 6B07203 - "Metallurgy and mineral processing"

Group of Educational programs B071 - "Mining and extraction of minerals"

Full-time study Study duration : 4 years Academic degree: bachelor of engineering and technology

Year of study	Elective code	Code of discipline	Name of discipline	Cycle	Credits	lec/lab/pr/siw	Prerequisites
3			**5th semester (AUTUMN 2023)**				
	3302	MET513	Theory and technology of steelmaking processes	S	5	2/0/1/2	MET429
		MET515	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing			2/1/0/2	MET429
		MET623	Powder metallurgy			2/0/1/2	CHE199
		MET624	Experimental bases in metallurgy			2/1/0/2	CHE192
		MET516	Magnetic and special methods of enriching			1/1/1/2	MET163
		MET517	Flotation reagents in EMP			2/1/0/2	CHE192
	3303	MET518	Special electrometallurgy	S	5	2/0/1/2	MET429
		MET520	Recycling of fine industrial waste			2/0/1/2	MET429
		MET625	Corrosion and protection of metals			2/1/0/2	MET429
		MET626	Technology of composite materials			2/0/1/2	CHE199
		MET521	Processes and devices of concentrating production			2/1/0/2	MET163
		MET522	Auxiliary facilities in EMP			2/0/1/2	MET163
			6th semester (SPRING 2024)				
	3304	MET553	Basics of scientific research in metallurgy	S	**5**	2/0/1/2	MET412
		MET554	Technology of processing of technogenic waste			2/0/1/2	MET412
		MET555	Receive, the quality and certification of by-products in the process of recycling			2/0/1/2	MET429
		MET590	Consumer properties of metallurgical products			2/0/1/2	MET429
		MET591	Geotechnologies in metallurgy			2/0/1/2	MET412
		MET571	Special and combined methods of enrichment			1/1/1/2	MET180
		MET572	Fundamentals of scientific research in ore dressing			2/1/0/2	MET180
	3305	MET523	Processes andapparatuses in ferrous metallurgy	S	5	2/0/1/2	MET412
		MET524	Processes and apparatuses in non-ferrous metallurgy			2/0/1/2	MET412
		MET578	Metallurgical furnace			2/0/1/2	MET430
		MET579	Types of coatings on metals and their production processes			2/0/1/2	MET429
		MET526	Enrichment of gold and uranium ores			2/1/0/2	MET153
		MET527	Modeling ofconcentrating processes			1/1/1/2	MET163
	3306	MET528	The alloys of non-ferrous and ferrous metals	S	5	2/0/1/2	MET412
		MET529	Recycling technologies in ferrous metallurgy			2/0/1/2	MET429
		MET580	Heat and mass transfer of metallurgical processes			2/0/1/2	MET430
		MET581	Processes and devices of powder metallurgy			2/0/1/2	MET430
		MET531	Enrichment of polymetallic ores			2/1/0/2	MET175
		MET532	Enrichment of of rare metal ores			2/1/0/2	MET175
			Total:		**25**	**25**	
4			**7th semester (AUTUMN 2024)**				
	4307	MET558	Modeling of metallurgical processes	S	5	2/0/1/2	MET412
		MET573	Design of metallurgical units in ferrous metallurgy			2/0/1/2	MET412
		MET592	Processing of uranium and rare metal raw materials in Kazakhstan			2/0/1/2	MET430
		MET617	Theory and practice of metal refining			2/1/0/2	MET117
		MET560	Assay and control of concentrating processes			1/1/1/2	MET180
		MET574	Ore beneficiation research			2/1/0/2	MET180
	4308	MET575	Fundamentals of metallurgical production design	S	5	2/0/1/2	MET412
		MET563	Dust collection and purification of gases in non-ferrous metallurgy			2/0/1/2	MET412
		MET594	Technology of refractory and heat-insulating materials			2/0/1/2	MET412
		MET618	Modern ecological schemes and forecasting in metallurgy			2/0/1/2	MET429
		MET564	Design of concentrating factory			2/1/0/2	MET180
		MET576	Digitalization of mining and processing and metallurgical plants			2/1/0/2	MET180
			8th semester (SPRING 2025)				
	4309	MET533	Metallurgy of ferroalloys	S	5	2/0/1/2	MET412
		MET534	Recycling technologies in steel production			2/1/0/2	MET429
		MET582	Advanced metallurgy and product design			2/0/1/2	MET429
		MET583	Metallurgical systems research			2/1/0/2	MET429
		MET536	Enrichment of mining and chemical and non-metallic raw materials			2/1/0/2	MET163
		MET537	Concentration of ferrous metals ores			1/1/1/2	MET163
	4310	MET538	Casting production of metals and alloys	S	5	2/0/1/2	MET412
		MET539	Metallurgy of radioactive and associated metals			2/0/1/2	MET412

		MET584	Production of special alloys			2/0/1/2	MET412
		MET585	Technology of firing and melting processes			2/0/1/2	MET430
		MET541	Enrichment of ores of ferrous metals			1/1/1/2	MET180
		MET542	Geotechnological methods of enriching			1/1/1/2	MET153
	Total:				**20**	**20**	

Number of credits on elective subjects for the entire period of study	
Cycles of disciplines	**Credits**
Cycle of General subjects (G)	0
Cycle of basic disciplines (B)	0
Cycle of profiling disciplines (P)	45
Overall:	**45**

Descriptors of the level and volume of knowledge, skills, competencies (prescribe)

A - knowledge and understanding:

A1 - in the field of history and culture of the Republic of Kazakhstan;

A2 - Kazakh, Russian and foreign languages in order to increase communication.

A3 - knowledge and understanding in the field of metallurgy and mineral processing, including elements of the most advanced knowledge, the complexity of ores and methods for their processing.

A4 - on the modern achievements of the natural sciences, the physical principles of operation of modern technical devices;

A5 - about information, methods for its storage, development and transmission.

A6 - standards, methodological and regulatory materials that accompany the operation, installation and commissioning of production systems for mineral processing and metallurgical production.

B - application of knowledge and understanding

B1 - understand and demonstrate knowledge in the field of general chemistry, physical and analytical chemistry at the level capable of moving to metallurgical production.

B2 - to understand and demonstrate knowledge in the field of mathematics, mathematical analysis and approach to the production metallurgical problem.

B3 - demonstrate knowledge and understanding in the field of metallurgy and mineral processing, including elements of the most advanced knowledge in these areas: integrated use of minerals, critical metals and raw materials, greening production, waste management, obtaining innovative alloys and products, nanotechnology;

B4 - apply this knowledge and understanding at a professional level in the field of metallurgy and mineral processing; to develop a project of workshops and factories, own metallurgical calculations, design skills in the field of enrichment and metallurgy.

C - formation of judgments

C1 - to formulate arguments and solve problems in the field of metallurgy and mineral processing;

C2 - for independent work and preparation of proposals for various options for solving professional problems using theoretical and practical knowledge;

C3 - to collect and interpret information to form judgments taking into account social, ethical and scientific considerations in the framework of the development of enrichment metallurgy industries;

C4 - communicate information, ideas, problems and solutions to both specialists and non-specialists.

C5 - about the possibility of extracting valuable metals, methods, profitability, economic efficiency.

D - personality abilities

D1 - demonstrate leadership, determination, openness, goodwill, determination, accuracy, demonstrate motivation for learning activities, teamwork, motivation to avoid failure;

D2 - apply self-esteem, sociability, leadership skills, ability to lead and manage, teamwork, motivation to avoid failure;

D3 - integrate adaptive abilities: behavioral regulation, communicative potential, moral normativeness, personal adaptive potential;

D4 - continue training yourself.

Competencies to complete the training

B - Basic knowledge, skills;

B1 - Know the history of the Republic of Kazakhstan, stages and prospects of development of the state;

B 2 - The ability to use modern technology to gain access to information sources and exchange them. To possess computer skills as a means of managing, storing and processing information and performing calculations using software products for general and applied purposes.

B 3 - To know the state, Russian and one of the foreign languages widespread in the industry at a level that ensures human communication.

B4 - To be able to use fundamental general engineering knowledge, the ability to practically use the foundations and methods of mathematics, physics and chemistry in their professional activities.

B5 - The ability to use the knowledge and methods of engineering disciplines (the basics of automation and mechanics) in practice.

B6 - Awareness in the field of financial analysis and evaluation of projects, project management and business, in the basics of macro and microeconomics, knowledge and understanding of risks in market conditions.

B7 - Acquaintance with technological processes and work skills at metallurgical enterprises.

B8 - Know and own the basic business processes in an industrial enterprise.

B9 - Know the basics of military training and be able to work with military equipment.

P - Professional competencies, including according to the requirements of industry professional standards;

P1 - A wide range of theoretical and practical knowledge in the professional field;

P2 - Proficiency in professional terminology and the ability to work with educational and scientific materials by profession in the original in the state, Russian and foreign

languages. The ability is logically true, reasoned, and clearly build oral and written speech in three languages
P3 - Knowledge of the requirements of the Rules of safety and labor protection at work and the ability to use them in practice.
P4 - Possession of a culture of occupational safety; ability to identify dangers and assess risks in their field; mastering the basic methods of protecting production personnel and the population from the possible consequences of accidents, disasters, natural disasters and improving working conditions in the field of professional activity.
P5 - Willingness to apply professional knowledge to prevent and minimize negative environmental consequences at work.
P6 - The ability to use regulatory legal documents in their activities.
P7 - Choose rational methods for the production and processing of ferrous and non-ferrous metals that meet the requirements of integrated technology, economics and ecology.
P8 - To be able to realize the social significance of their future profession. Possess knowledge of the formation and development of the mining and processing and metallurgical industries of Kazakhstan and current priority trends
P9 - To be able to combine task theory and practice to solve engineering problems, conduct balance thermotechnical, hydraulic, aerodynamic calculations of metallurgical processes and apparatuses, based on practical data.
P10 - Be able to apply in practice the principles of rational use of natural resources and environmental protection.
P11 - To be able to choose measuring instruments in accordance with the required accuracy and operating conditions.
P12 - To be able to carry out and adjust technological processes in metallurgy.
P13 - To be able to identify objects for improvement in engineering and technology.
P14 - The ability to identify enrichment and metallurgical apparatus and systems for transporting melts (reagents, pulps, etc.) that have low efficiency, an increased level of danger, and determine the necessary measures to improve equipment and / or production technology.
P15 - To be able to apply the methods of technical and economic analysis. To calculate and analyze chemical and physico-chemical processes, mass transfer processes occurring in technological processes of processing (enrichment) of mineral raw materials, production and processing of ferrous and non-ferrous metals.
P16 - To be able to choose research methods, plan and conduct the necessary experiments, interpret the results and draw conclusions.
P17 - Calculate and analyze the processes of fuel combustion and heat generation, external and internal heat transfer in furnaces for various technological purposes, choose rational temperature and thermal modes of operation of metallurgical furnaces.

Calculate and analyze hydrometallurgical processes and devices, choose the optimal technological conditions.
P18 - Have the ability to analyze and synthesize. Conduct literary and analytical reviews.
P19 - To be able to use the basic concepts, laws and models of thermodynamics, chemical kinetics, heat and mass transfer. Be able to choose and apply appropriate modeling methods for physical, chemical and technological processes.
P20- Be able to carry out project elements.
P21 - Independently perform: calculations of pyro- and hydrometallurgical equipment; drawings of parts and structural elements; strength and stiffness calculations; calculations of machine parts and mechanisms; choose electrical equipment and calculate its operation modes; offer an automation system for the main equipment.
P22- To be able to justify the choice of equipment for the implementation of technological processes.
P23 - Conduct a feasibility study of the metallurgical process. To plan the volume of production and to calculate the costs of production and sale of products, to determine the breakeven conditions. Carry out tentative calculations of harmful emissions and assess the environmental status of existing and planned technological processes and units.
P24 - Independence: the implementation of independent work in typical situations and under the guidance in difficult situations of professional activity; independent organization of training. Responsibility: for the results of the work; for their safety and the safety of others; for fulfilling the requirements for environmental protection and fire safety. Difficulty: solving typical practical problems; the choice of a method of action from those known on the basis of knowledge and practical experience: conducting the main technological process in accordance with their field of professional activity;

O - Human, social and ethical competencies

O1 - In work and everyday life to show respect for the environment.
O2 - Take into account ethical and legal norms in interpersonal communication, knowledge and understanding of their rights and obligations as a citizen of the Republic of Kazakhstan.
O3 - The ability to critical generalization, analysis and perception of socio-political information using the basic laws of the development of society in solving social and professional problems, the ability to analyze socially significant problems and processes in society. Own a culture and logic of thinking, an understanding of the general laws of development of society and the ability to analyze them.
O4 - Awareness of the need and the acquisition of the ability to independently learn and improve their skills throughout their work. O5 - Understanding and practical use of healthy living standards, including prevention issues to improve performance

О6 - The ability to build interpersonal relationships and work in a group (in a team).

С - Special and managerial competencies

С1 - Independent management and control of the processes of labor and training activities within the framework of the strategy, policy and goals of the organization, discussion of the problem, argumentation of conclusions and competent handling of information;

С2 - Independence: executive management activities for the implementation of tasks under the guidance of independent definition of tasks, organization and monitoring of the implementation of its subordinate employees. Responsibility: for the results in the implementation of the norm; for their safety and the safety of others; for fulfilling the requirements for environmental protection and fire safety.Difficulty: solving various typical practical problems requiring an independent analysis of working situations: Maintaining the main technological process in the field of their professional activity, various levels of complexity, mentoring in the team. Quality control of semi-finished products, technological processes and finished products.

С3 - Independence: managerial activity within the framework of the technological process section and the enterprise activity strategy. Responsibility: for the assessment and improvement of their own work, their own education and training of others; for their safety and the safety of others; for fulfilling the requirements for environmental protection and fire safety.

Difficulty: solving practical problems based on the choice of solutions in various changing conditions of working situations: Carrying out work on the organization of the technological process of production of the mining and metallurgical industry, designing, developing and introducing new equipment, technologies and assortment, organizational and managerial work to improve the quality production and production efficiency of the mining and metallurgical industry.

С4 - Independence: management activities within the framework of the enterprise’s activity strategy, involving coordination of work with other sites. Responsibility: for the planning and development of business processes that can lead to significant changes or development, responsibility for improving the professionalism of employees.

Difficulty: activity aimed at solving problems involving a choice and a variety of ways to solve. Conducting research and experimental work, designing the expansion and modernization of production, expanding and updating the assortment of the mining and metallurgical industry, introducing new technologies.

Minor Continuing Education Policy

Obtaining additional education Minor in the specialty "Automation and Control - 6B070200"

With the development of at least 12 credits in the disciplines of the program, including the following compulsory disciplines:
M1 - Linear automatic control systems
M2 - Nonlinear automatic control systems
M3 - Theoretical Foundations of Electrical Engineering
An additional Minor specialty is assigned with the issuance of an attachment to the diploma of the established sample.

Appendix to the ECTS diploma

Description of requirements and format.

Appendix to the ECTS diploma

Bachelor of engineering and technology, level 5-6 of the national qualifications framework with the right to hold the following positions: shift master/site master/shop master; foreman of the Department of calibration, drawing and grinding of metal/foreman of the section of preparation of molding mixture/foreman of the ore yard (level 5); chief mechanic, chief instrument maker/chief rolling operator; chief welder/chief steelmaker; metal engineer/process engineer-Metallurgist; research engineer in the field of metal casting; research engineer in the field of plastic and heat treatment; head of duty shift/head of Department; head of production/head of sector; head of shop/head of point; head of service/head of shift; head of drying and cleaning tower/head of Department; head of section (level 6) at mining and metallurgical enterprises according to the Industry qualification framework "Mining and metallurgical industry" from "30" July 2019 No. 1 of the Association of legal entities "Republican Association of mining and metallurgical enterprises".

English
CODE – LNG108
CREDIT - 10 (0/0/6)
PREREQUISITE - Diagnostic Test / LNG1051-1056

LNG1051 PURPOSE AND OBJECTIVES OF THE COURSE
The discipline in English "Beginner English" is intended primarily for learning from scratch. This course is also suitable for those who have only general basic knowledge of the language. After passing this level, the student will be able to confidently communicate on basic topics in English, learn the basics of grammar and lay a certain foundation that will improve his skills at the next stage of learning English.
The discipline "Elementary English" is the foundation for learning English, which is aimed at developing the receptive skills of students (reading and listening) and productive skills (writing and speaking), the analysis of basic knowledge, the use and memorization of basic grammar rules and the development of pronunciation and elementary vocabulary as well as encouraging self-study and critical thinking.
The goal of the "General English 1" course is to provide students with the opportunity to gain sufficient knowledge to become more free in everyday social and academic conditions. Students work on improving pronunciation, expanding vocabulary, and grammar. At this level, the main task will be to consolidate the skills acquired earlier, to learn how to compose and correctly apply complex syntactic constructions in the English language, and also to achieve a really good pronunciation.
The General English 2 course is designed for students who continue to study General English 1. The course is focused on the ability to actively use in practice most aspects of the English language, conditional sentences, passive phrases, etc. At this stage, the student will be able to maintain a conversation with several interlocutors or express their point of view. The student significantly expands his vocabulary, which will allow him to freely express his thoughts in any environment. At the same time, the speech will be replenished with various synonyms and antonyms of already familiar words, phrasal verbs and stable expressions.
The main goal of the Academic English course is to develop academic language skills. Discipline is a language style that is used in writing academic works (paragraph, abstract, essay, presentation, etc.). This course is designed to help students become more successful and effective in their learning, developing critical thinking skills and independent learning.
"Business English" is English for business communication, business and career. Knowledge of business English is useful for negotiating and business correspondence, preparing presentations and informal communication with business partners.
Features of the training are that it is necessary not only to master the vocabulary, but also to master new skills: presentation, communication, language, professional.
The "Professional English" course is designed for B2 + students, whose goal is to increase the language competence of students in relevant professional fields. The main goal of the course is to teach students how to work with texts, both audio and written, in their specialty. The curriculum is built on the necessary vocabulary (words and terms), often used in English for special purposes.
Students will acquire professional English language skills through integrated learning based on content and language, master the vocabulary in order to read and understand original sources with a high degree of independence, and practice various communication models and vocabulary in specific professional situations.

Kazakh / Russian language
CODE - LNG104
CREDIT - 10 (0/0/6)
PREREQUISITE - Diagnostic Test

PURPOSE AND OBJECTIVES OF THE COURSE
- To teach students to listen to statements on well-known topics related to home, study, free time;
- understand texts on personal and professional topics containing the most frequent words and phrases;
- be able to conduct a conversation on everyday topics; describe your experiences; tell your opinion; retell and evaluate the content of the book you've read, the movie you've seen;
- Be able to create simple texts on known topics, including those related to professional activities.

BRIEF DESCRIPTION OF THE COURSE
The language material of the course is selected in such a way that the student, while assimilating the lexical and grammatical minimum, has the opportunity to get acquainted with typical communicative situations and he himself finds himself in such situations, is able to correctly evaluate them and choose the appropriate model (strategy) of speech behavior.
The main emphasis of training is shifted from the process of transferring knowledge to teaching the ability to use the studied language in the course of the implementation of various types of speech activity, such as reading (assuming reading comprehension), listening (under the same condition) and producing texts of a certain complexity with a certain degree of grammatical and lexical correctness. The material for the classes is selected so that students learning Kazakh / Russian acquire the skills of reading, writing and understanding sounding speech based on the simultaneous mastery of the basics of grammar (phonetics, morphology and syntax) and word usage during constant repeated repetition with the gradual complication of tasks.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
The student, subject to the active organization of work in the classroom and conscientious fulfillment of homework at the end of the first semester, acquires skills corresponding to the pan-European level A2 (Threshold according to the ALTE classification), that is, he is on the verge of independent language proficiency.

Contemporary History of Kazakhstan
CODE - HUM100
CREDIT - 5 (1/0/2)
PREREQUISITE - no

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course is to familiarize students of technical specialties with the main theoretical and practical achievements of domestic historical science on the problems of the history of modern Kazakhstan, an integrated and systematic study of the main stages of the formation and development of Kazakhstani society.
- analyze the features and contradictions of the history of Kazakhstan in the Soviet period;
- to reveal the historical content of the foundations of the laws of political, socio-economic, cultural processes at the stages of the formation of an independent state;
- to contribute to the formation of citizenship of students;
- to educate students in the spirit of patriotism and tolerance, ownership of their people, the Fatherland;

BRIEF DESCRIPTION OF THE COURSE
The course Modern History of Kazakhstan is an independent discipline and covers the period from the beginning of the twentieth century to the present day. The modern history of Kazakhstan is studying the national liberation movement of the Kazakh intelligentsia at the beginning of the 20th century, the period of the creation of the Kazakh Autonomous Soviet Socialist Republic, and the process of formation of a multinational society.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
- knowledge of events, facts and phenomena of modern history of Kazakhstan;
- knowledge of the history of ethnic groups living in Kazakhstan;
- knowledge of the main stages of the formation of the Kazakh state;
- ability to analyze complex historical events and predict their further development;
- ability to work with all types of historical sources;
- ability to write essays and scientific articles on the history of the Fatherland;
- ability to operate with historical concepts;
- ability to conduct a discussion;
- skills of independent analysis of historical facts, events and phenomena;
- public speaking skills.

Physics I
CODE - PHY111
CREDIT - 5 (1/1/1)
PREREQUISITE - Diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE
The main purpose of teaching the course Physics I and Physics II is to form ideas about the modern physical picture of the world and scientific worldview.

BRIEF DESCRIPTION OF THE COURSE
The disciplines of Physics I and Physics II are the basis of theoretical preparation for engineering and technical activities of graduates of the higher technical school and represent the core of physical knowledge necessary for an engineer operating in the world of physical laws. The course "Physics 1" includes sections: physical fundamentals of mechanics, the structure of matter and thermodynamics, electrostatics and electrodynamics.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
- the ability to use knowledge of fundamental laws, theories of classical and modern physics, as well as the use of methods of physical research as the basis of the system of professional activity.

Mathematics I
CODE – MAT101
CREDIT - 5 (1/0/2)
PREREQUISITE - Elementary mathematics-school course / diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE
The main goal of the course is to give a future specialist a certain amount of knowledge on the sections of the course "Mathematics-I", necessary for the study of related engineering disciplines. To introduce students to the ideas and concepts of mathematical analysis. The main attention should be paid to the formation of basic knowledge and skills with a high degree of their understanding of differential and integral calculus.
Course Objectives:
the acquisition of knowledge necessary for the effective use of rapidly developing mathematical methods; gaining the skill of building and researching mathematical models; knowledge of the fundamental areas of mathematics necessary for solving research and practical problems in the professional field.

BRIEF DESCRIPTION OF THE COURSE
The course "Mathematics-I" gives an account of the sections: an introduction to analysis, differential and integral calculus

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Studying this discipline will allow the student to apply the course “Mathematics-I” to solve simple practical problems, find tools sufficient for their research, and get numerical results in some standard situations.

Engineering and computer graphics
CODE – GEN177
CREDIT – 5 (1/0/2)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "Engineering and computer graphics" is to study the rules for the implementation of technological documentation based on the ESCD standards; the ability to build, transform and edit graphic objects and images on a computer using modern software, in compliance with the ESCD standards.
Tasks. To form students ' knowledge, skills and abilities that allow them to:
- use modern software tools to create geometric models of radio engineering devices and perform and edit drawings, diagrams on a personal computer;
- prepare design and technological documentation;
- work with the computer as a means of information management.

BRIEF DESCRIPTION OF THE COURSE
The course develops students the following skills: to depict all possible combinations of geometric shapes on the plane, to make research and measurements, allowing for image transformation; to create technical drawings, which are the main and reliable means of information that provides a link between the designer and the designer, technologist, Builder. Introduces students to the basics of automated preparation of the graphic part of design documents in the AutoCAD environment.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
Know: analytical, computational and system-analytical methods for solving applied problems; methods and tools of geometric modeling and computer graphics.
Be able to: work with traditional information carriers, knowledge bases; be able to formulate tasks and develop algorithms for their solution, develop basic design documents that meet the requirements of standards and regulations.
Possess: methods and technologies of design documentation and products; software tools for research and design of electronic devices; registration of technical documentation.

Political science
CODE – HUM128
CREDIT – 2 (1/0/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is the political socialization of students of the Technical University, ensuring the political aspect of training a highly qualified specialist on the basis of modern world and domestic political thought.
The aim of the course is to give the future specialist primary political knowledge that will serve as a theoretical basis for understanding political processes, for the formation of political culture, developing a personal position and a clearer understanding of the measure of their responsibility.

BRIEF DESCRIPTION OF THE COURSE
The course of political science is designed to introduce students to the basics of political science and form a general idea of politics, its main aspects, problems, patterns and interaction with other spheres of public life.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
At the end of the course, the student should know: basic conceptual apparatus of political science; basic methodological approaches and paradigms of political science; the system of power relations
The student must be able to: analyze the features of political systems and the functioning of political institutions; critically evaluate the theoretical approaches of political science; to compare political systems, institutions and actors in the cross-country and subnational context, based on the knowledge gained and the methods mastered; to make proposals and recommendations to public authorities.
Formation of critical thinking skills and the ability to apply it in practice. Development of skills for describing and analyzing current problems of modern society, the essence of social processes and relationships.

Technological Mineralogy
CODE – MET501
CREDIT - 5 (2/1/0)
PREREQUISITE - no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to study the fundamentals of the theory of the formation of minerals in nature by students and their basic properties used in the production of various metals and main raw materials of the Republic of Kazakhstan, as well as instilling skills in the active use of various types of literature.
The objectives of the discipline is to obtain knowledge about the structure of the earth and the formation of minerals in nature, their basic properties used in the processing of mineral raw materials to produce various metals.

BRIEF DESCRIPTION OF THE COURSE
General information about mineralogy. The formation of minerals in nature. Basic concepts about crystals. Properties of minerals and their classification. The properties of the minerals used in the processing of various mineral raw materials to produce metals. Concepts about minerals and deposits. Mineral deposits of the Republic of Kazakhstan.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
General information about the structure of the earth and the formation of minerals;
Basic concepts about crystals, properties of minerals and their classification;
Concepts about minerals and deposits;
The main raw material sources of mineral raw materials of the Republic of Kazakhstan;
Ability to use special, scientific, technical and advertising literature.

Basics of mineral processing
CODE – MET499
CREDIT – 5 (2/1/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying this discipline is to gain knowledge of the future engineer of the basics of mineral processing, processes, technologies for processing and integrated use of mineral raw materials. Study of the main directions in mineral processing;
The main tasks of studying the discipline are:
- mastering the methods of calculating qualitative-quantitative and water-sludge schemes for mineral enrichment. Drawing up tables and diagrams. Form of records and calculations. Formulas of technological indicators with the interpretation of incoming quantities and units of measurement;
− familiarity with processes and devices for processing and processing of minerals.

BRIEF DESCRIPTION OF THE COURSE
The course covers the basic sections: processes of preparation of mineral raw materials for enrichment, the main laws used in their implementation, the processes of separation of minerals based on the contrast of physical and physico-chemical properties, the laws of physics and chemistry that form the basis of these processes, auxiliary processes implemented in solid mineral processing technologies, the design of devices used in various stages of mineral processing technologies, wastewater treatment and waste storage of processing plants, quality control, production, research on enrichment.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
have an idea: - about the principles of selecting technological schemes for mineral processing; - about the modes of mineral processing.
know: the physical properties of rocks, the physical nature and parameters of mining processes in the processing of minerals; the role and place of enrichment methods in the processing of coal, ferrous, non-ferrous and rare metals, construction mineral and mining-chemical raw materials, products of man-made origin; the theoretical basis of enrichment methods; design, technical characteristics, operational data of equipment and devices used in the processing of minerals; principles of constructing technological schemes taking into account the characteristics of the material composition of various raw materials, economic and environmental factors.
be able to: make plans for the implementation of technological regulations for processing minerals; perform calculations of parameters of technological processes for processing minerals; have the skills to develop technological schemes for processing minerals.

Mathematics II
CODE – MAT102
CREDIT - 5 (1/0/2)
PREREQUISITE – MAT101

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the course "Mathematics II" is the formation of bachelors' ideas about modern mathematics as a whole as a logically coherent system of theoretical knowledge. The objectives of the course are to instill in students solid skills in solving mathematical problems with bringing the solution to an almost acceptable result. To develop primary skills in mathematical research of applied issues and the ability to independently understand the mathematical apparatus contained in the literature related to the student's specialty.

BRIEF DESCRIPTION OF THE COURSE
The course "Mathematics II" provides an accessible presentation of the sections: elements of linear algebra and analytic geometry, differential calculus of functions of many variables, multiple integrals. "Mathematics II" is a logical continuation of the course "Mathematics I".

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Studying this discipline will make it possible to put into practice the theoretical knowledge and skills obtained with a high degree of understanding of the sections of the course, to use them at the appropriate level; translate into mathematical language the simplest problems posed in terms of other subject areas; acquire new mathematical knowledge using educational and information technologies; solve applied problems in the field of professional activity.

Culturology
CODE – HUM129
CREDIT – 2 (1/0/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to form undergraduate students' understanding of the specifics of the development of national culture in the context of world culture and civilization, the need to preserve the cultural code of the Kazakh people, the ability in independent professional activity to carry out a strategy for preserving the cultural heritage of the Kazakh people in a dynamically changing multicultural world and society.
Course objectives: to describe the morphology and anatomy of culture as a system of parameters and forms in the contexts; nature, man, society; to explain the origin and essence of signs, meanings, archetypes, symbols as a system of cultural code through correlation with the type of material culture determined by the way of being; to organize information about the cultural heritage of the inhabitants of Kazakhstan and to determine the channels of their influence on the formation of the culture of the Kazakh people; to classify the cultural capital of the Turks, to organize the forms and channels of cultural interaction with the peoples of Western Europe, the Middle East, to identify their contribution to the intellectual and cultural history of mankind and the Kazakh people; provide reasoned and reasonable information about the various stages of the development of Kazakh culture as a factor in the preservation of cultural heritage and the Kazakh language, including modern state programs for its development and modernization; to give an objective assessment of the national.

BRIEF DESCRIPTION OF THE COURSE
The course is intended for students of the EP «Cultural Studies» aimed at the development of a socio-humanitarian worldview as the basis for the modernization of public consciousness through the formation of cultural identity, the ability to analyze and evaluate cultural situations based on understanding the nature of cultural processes, the specifics of cultural objects, the role of cultural values in intercultural communication.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As part of the course, the student will master the practical use of methods of cultural studies in various aspects of life. The basic knowledge and skills in the field of philosophy and cultural studies will be presented, as well as methods of comparison, analysis, synthesis, and resolution of the situation by the method of dialogue.
At the end of the course, the student should know: information about the cultural heritage of the inhabitants of Kazakhstan and determine the channels of their influence on the formation of the culture of the Kazakh people; classification of the cultural capital of the Turks, to organize the forms and channels of cultural interaction with the peoples of Western Europe, the Middle East, to identify their contribution to the intellectual and cultural history of mankind and the Kazakh people; provide reasoned and reasonable information about the various stages of the development of Kazakh culture as a factor in the preservation of cultural heritage and the Kazakh language, including modern state programs for its development and modernization.

Chemistry
CODE – CHE495
CREDIT - 5 (2/1/0)
PREREQUISITE - Diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form knowledge on fundamental issues of General chemistry and skills of their application in professional activities.
Course objective:
- transfer the basic theoretical knowledge of the course of chemistry;
- help students get the skills to perform laboratory work;
- learn to solve typical problems and paint the reaction equations;
what contributes to the informal assimilation of theoretical material;
- to form students' chemical thinking skills.

BRIEF DESCRIPTION OF THE COURSE
The course "General chemistry" examines the laws, theoretical positions and conclusions that underlie all chemical disciplines, studies the properties and relationships of chemical elements based on the periodic law of D. I. Mendeleev and on modern ideas about the structure of matter, the basics of chemical thermodynamics and kinetics, processes in solutions, the structure of complex compounds.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: - basic chemical laws and concepts, - various chemical systems, - basic laws of chemical reactions, - reactivity of substances based on knowledge of the structure of atoms, the periodic system of elements and chemical bonds.
be able to: - solve problems using the acquired knowledge, - paint reaction equations, - make calculations using basic chemical patterns.
possess skills: - to be guided in the basic concepts of chemistry, properties of elements-nonmetals and metals of groups of the periodic system; - acquire skills in drawing up chemical equations, solving problems, explaining the properties of elements and their compounds based on the laws of chemistry, conduct chemical experiments and explain the phenomena occurring.

Information and communications technology (English)
CODE – CSE677
CREDIT - 5 (2/1/0)
PREREQUISITE - no

PURPOSE AND OBJECTIVES OF THE COURSE
Training in the use of modern information technologies in the field of professional activity. The objectives of the course include:
To reveal the basic concepts of architecture of computer systems;
To reveal the basic concepts of information and communication technologies and subject terminology;
To teach how to work with software interfaces of operating systems;
To teach how to work with data in a variety of representations, both tabular structured and unstructured;
To teach to apply the basic principles of information security;
Expand the concepts of data formats and multimedia content. Learn to work with typical multimedia data processing applications. Use modern approaches to presenting material;
To reveal the concepts of modern social, cloud and email platforms and how to work with them;
Train to use the methods of algorithmization and programming to solve the problems of automating business processes

BRIEF DESCRIPTION OF THE COURSE
The course contains a training program aimed at leveling the basic knowledge of students in the field of information and communication technologies. It contains a full range of topics, according to the GOSO Model Curriculum, with a predominance of educating practical skills in working with data, algorithmization and programming. The course is designed in such a way as to teach students not only the basic concepts of architecture and modern infrastructure of information and communication technologies, but also to teach how to use these tools to solve applied problems. To teach you how to optimize processes, apply adequate models and methods for solving practical problems using modern methods and tools of information technology, automate routine processes, be productive and efficient.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Students will know: computer device; Architecture of computing systems; Infrastructure of information and communication technologies; Interfaces of modern operating systems; Modern tools for working with data of various nature and purpose; Types of information security threats, principles, tools and methods of data protection; Python programming language.
Students will be able to: - Work with interfaces of modern operating systems; - Work with modern application software for working with data of various nature and purpose; - Apply modern social, cloud, email platforms for organizing business processes; - Program in an algorithmic programming language; - Analyze, model, design, implement, test and evaluate information and communication technology systems.

Mathematics III
CODE – MAT103
CREDIT - 5 (1/0/2)
PREREQUISITE – MAT101, MAT102

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the course "Mathematics III" is the formation of basic knowledge and skills with a high degree of understanding of the sections of the course, helping to analyze and solve theoretical and practical problems.
Course objectives: instilling in students the ability to independently study the educational literature, conduct probabilistic and statistical analysis of applied problems; development of logical thinking and raising the general level of mathematical culture.

BRIEF DESCRIPTION OF THE COURSE
The course "Mathematics III" includes sections: theory of series, elements of probability theory and mathematical statistics and is a logical continuation of the discipline "Mathematics II".

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Student
must know:
- number series theory;
- theory of functional series;
- Fourier series;
-elements of probability theory and mathematical statistics;
should be able to:
- solve problems in all sections of the theory of series;
- find the probabilities of events;
- find the numerical characteristics of random variables;
- use statistical methods to process experimental data.

Sociology
CODE – HUM127
CREDIT – 2 (1/0/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: the formation of theoretical knowledge about society as an integral system, its structural elements, connections and relationships between them, the features of their functioning and development, as well as about existing sociological theories explaining social phenomena and processes.
Objectives of mastering the discipline: study of the basic values of social culture and the willingness to rely on them in their personal, professional and general cultural development; study and understanding of the laws of development of society and the ability to operate with this knowledge in professional activities; the ability to analyze socially significant problems and processes, etc.

BRIEF DESCRIPTION OF THE COURSE
The discipline is designed to improve the quality of both general humanitarian and professional training of students. Knowledge in the field of sociology is the key to effective professional activity of a future specialist, which is impossible in modern society without understanding social processes, as well as without mastering the skills of their correct interpretation.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
know: features of the sociological approach to the interpretation of the basic concepts and terms of the social sciences; basic classical sociological theories and schools; key concepts of sociology: society, group, socialization, social facts and social actions, norms, values, social structure, mobility, culture, social institution, social organization, social process, etc .; basic approaches to identifying and analyzing the social structure of society, social changes; the main regularities of the course of social processes and the mechanisms of functioning of the main social communities; patterns of socio-economic, political and managerial processes, the main approaches to their study, as well as features of their application;
be able to: describe the processes and observed phenomena occurring in society using sociological terminology; explain differences in approaches to defining sociological concepts; consider social phenomena, institutions and processes from different points of view, argue their own position on the problem, comparing and comparing some theoretical perspectives; find, analyze and present factual data, analytical information about social groups, institutions, processes and phenomena, revealing abstract concepts using examples using various kinds of data;
own: the ability to use sociological knowledge in practice to analyze the phenomena and events of social reality; the skills of independent individual preparation, constructive communication and the performance of appropriate roles in the implementation of group projects, participation in the discussion; presentation of the results of individual and group analytical work in written and oral form;
• skills of academic and grammatically correct writing, text structuring, processing of sources, design of the reference apparatus.

Physical chemistry
CODE – CHE127
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495

PURPOSE AND OBJECTIVES OF THE COURSE
The main purpose of studying the discipline is to develop students ' chemical worldview and acquire modern ideas about the structure of substances and the chemical process based on thermodynamics and kinetics.
To achieve this goal, the following course objectives are highlighted:
− students gain knowledge about the structure and state of substances (atomic nucleus, atom, molecule, substance) and chemical process (stoichiometry, equilibrium, kinetics);
- students acquire the skills to consider any chemical processes (first of all, the most common and important acid-base and redox reactions) within the framework of modern concepts of the structure of substances, chemical thermodynamics and chemical kinetics.

BRIEF DESCRIPTION OF THE COURSE
Physical chemistry is an important part of chemistry that studies the relationship between chemical and physical processes. The main questions of physical chemistry are: why the physical and chemical process occurs; in this case, it is necessary to change the reaction state for the desired direction; the process can move to the relationship between primary reagents and products; What is the structure and properties of the substance in the physical and chemical process.
Determining the behavior of a chemical reaction allows you to control the chemical process, which means that it provides fast and complete production of the most important reactions for technology in the right direction and the most profitable for the industry.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After studying the discipline, students must:
know the fundamental laws of chemical thermodynamics, chemical and phase equilibrium, phase transformations, chemical kinetics, catalysis and electrochemistry.
be able to justify the technical and chemical requirements for the conduct of the technological process of obtaining intermediates and the finished product.
be able to theoretically justify the possibility and direction of the process or chemical reaction under consideration.
master methods for calculating and experimentally determining the thermal effects of various processes, chemical reactions; calculating and plotting the state of two or three-component systems; determining the influence of various parameters on the yield of chemical reaction products; determining the rate constants of simple chemical reactions; calculating the EMF of chemical chains.

General metallurgy
CODE – MET500
CREDIT - 5 (2/0/1)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the theoretical foundations of methods of ore mining, enrichment, preparation of raw materials for metallurgical processing and metallurgical processing of raw materials of ferrous, non-ferrous and rare metals.

BRIEF DESCRIPTION OF THE COURSE
This course is an introductory part of metallurgy and helps the student to master the basic terms and definitions in metallurgy, general principles of development of technological processes, as well as the design and operation principles of the main metallurgical units.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
- *to know* classification of metals, ores and minerals; the main base, the types and abundance of minerals, ferrous and nonferrous metals in the earth's crust; the essence of key terms and concepts in the field of metallurgy, types and theoretical foundations of the processes of enrichment and preparation of raw materials for metallurgical redistribution; theoretical bases of pyro-, hydro - and electrometallurgical processes; flow diagrams for ferrous, non-ferrous and rare metals; design and operation of the main metallurgical units; operating parameters and characteristics of technological processes.
- *be able to*: use the acquired knowledge from the course "General metallurgy" to solve modern issues of processing raw materials of ferrous, non-ferrous and rare metals and extract valuable components from them.

Theory of metallurgical processes I
CODE – MET619
CREDIT – 5 (2/1/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form students ' systematic knowledge about the main metallurgical processes of processing oxidized and sulfide mineral and man-made raw materials, salt melts.
Course objective: basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes; to help students gain skills in performing laboratory work; to teach them to solve problems in the kinetics and thermodynamics of processes.

BRIEF DESCRIPTION OF THE COURSE
The course "Theory of metallurgical processes 1" examines the laws, theoretical provisions and conclusions about the structure and properties of metal, oxide and sulfide systems: thermodynamics and kinetics of metallurgical processing of oxidized and sulfide mineral and man-made raw materials, salt melts; liquation and distillation processes; methods of metal refining and the main directions of development of the theory and practice of extracting and refining metals, taking into account the complex use of raw materials and modern environmental requirements.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: basic laws of thermodynamics, mechanism and kinetics of basic metallurgical processes; skills in performing calculations on thermodynamics and kinetics of various metallurgical processes;
be able to: analyze existing and projected processes; predict the performance of certain specific processes and trends in the development of technologies for processing ore and man-made raw materials; assess the speed of individual stages of metallurgical processes, identify speed-limiting links of simple and complex processes;
possess the following skills: skills of performing calculations on thermodynamics and kinetics of metallurgical processes, substantiating the choice of processes and requirements for their hardware design, forecasting the indicators of certain specific processes and directions of development of technologies for processing ore and man-made raw materials.

Philosophy
CODE – HUM124
CREDIT – 5 (1/0/2)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The goal of the course is to develop cognitive, operational, communicative, and self-educational competencies
To solve the tasks: to contribute to the development of adequate worldview guidelines in the modern world; to form creative and critical thinking among students; to distinguish the ratio of spiritual and material values, their role in the life of a person, society and civilization; to help determine their attitude to life and the search for harmony with the surrounding world.

BRIEF DESCRIPTION OF THE COURSE
"Philosophy" is the formation of an integral worldview that developed in the context of socio-historical and cultural development of mankind. Introduction to the main paradigms of the methodology of teaching philosophy and education in the classical and post-classical traditions of philosophy. Philosophy is designed to develop stable life orientations, finding the meaning of one's existence as a special form of spiritual production. Contributes to the formation of a moral image of a person with the ability of critical and creative thinking. The theoretical sources of this course are the concepts of Western, Russian, and Kazakh scientists on the history and theory of philosophy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
- knowledge of the main terms, main concepts and problems of philosophy;
- knowledge of the main philosophical ways of solving worldview issues in the context of culture;
- ability to analyze the history of the development of philosophical thought;
- ability to identify alternative ways of setting and solving worldview issues in the history of human development;
- ability to identify the main theoretical approaches in the relationship of a person with society;
- ability to master the method of performing independent work;
- search and systematization skills;
- skills to freely discuss and make rational decisions;
- skills of ethical principles in professional activities.

Psychology
CODE – HUM122
CREDIT – 2 (1/0/0)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline is the formation of psychological knowledge, skills and competencies necessary in professional activity; development of students' psychological thinking and systematization of their knowledge based on the study of general psychological laws.
Objectives of mastering the discipline: 1) mastering basic psychological concepts, theories and approaches to the study of personality and society; 2) the formation of ideas about the basic principles of the functioning of socio-psychological phenomena, psychological patterns of age and cultural socialization of a person, factors of his learning and cognitive development; 3) instilling the skills of using the knowledge gained in the process of mastering psychology in professional activity. 4) to develop the skills and abilities of analytical and research thinking, creative development of the content of psychological sources of foreign and domestic authors and methods of obtaining psychological information; 5) the formation of critical thinking skills and the ability to apply it in practice

BRIEF DESCRIPTION OF THE COURSE
The discipline "Psychology" examines the patterns of the emergence, development and functioning of mental processes, states, personality traits involved in this or that activity, the patterns of development and functioning of the psyche as a special form of life. The study of this discipline is aimed at the formation of psychological culture, worldview, self-awareness, psychological thinking of the individual for social and professional interaction.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
know: characterization of psychology as a science, its methods, tasks and history of development; the essence and structure of the emergence and development of the psyche and mental phenomena, taking into account the age and social characteristics of manifestation; general psychological patterns of development of psychological phenomena; knowledge of the psychological laws of communication and interaction of people; the dynamics of development and structure of personality and human activity;
be able to: understand and explain the need for psychological and socio-psychological knowledge in professional activities; to analyze the main categories of psychology, interpersonal relationships in a group, the characteristics of the activities of various individuals; to apply psychological knowledge as a means of self-knowledge and self-development; to design effective methods of work in various spheres of social communication based on the content of psychological theories and ideas;
own: skills of argumentation, focused on achieving high results of educational and professional activities. the ability to work in a team, correctly defend one's point of view, propose new solutions, find compromises; skills of systemic thinking and holistic perception of psychological reality; the ability to analyze and form judgments about the psychological problems of a person in the modern conditions of the development of society.

Processes of ore preparation and equipment
CODE – MET502
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to provide students with fundamental knowledge in the field of ore preparation processes, as well as performing calculation tasks and making design decisions.
Course objectives: the development of theory students practice processes of ore dressing and processing various types of mineral raw materials; skills-active use of technical literature in the study of disintegration; skills active use reference for calculations used in ore processing.

BRIEF DESCRIPTION OF THE COURSE
Ore preparation is widely used in the processing of ferrous and non-ferrous metals, rare metal and gold-containing raw materials, as well as non-metallic raw materials, construction materials and other areas of the national economy of the Republic of Kazakhstan. In this course, you will learn in detail the technological processes of ore preparation and enrichment, the design of the equipment used, methods of calculation and selection of main and auxiliary equipment, operation of crushing and grinding equipment.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After studying the discipline, students must:
be able to: navigate the variety of processes and devices used in ore preparation; perform technological calculations of schemes and choose equipment for ore preparation; design technological and hardware schemes; use scientific and technical and advertising literature for acquaintance and analysis of new technologies and devices.
have a spatial understanding of the structures of crushing and grinding equipment.

Theory of metallurgical processes II
CODE – MET596
CREDIT – 5(2/1/0)
PREREQUISITE – MET619

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course: to Form a systematic understanding of theoretical fundamentals and technologies of modern hydrometallurgical methods for complex extraction of metals from ore and metallurgical industrial products, to prepare the student to work independently on the analysis of technological processes and methods of improving the technology.
The purpose of the course: basic laws of thermodynamics, mechanism and kinetics of the main hydro - and electrometallurgical processes; to help students gain skills in performing laboratory work; to teach them to solve typical problems and paint reaction equations, which contributes to the informal assimilation of theoretical material.

BRIEF DESCRIPTION OF THE COURSE
The Course "theory of metallurgical processes II" examines the main processes and operations in hydrometallurgy. Theoretical bases and technological schemes of leaching processes. Thermodynamics and kinetics of leaching processes. Non-oxidative and oxidative leaching of metallurgical raw materials. Hydro-and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of deposition processes of poorly soluble compounds. Fundamentals of hydro-and electrometallurgical processes. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and obtaining metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
to know: about the ways of intensification of hydro - and electrometallurgical processes, methods of critical analysis of the current level of technologies; about the theoretical laws and practice of the main hydro - and electrometallurgical processes.
be able to: direct engineering efforts to create effective hydro - and electrometallurgical technologies, based on the analysis of the technological process, suggest ways to improve the technology, choose methods for implementing the tasks, choose and justify the hydrometallurgical scheme for processing specific metallurgical raw materials;
possess the following skills: skills of performing calculations on thermodynamics and kinetics of hydro-and electrometallurgical processes, substantiating the choice of processes and requirements for their hardware design, predicting the indicators of certain specific processes and trends in the development of technologies for processing ore and man-made raw materials.

Metallurgy of heavy non-ferrous metals
CODE – MET503
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the main methods for obtaining heavy non-ferrous metals.

BRIEF DESCRIPTION OF THE COURSE
Technological and theoretical bases of metallurgical processes of production of copper, Nickel, lead and zinc. Properties of these metals and their compounds, preparation of raw materials for metallurgical processing. Pyrometallurgical and hydrometallurgical methods of processing: roasting, smelting, fire refining, leaching, cleaning solutions, electrolysis and their hardware design. Methods for processing industrial products and new technologies to increase the complexity of the use of heavy non-ferrous metals in metallurgy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must know the physical and chemical properties, applications, characteristics of the technology for producing heavy non-ferrous metals, sources and main processes of processing raw materials.

Gravitational methods of enrichment
CODE – MET505
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to master the theory and practice of processing various types of mineral raw materials using gravitational enrichment processes, as well as to instill skills of active use of reference literature for calculations of the applied processes. The subject is a special one, so a bachelor's degree in metallurgy (specialization in mineral processing) must be fluent in the field of gravitational mineral processing.

BRIEF DESCRIPTION OF THE COURSE
Outline: In this course, you will learn in detail: the Theoretical foundations of gravitational enrichment; hydraulic and pneumatic classification Processes and devices; Enrichment in heavy environments; deposition Enrichment; Enrichment in a stream of water flowing on an inclined surface; Pneumatic enrichment; washing of ores.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
In this course, the student must:
to know the place and the role of the gravitational methods of concentration in mineral processing; theoretical bases of processes; construction and principles of operation of basic devices used in practice;
be able to determine the parameters of the motion of bodies in environments performance indicator of gravitational processes and regulation principles, performance calculations basic devices.

Flotation methods of dressing
CODE – MET507
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495, PHY111, PHY112, MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to prepare students to work at enterprises, research institutes and laboratories related to the processing of ores by flotation methods of enrichment, which are the main ones for the enrichment of non-ferrous metals, Apatite, fluorite, and other types of mineral raw materials.
The task of studying the discipline is to gain students ' knowledge in the field of processes and devices of flotation enrichment production, as well as making design decisions.

BRIEF DESCRIPTION OF THE COURSE
The physical and chemical bases of the flotation process are considered. Reasons for the appearance of free energy at interphase boundaries. The application of flotation agents to regulate the energy change at the phase boundary. Adsorption processes on phase sections. Classification of flotation agents and their role in flotation. Mechanism of action of reagents. Flotation machines, features of their design and application. Flotation schemes of enrichment. Brief information about the use of reagents for flotation enrichment of various types of ores.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Technological equipment that is used for flotation. Physical and chemical bases of formation of mineralized air bubbles and their fixing on the phase section T:J. Flotation reagents and their interaction with the surface of minerals. Rapid determination of the type and quantity of photoreagents for a given ore. Technological schemes of flotation of various types of ores. Selection and justification of flotation ore dressing schemes. Selection of the necessary flotation equipment. Calculation of the technological scheme of flotation enrichment, taking into account the productivity of the factory.

Metallurgy of ferrous metals
CODE – MET509
CREDIT – 5 (2/0/1)
PREREQUISITE – MET500

PURPOSE AND OBJECTIVES OF THE COURSE
The objectives of the discipline are as follows: familiarity with the main metallurgical processes used in the production of ferrous metals; familiarity with modern technologies for the preparation and processing of metallurgical raw materials and aggregates for their implementation, directions for their improvement, including in terms of environmental friendliness, efficient use of energy resources and the possibility of waste-free production; familiarity with the theoretical foundations and description of specific metallurgical processes, the basics of technological calculations, selection of raw materials and selection of equipment, the main indicators of processes.
Objectives of the discipline: formation of an idea about the history of the development of ferrous metallurgy, the place and importance of ferrous metal production in the modern world; formation of a system of knowledge about the basic concepts, technological processes, metallurgical aggregates and methods of organizing metallurgical production; formation of skills to calculate the technological parameters of metallurgical processes; formation of skills of independent work, organization of research work.

BRIEF DESCRIPTION OF THE COURSE
History, current state and trends in the development of ferrous metallurgy. The history of the development of metallurgy. Modern methods for producing cast iron, steel and ferroalloys. Objective conditionality of the appearance of Converter, open-hearth and electric steelmaking methods. Structure and products of steelmaking. Integrated and mini-factories. The role of the electric steelmaking method at different stages of development. Trends and prospects for the development of steelmaking. Place and role of special electrometallurgy. Raw material base of ferrous metallurgy. The main minerals, the quality of the ore, and the availability of iron, manganese, and chromium ores for metallurgical enterprises. The main deposits of coals and fluxes. Preparation of raw materials for melting. Getting coke, coke battery. Preparation of ores for smelting. Crushing, separation, and ore dressing. Production of agglomerate and pellets. Processes occurring during sintering of agglomerate and firing of pellets. The smelting of iron. The device of the blast furnace. The principle of operation of the blast furnace. Processes occurring in the blast furnace. Reduction of iron, manganese and silicon in a blast furnace. Behavior of other elements in the furnace. Processes of slag formation in a blast furnace. Intensification of blast furnace melting. Smelting of carbonaceous ferromanganese in a blast furnace. Technologies of coxless production of cast iron and steel. Non-straw production of cast iron. COREX-process. Processes for direct production of metallic iron from ore. The MIDREX process, HILL. Ferroalloys. Appointment. Methods for obtaining ferroalloys. Ore recovery and refining furnaces. Production of ferrosilicon, ferrochrome, and ferromanganese in ore recovery furnaces. Steel production. General information. The range of steel to be smelted. Raw materials for steel smelting. Cast Iron. Scrap. Slag-forming. Other material. Requirements for source materials. Preparation of the metal charge for melting. Steel smelting in an oxygen Converter (CC). The device and principle of operation of the QC. Heat source in the CC. Chemical reactions occurring in the CC. Interaction of a gas jet with a metal melt. Changes in the composition of metal and slag during purging. Features of the process with bottom and combined purge. Features of conversion of vanadium-containing cast iron. Control of Converter melting. Steel production in electric arc furnaces (EAF). Heating of metal by an electric arc. Plasma arc. Plasmatrons. The device of a modern arc steel furnace. Design features of DC

chipboard. Intensification of melting in chipboard. Technology of semi-product melting in chipboard. Remelting of doped waste into chipboard. Extra-heat treatment of steel. The need to separate the stages of steel smelting and finishing. Out-of-batch processing goals. Treatment of steel with gases, vacuum and synthetic slags. Out-of-batch processing units. Ladle-furnace. Installation of vacuum degassing. Circulation vacuum cleaner. Combined installations. Casting of steel. Pouring into the lids. Structure of a calm and boiling steel ingot. Continuous casting of steel. Continuous steel casting machines, types of CMMS. The combination of casting and rolling. Casting and rolling modules. Special electrometallurgy. Goals and objectives. Electroslag. Additive technologies in metallurgy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know the basic concepts, principles and technologies in metallurgy, the basic formulas and methods of calculation of metallurgical furnaces and equipment, the main regularities of technological processes to improve the efficiency of production of ferrous metals-the basis of the theory of automatic control.
be able to implement and correct technological processes in metallurgy and material processing.
master the methods of calculating the charge for melting, oxygen-Converter, electric-furnace and open-hearth shops, the method of selecting the optimal melting modes and material processing technology.

Metallurgical heat engineering
CODE – MET620
CREDIT – 5 (2/1/0)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to acquire students ' knowledge in the field of heat engineering processes, as well as the theory of metallurgical furnaces, familiarization with the designs of furnaces, heat exchangers and heat generators, the ability to calculate fuel Gorenje, heat transfer characteristics, make thermal balances of metallurgical furnaces.
The objectives of the discipline are to master the basic laws of technical thermodynamics and various types of heat transfer, the types and principles of heat transfer, the modes of movement of gases and liquids, the main types and characteristics of heat exchange equipment.

BRIEF DESCRIPTION OF THE COURSE
Technical thermodynamics. Introduction to metallurgical heat engineering. Heat generation due to chemical energy of fuel and electricity. The main provisions of the theory of heat transfer. Heat transfer by thermal conductivity. Heat transfer by convection. Heat exchange by radiation. Mechanics of liquids and gases. Fundamentals of similarity theory and modeling. Fundamentals of the General theory of furnaces. Thermal operation and design of roasting and drying furnaces. Melting and casting furnaces. Refractory material. Power equipment. Use of secondary energy resources.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: about heat generation due to the chemical energy of fuel and electricity; about the types and principles of heat transfer; about the modes of movement of liquids and gases; about the classification of metallurgical furnaces; about the typical operating modes of metallurgical furnaces, heat exchangers, heat generators and heat recuperators; the main characteristics of drying, roasting and melting furnaces; the main types of mechanical and auxiliary equipment;
Gorenje Gorenje: be able to: calculate the main parameters of fuel combustion; calculate the head loss when moving gases in the flue system; evaluate the completeness of fuel combustion and air consumption for its combustion; determine the fire resistance and thermal stability of refractory materials and products; determine the humidity, yield of volatile components and ash content of solid fuel;
have skills: experimental determination of a number of thermal parameters; experimental study of characteristics of refractory materials; calculate heat exchange equipment.

Metallurgy of light metals
CODE – MET504
CREDIT – 5 (2/1/0)
PREREQUISITE – MET500

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the main technologies for producing light metals.

BRIEF DESCRIPTION OF THE COURSE
Methods of opening ores, concentrates, industrial products containing light metals. Processing of light metal compounds by hydro-and pyrometallurgical methods of concentration, separation in order to obtain pure compounds and their further processing by rectification, electrolysis, and thermal processes.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: physical and chemical properties, applications, characteristics of light metal production technology, sources and main processes of raw materials processing.
be able to: analyze methods for obtaining light metals.

Theory and technology of steelmaking processes
CODE – MET513
CREDIT – 5 (2/0/1)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
Give students knowledge about the main theoretical and technological aspects of obtaining ferrous and non-ferrous metals and alloys, as well as knowledge and skills necessary for managing technological processes in steelmaking shops, rational operation of units, disclosure of new reserves for improving Converter and hearth processes.

BRIEF DESCRIPTION OF THE COURSE
Steel production is the second stage of a two-stage scheme for extracting iron from ores by converting cast iron and metal waste into steel. The essence of steelmaking processes consists in the oxidation of impurities of cast iron and steel scrap (carbon, silicon, manganese, phosphorus, and others) with iron oxides of slag, iron ore, pure oxygen or air oxygen and bringing the composition of the liquid metal to the composition of grade steel, followed by its deoxidation and alloying.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
The student must:
know: about the current trends in the development of technology for obtaining ferrous metals and metal powders, the applicable equipment and features of processes; about methods of non-straw production of iron; the structure of the steelmaking bath and the reaction zone and the features of phenomena in it; dynamics of the oxidation of impurities; temperature and slag mode of melting; varieties of melting technology in oxygen converters and other units of this type.
be able to: evaluate technological features of processes; perform analysis, selection and calculations of charge, processing parameters; perform technological calculations.

Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing
CODE – MET515
CREDIT – 5 (2/1/0)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course: to Form a systematic understanding of theoretical fundamentals and technologies of modern hydrometallurgical methods for complex extraction of metals from ore and metallurgical industrial products, to prepare the student to work independently on the analysis of technological processes and methods of improving the technology.
The purpose of the course: basic laws of thermodynamics, mechanism and kinetics of the main hydro- and electrometallurgical processes; to help students gain skills in performing laboratory work; to teach them to solve typical problems and paint reaction equations; which contributes to the informal assimilation of theoretical material.

BRIEF DESCRIPTION OF THE COURSE
Scrap metal as a man-made raw material for metallurgical enterprises. Material and energy saving in the recycling of scrap metal. Technologies for the preparation of ferrous and non-ferrous metals used in metallurgical enterprises. The concept of the elements - "the vagrants". Their influence on the quality of ferrous metal products and metallurgical technologies. Circulation of "vagants" in the technological cycle of metallurgical enterprises. Modern standards of the EU, USA and Japan that take into account the presence of "vagants" in metallurgical raw materials. Preparation of man-made energy resources. Plastics, MSW, waste oils and lubricants. Methods of environmentally safe use of man-made energy resources in metallurgical production.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
to know: about the ways of intensification of hydro - and electrometallurgical processes, methods of critical analysis of the current level of technologies; about the theoretical laws and practice of the main hydro - and electrometallurgical processes.
to be able: to direct engineering efforts on the creation of an effective hydro – and electrometallurgical techniques. based on the analysis of the technological process, suggest ways to improve the technology, choose methods for implementing the tasks; choose and justify the hydrometallurgical scheme for processing specific metallurgical raw materials; based on the analysis of the technological process, suggest ways to improve the technology, choose methods for implementing the tasks.
possess the following skills: skills of performing calculations on thermodynamics and kinetics of hydro-and electrometallurgical processes, substantiating the choice of processes and requirements for their hardware design, predicting the indicators of certain specific processes and trends in the development of technologies for processing ore and man-made raw materials.

Powder metallurgy
CODE – MET623
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE127, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Develop knowledge, skills and abilities in the field of powder metallurgy and their application in professional activities.
Objectives of the course: to transfer the basic theoretical knowledge of the course "Powder metallurgy"; to teach to solve typical problems in the field of obtaining powder materials; to form students ' analytical thinking skills in the field of powder metallurgy technology.

BRIEF DESCRIPTION OF THE COURSE
The course "Powder metallurgy" examines the main technological patterns of obtaining metal powders, their properties, methods of quality control of powder materials and the use of metal powders for the manufacture of molded and sintered products.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
In the result of mastering the discipline a student should:
know: the main methods of obtaining powder materials; principal equipment for production of powder materials; information about the properties of powder materials and their dependence on methods of preparation, and properties of the original substances; methods of quality control of powder materials;
be able to: solve problems using the acquired knowledge, choose and justify the technological scheme for obtaining a specific powder material; based on the analysis of technological processes, suggest ways to improve the technology for obtaining powder materials;
possess skills: comparative analysis of various methods of obtaining powder materials and properties of the resulting powder materials; formulation of conclusions about the effectiveness of the process as a whole and its individual technological operations, based on the analysis of the technological process.

Experimental bases in metallurgy
CODE – MET624
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE127, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form knowledge, skills and abilities in the field of metallurgical experiment techniques and their application in professional activities.
Objectives of the course: to transfer the basic theoretical knowledge of the course "Experimental foundations in metallurgy"; to teach to solve typical tasks for the implementation of metallurgical experiment;
to form students ' practical skills in the laboratory of research of metallurgical processes and systems.

BRIEF DESCRIPTION OF THE COURSE
The course examines the main methods and techniques of working in the laboratory, research of metallurgical processes and systems, introduces the main metallurgical processes associated with the production of metals and their compounds.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: the procedure for conducting experimental work in metallurgy; methods for calculating and controlling the main technological parameters when performing works related to metallurgical experiments; design features of laboratory equipment and principles of its operation;
be able to: make analytical calculations when setting up a metallurgical experiment and processing the results obtained; make a competent justification for the choice of reagents and equipment for conducting experimental work in the field of metallurgy;
possess the skills to: perform experimental work in the field of pyro -, hydro - and electrometallurgical processes; analyze the results of metallurgical experiment and formulate appropriate conclusions; rational use of equipment and materials and organization of metallurgical experiment.

Magnetic and special methods of enrichment
CODE – MET516
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to master the theory and practice of processing various types of mineral raw materials using magnetic and special enrichment processes, as well as to instill skills of active use of reference literature for calculations of the applied processes. Students specializing in the field of mineral processing acquire knowledge of the theory, technology and practice of enrichment, as well as the study of devices used for processing various ores, skills in setting up and operating laboratory and industrial equipment, skills in setting up research works in the field of ore dressing of complex material composition.

BRIEF DESCRIPTION OF THE COURSE
Magnetic properties of minerals, Theory of magnetic fields of magnetic separators. Classification of magnetic separators. Structure and dynamics of movement of mineral particles in them. Practice of using magnetic separators and auxiliary devices. Obtaining artificial concentrates from mineral raw materials that cannot be enriched. The combined processes of processing of mineral raw materials (a combination of the processes of enrichment and metallurgical operations). Finishing of substandard concentrates.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Know the theoretical principles of separation of minerals in magnetic fields, technologies of specific methods of enrichment, sorting, chemical enrichment, leaching. Existing equipment for magnetic enrichment, equipment for performing special enrichment processes, be able to calculate and select the necessary equipment, have practical skills in adjusting the equipment.

Flotation reagents in mineral processing
CODE – MET517
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE127, MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline: the development of students ' holistic natural science dialectical worldview, logical chemical thinking, the ability to professionally understand the issues of modern chemistry and chemical technology, environmental protection, industrial and environmental safety, enrichment and, in particular, flotation of minerals (minerals and ores), as well as to acquire skills in the use of special flotation reagents in the flotation of coal and minerals.
Tasks in the study of the discipline: development of students ' ability to accept the acquired knowledge to solve technical and technological problems and prepare students for the perception of the educational material of special courses.

BRIEF DESCRIPTION OF THE COURSE
Basic theories of flotation in its current state. The methods of investigation of the action of flotation reagents and the mechanism of the flotation process are described in detail, as well as the processing of the results obtained. The basics of the theory and practice of using flotation reagents for flotation of non-ferrous ores and their accompanying rare metals are described. The structure and composition, physical and chemical properties of reagents are described.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
The student must:
know: chemical, physical and physico-chemical properties of flotation reagents (collectors, foaming agents, depressors, activators, regulators of the medium and ion composition, modifiers, and so on), their cleaning, transportation, storage and application (use).
be able to: use flotation reagents for flotation of minerals, ores, and coal, as well as correctly select flotation reagents for various types of flotation (minerals, coal, and so on); correctly select medium regulators and ion composition regulators.

Special electrometallurgy
CODE – MET518
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the basics of theoretical and applied electrochemistry, as well as technologies for refining and deposition of non-ferrous metals by special electrometallurgical methods.

BRIEF DESCRIPTION OF THE COURSE
Basic laws of theoretical and applied electrochemistry. Technological bases of electrofining and electrodeposition of non-ferrous metals in aqueous and molten media, electroplating of the surface of products, as well as the production of metal powders under electrolysis conditions.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: theoretical foundations and technology of electrolysis processes of water solutions and molten salts, as well as electroplating; design features of devices and units of electrolysis baths.
be able to: apply the knowledge gained in the field of using traditional and modern electrometallurgical processes for the production of non-ferrous metals; work with equipment designed for the electrolytic production of metals from aqueous solutions and molten salts; make calculations to determine the energy and technological parameters of electrolysis; choose cost-effective process parameters.

Recycling of fine industrial waste
CODE – MET520
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "Recycling of fine industrial waste" is to form students ' knowledge about the technological features of metallurgy of man-made raw materials; modern processes of production of non-ferrous and ferrous metals from man-made waste, ensuring the integrated use of raw materials, environmental protection, resource, energy conservation and waste elimination.

BRIEF DESCRIPTION OF THE COURSE
The market of anthropogenic fine materials. Fine solid household and industrial waste. Ash and slag waste. The concept of "shredding" technologies. Shredders. Composition and metallurgical characteristics of "shredding" dusts. Meal, "heavy" and "light" fraction of shredding dust. Development and prospects of shredding technology. Compacting, briquetting, and pelletizing of fine man-made materials. The role of ash and slag accumulators in the structure of a modern ferrous metallurgy enterprise. Sludge processing technologies: current state and prospects. Agglomeration and production of pellets using man-made and secondary materials.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: sources of technogenic waste generation; qualitative and quantitative characteristics of technogenic raw materials; methods of preparation of technogenic waste for metallurgical processing and the main technological schemes of their processing;
be able to: analyze the main sources of technogenic waste of non-ferrous and ferrous metals; evaluate and compare various ways of processing them; perform appropriate metallurgical calculations; select and calculate the main and auxiliary equipment for processing technogenic waste.

Corrosion and protection of metals
CODE – MET625
CREDIT – 5 (2/1/0)
PREREQUISITE – MET500, MET619

PURPOSE AND OBJECTIVES OF THE COURSE
Formation of knowledge about the interaction of metals with the environment, the mechanism of this interaction and appropriate methods of protection against corrosion.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students gain skills in performing laboratory work; to make an informed choice and calculation of methods of protection against corrosion; to use physical and chemical laws to predict the corrosion resistance of metal materials in gas and liquid environments.

BRIEF DESCRIPTION OF THE COURSE
Classification of corrosion processes. Fundamentals of the theory of chemical corrosion of metals. Films on metals. The law of growth of a porous (unprotected) film on metals. Growth of a solid (protective) film on metals. The mechanism of diffusion in the protective films. Electrochemical corrosion of metals. Electrode potentials of metals. Thermodynamics of electrochemical corrosion of metals. Polarization. Secondary processes and products of electrochemical corrosion of metals. Corrosion processes with oxygen and hydrogen depolarization. Calculation of the electrochemical corrosion process. Passivity of metals. Atmospheric corrosion. Methods of protection against chemical corrosion. Methods of protection against electrochemical corrosion.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: basic laws and concepts of chemical and electrochemical corrosion; thermodynamics and kinetics of corrosion processes; basic methods of metal protection from chemical and electrochemical corrosion;
be able to: determine and calculate the probability and mechanism, rate of metal corrosion in gas and liquid process environments; choose a method of corrosion protection depending on the operating conditions and the purpose of the metal and structure;
master the skills: evaluate the corrosion resistance of metals with indicators and points; determine the influence of internal and external factors on the rate of corrosion.

Technology of composite materials
CODE – MET626
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE127

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Develop students ' knowledge and skills about composite materials, to train specialists in the field of composite materials technology who have and understand their properties, methods of developing compositions, and features of the production technology of basic composite products.
The purpose of the course: to form a General knowledge of the technology for obtaining composite materials: to familiarize them with modern methods for determining the properties and technologies for obtaining various composite materials, and their areas of application. teach to solve typical tasks for determining the physical, chemical and mechanical properties and other parameters of composite materials; give knowledge of the management of technological processes for the production of composite materials.

BRIEF DESCRIPTION OF THE COURSE
The course "Composite materials" examines the main types and properties of composite materials, the main components of composite materials, methods of developing compositions, and features of the production technology of composite materials.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: the most important characteristics of composite materials, understand their properties, methods of developing compositions, features of the production technology of the main products;
be able to: correctly select the source materials that provide the required indicators of reliability, safety, economy and efficiency of structures; analyze the impact of the environment on the material in the structure, set requirements for composite materials and choose the optimal material based on its purpose and operating conditions.
possess skills: modern methods of setting, research and solving problems on composite materials; select compositions, production technologies, finishing, research and quality control of composite materials.

Processes and devices of concentrating production
CODE – MET521
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to provide students with the theoretical foundations of enrichment processes, the design of typical devices and the rules for their maintenance.
Objectives of the course: students ' development of the theory of processes of enrichment of various types of mineral raw materials; instilling skills of active use of technical literature in the study of processes and devices of processing production; study of the design of typical devices.

BRIEF DESCRIPTION OF THE COURSE
The course covers the theoretical foundations of processes, describes the design of typical devices and methods of their calculation, highlights the issues of maintenance of devices.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After studying the discipline, students must:
be able to navigate the variety of processes and devices used in enrichment; perform technological calculations of schemes and choose equipment for enrichment processes; design technological and hardware schemes; use scientific and technical and advertising literature for acquaintance and analysis of new technologies and devices;
have a spatial understanding of the structures of the equipment used for enrichment.

Auxiliary economy in mineral processing
CODE – MET522
CREDIT – 5 (2/0/1)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to obtain knowledge on water and air supply of technological processes of enrichment and water and air supply equipment at processing plants, transportation of products, bunkering, storage of raw materials and processed products in the technological process and lifting and transport devices, bunkering and repair facilities of processing plants.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies the devices and operation of water supply, air supply, transport of products at processing plants, the theoretical basis of dewatering and dust collection processes, the design and operation of devices used for drainage, centrifugation, condensation, filtration, drying and dust collection. Methods for selecting and calculating the main auxiliary equipment and dewatering schemes are considered. Relationship of auxiliary economy with technological processes of enrichment. Methods of calculation and selection of auxiliary equipment, as well as the structure of the auxiliary economy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After taking this course, the student must:
know the place and role of auxiliary facilities in the production activities of processing plants, water and air processing processes, hydraulic transport of processing products, pumps and air supply devices, transport machines and mechanisms for the displacement of processing products, bunker and repair facilities of processing plants. Dewatering, dust collection in the schemes of mineral processing, the theoretical basis of the processes; the design and principle of operation of the main devices used in practice.
be able to determine the parameters that characterize the dewatering process, the principles of regulation and calculation of the performance of the main devices.

Heat power engineering of metallurgical processes
CODE – MET622
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "heat And power engineering of metallurgical processes" is to give students a deep knowledge of the processes of heat and mass exchange occurring in the production of sinter and pellets, in a blast furnace, converters, electric furnaces; about heat sources in sintering, blast furnace, steelmaking processes, the process of firing pellets.
The objectives of the discipline are to master the General laws of heat and mass transfer processes occurring in metallurgical units; to master methods for calculating the thermal balance of sinter, cast iron, steel and ferroalloys production processes;the energy balance of electric furnaces.

BRIEF DESCRIPTION OF THE COURSE
Heat and power engineering of the agglomeration process. Heat energy of pellet firing. Heat power engineering of the domain process. Heat exchange in a blast furnace. Heat transfer in the layer of lump materials. Factors affecting heat exchange processes. Heat power engineering of Converter production. Laws of mass and heat transfer. Mass and heat transfer in the baths of steelmaking units. Thermal balance of oxygen-Converter melting. The thermal losses of the converters. Influence of technological parameters on the thermal operation of converters. Heat power engineering of electric steelmaking processes. Features of thermal operation of electric stoves. Energy balances of electric furnaces. Features of thermal operation of Ferroalloy furnaces.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: General laws of heat and mass transfer processes occurring in metallurgical aggregates;
be able to: calculate the thermal balance of sinter, cast iron, steel and ferroalloys production processes; the energy balance of electric furnaces.
possess the following skills: fuel analysis and selection of thermal power plants, analysis of technological processes: agglomeration, blast furnace, steelmaking, electric steelmaking and Ferroalloy production.

Metallurgical engineering (in English)
CODE – MET621
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE127

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to acquire students ' knowledge in the field of theory of metallurgical processes, basic methods of mineral processing, classification of metals and metallurgical processes, and technologies, methods for obtaining ferrous and non-ferrous metals, while students perform a critical analysis of domestic and foreign, world literature of metallurgical profile in English.
The objectives of the discipline are to master the basic basics of thermodynamics of oxide systems, the kinetics and mechanism of metallurgical processes, classification of metals, basic schemes for processing ores containing ferrous and non-ferrous metals, to gain skills in metallurgical calculations.

BRIEF DESCRIPTION OF THE COURSE
Composition and properties of the gas phase. Thermodynamics of metallurgical processes. Theory of dissociation and strength of chemical compounds. Structure and properties of oxide and metal melts. Fundamentals of interaction of metal and oxide phases. The kinetics of the processes. Preparation of raw materials for the metallurgical process. Classification of metals. Metallurgy of ferrous metals. Production of cast iron and steel. Metallurgy of non-ferrous metals. Hydrometallurgy. Pyrometallurgy. Metallurgical calculations.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: in English, the terminological minimum on metallurgy, know about the composition and properties of the gas phase; about the theory of dissociation and strength of chemical compounds; about the structure and properties of oxide and metal melts; about the basics of interaction of metal and oxide phases;
be able to: use programs for thermodynamic calculations, the program for calculating kinetic parameters and kinetic modeling.
have the following skills: setting up a metallurgical experiment, analyzing the experiment, and presenting the results (graphic design of the results).

Metallurgy of secondary raw materials
CODE – MET508
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495, MET500, MET619

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course: to Form a systematic understanding of theoretical fundamentals and technologies of modern hydrometallurgical methods for complex extraction of metals from ore and metallurgical industrial products, to prepare the student to work independently on the analysis of technological processes and methods of improving the technology.
The purpose of the course: basic laws of thermodynamics, mechanism and kinetics of the main hydro- and electrometallurgical processes; to help students gain skills in performing laboratory work; to teach them to solve typical problems and paint reaction equations; which contributes to the informal assimilation of theoretical material.

BRIEF DESCRIPTION OF THE COURSE
The course "secondary raw materials metallurgy" examines the main processes and operations in hydrometallurgy. Theoretical bases and technological schemes of leaching processes. Thermodynamics and kinetics of leaching processes. Non-oxidative and oxidative leaching of metallurgical raw materials. Hydro-and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of deposition processes of poorly soluble compounds. Fundamentals of hydro-and electrometallurgical processes. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and obtaining metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
to know: about the ways of intensification of hydro - and electrometallurgical processes, methods of critical analysis of the current level of technologies; about the theoretical laws and practice of the main hydro - and electrometallurgical processes.
to be able: to direct engineering efforts on the creation of an effective hydro – and electrometallurgical techniques. based on the analysis of the technological process, suggest ways to improve the technology, choose methods for implementing the tasks; choose and justify the hydrometallurgical scheme for processing specific metallurgical raw materials; based on the analysis of the technological process, suggest ways to improve the technology, choose methods for implementing the tasks.
possess the following skills: skills of performing calculations on thermodynamics and kinetics of hydro-and electrometallurgical processes, substantiating the choice of processes and requirements for their hardware design, predicting the indicators of certain specific processes and trends in the development of technologies for processing ore and man-made raw materials.

Metallurgy of precious metals
CODE – MET510
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE127, MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the main methods for obtaining precious metals.

BRIEF DESCRIPTION OF THE COURSE
Properties and applications of precious metals and their compounds. Sources of raw materials and the history of mining of precious metals (gold and silver). Types of ores, minerals, processing and preparation of raw materials for metallurgical processing. Theoretical bases and practice of processes of opening (decomposition) of minerals of indigenous and alluvial ores and extraction of precious metals from them. Refining of precious metals. Hardware design of the main processes. Methods of associated extraction of precious metals from industrial products and waste of metallurgical production. New technologies in the metallurgy of precious metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: physical and chemical properties, applications, characteristics of the technology for obtaining precious metals, sources and main processes for processing raw materials.
be able to: work with literature and analyze the processes of obtaining precious metals.

Basics of scientific research in metallurgy
CODE – MET553
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the basics of scientific research in metallurgy.

BRIEF DESCRIPTION OF THE COURSE
The definition of "science". Stages of development of metallurgical science in Kazakhstan. Organization of scientific research in the Republic of Kazakhstan. Forms of research and development, their significance. Methodological foundations of scientific knowledge. Processing and storage of scientific information. Stages of scientific research. Sampling and sample preparation, setting up a metallurgical experiment. Types and classification of scientific documentation. Errors, errors and their exclusion, correlation analysis of experimental data. Registration of scientific documentation, presentation of research results. Efficiency and implementation of scientific developments. Directions of research in metallurgy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: stages of research, efficiency and implementation of scientific developments and research directions in metallurgy.
be able to: work with laboratory installations and conduct scientific experiments, as well as prepare scientific documentation.

Technology of processing of technogenic waste
CODE – MET554
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET596, MET508

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "Technology of processing of man-made waste" is to form students ' knowledge about the technological features of metallurgy of man-made raw materials; modern processes of production of non-ferrous and ferrous metals from man-made waste, ensuring the integrated use of raw materials, environmental protection, resource, energy conservation and waste elimination.

BRIEF DESCRIPTION OF THE COURSE
The course "Technology of processing technogenic waste" examines the main ways of processing technogenic raw materials of some heavy non-ferrous, noble, light and rare metals. In particular, the main sources of waste generation, their classification and characteristics are considered. Modern schemes are given, the design of the main and auxiliary equipment for waste preparation for metallurgical processing is described. Modern pyro - and hydrometallurgical methods of processing man-made waste, the main technological schemes and hardware design of processes for the production of major heavy, rare, light and precious metals from lump waste, slags, dusts, slurries, industrial solutions and a number of other man-made waste are highlighted.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: sources of technogenic waste generation; qualitative and quantitative characteristics of technogenic raw materials; methods of preparation of technogenic waste for metallurgical processing and the main technological schemes of their processing;
be able to: analyze the main sources of technogenic waste of non-ferrous and ferrous metals; evaluate and compare various ways of processing them; perform appropriate metallurgical calculations; select and calculate the main and auxiliary equipment for processing technogenic waste.

Receive, the quality and certification of by-products in the process of recycling
CODE – MET555
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET596, MET508

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is to form students ' systematic knowledge about the basics, technological features and hardware design of the main pyrometallurgical processes - roasting, smelting of ore and secondary raw materials and refining of metals.
The purpose of the course is to provide students with: theoretical knowledge of the main pyrometallurgical processes; theoretical knowledge of the processes of firing of sulfides, metal oxides: oxidizing, sulfidating, sulfatizing, chlorinating, etc.; theoretical knowledge of the melting processes; practical skills in conducting thermodynamic analysis of the firing and melting processes, practical skills in performing technological calculations of the firing and melting processes.

BRIEF DESCRIPTION OF THE COURSE
Features of metallurgical processes during smelting "for slag". Blast furnace melting using man-made materials and production of slag of a given composition. Regularities of mass exchange between metal and slag. The formation of neutral compositions of the elements of "vagrants". Associated products of coking chemical production. Application of fine carbon-containing technogenic materials in the production of coke. Slag processing. Glazing of potentially dangerous and toxic compounds. Production of metallurgical gases of a given composition using man-made raw materials. Quality and certification of associated products.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: theoretical bases of firing and melting processes; main technological equipment of firing and melting processes; current situation and development of processes at operating metallurgical enterprises; working principle and features of the structure of equipment for their implementation; methods of selection and calculation of melting and firing processes.
be able to: analyze existing and projected processes; justify the choice of the type of firing and melting, equipment depending on the composition of the initial metal-containing raw materials; evaluate the speed of individual stages, identify speed-limiting links of simple and complex processes of firing and melting; predict the indicators of processing of ore and man-made raw materials.
possess the skills: perform technological calculations for firing and melting, apply the knowledge gained in practice.

Consumer properties of metallurgical products
CODE – MET590
CREDIT –5 (2/0/1)
PREREQUISITE – MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: Formation of systematic knowledge, skills and abilities on consumer properties, technology requirements, physical and chemical properties and demand for metallurgical products of various metallurgical processing, on the main methods of management and quality control of metallurgical products.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to form students ' analytical thinking skills on the analysis of data on the quality and consumer properties of metallurgical products.

BRIEF DESCRIPTION OF THE COURSE
The course examines the classification of metallurgical products, quality control methods, requirements for consumer properties of metallurgical products, fixed in the system of standardization and certification, the specifics of consumer properties of metallurgical products used in the nuclear industry. The types of metal products, requirements for their quality, information about metallurgical products of the Republic of Kazakhstan, its consumer properties, demand and consumption of products on the domestic and world markets are considered. All methods and technologies used for the process of management and quality control of metallurgical products are considered.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: about the consumer properties of metallurgical products and the requirements imposed by consumers; types of metallurgical products of the Republic of Kazakhstan, the state of the metallurgical industry in terms of demand in the domestic and world markets;
be able to: solve situational problems related to the use of metallurgical products, depending on their quality and properties;
possess the following skills: analysis of data on the quality, design, chemical, physical and consumer properties of metallurgical products.

Geotechnologies in metallurgy
CODE – MET591
CREDIT – 5 (2/0/1)
PREREQUISITE – MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form systematic knowledge, skills and abilities in the field of geotechnological methods of processing complex metallurgical raw materials.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to form students ' skills to solve some technological problems in the field of metal Geotechnology.

BRIEF DESCRIPTION OF THE COURSE
The course "Geotechnologies in metallurgy" examines geotechnological concepts and terms, concepts of rock, ore and Deposit, methods and techniques of geotechnologies for extracting metals from the earth's interior. Underground, borehole and heap leaching, the influence of the nature of the reagent on the extraction of metals, the role of bacteria in geotechnological processes, examples of implementation of geotechnological processes for metal extraction in the Republic of Kazakhstan and abroad are considered in detail.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: information about the history of the origin and formation of Geotechnology; classification of methods of Geotechnology and its application in metallurgy; basics of thermodynamics and kinetics in the processes of leaching metals from ore raw materials;
be able to: make technological calculations for the implementation of various types of leaching of ore raw materials; make thermodynamic justification of leaching of ore raw materials using Purbe diagrams;
possess the following skills: in the field of selecting geotechnical methods for processing complex ore raw materials; in the field of preliminary planning of well location schemes in the ore field.

Special and combined methods of enrichment
CODE – MET571
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499, MET502

PURPOSE AND OBJECTIVES OF THE COURSE
Students specializing in the field of mineral processing acquire knowledge of the theory, technology and practice of enrichment, as well as the study of devices used for processing various ores, skills in setting up and operating laboratory and industrial equipment, skills in setting up research works in the field of ore dressing of complex material composition.

BRIEF DESCRIPTION OF THE COURSE
Special methods of mineral processing, ore picking (manual and automatic) to improve the quality of raw materials and isolate valuable minerals. Mineral raw materials that can not be enriched and methods of processing it with the use of combined processes (enrichment and metallurgy). Finishing of concentrates that are conditioned for the base metal, but are rejected for impurities. Processing of collective concentrates obtained by enrichment methods using pyro-and hydrometallurgical operations.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know the theoretical principles of the devices used in the special enrichment method, technologies of specific methods of enrichment, sorting, chemical enrichment, leaching, existing equipment and equipment for performing special enrichment processes;
be able to calculate and select the necessary equipment, have practical skills in the introduction of special equipment adjustment technology.

Fundamentals of scientific research in ore dressing
CODE – MET572
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499, MET502

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is to master the theory and practice of processing various types of mineral raw materials using research work.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies the problems of organizing and staging research works, the choice of the topic of research, the stages and content of research works, the principles of selecting information on the topic of research, planning and setting up an experiment, requirements for publication materials, registration of patent documentation, presentation of scientific results and a report on the topic of research. Familiarity with the biographies of scientists in Kazakhstan and the CIS, the role of scientific research in the formation and development of the enrichment industry.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student should be able to navigate the variety of processes and devices used in enrichment; choose and justify the best options for preparatory, basic and auxiliary enrichment processes for processing various types of mineral raw materials; design technological and hardware schemes; use scientific technical and advertising literature for acquaintance and analysis of new technologies and devices.

Processes and apparatuses in ferrous metallurgy
CODE – MET523
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, PHY111, PHY112, MAT101, MAT102, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
Study of theoretical provisions on the structure and properties of molten metal and slag, the theoretical basis and features of electrometallurgical processes of steel and ferroalloys smelting by traditional methods, the theoretical basis for the development of electrometallurgy. Study of the theoretical foundations of modern processes and devices of pyro-and hydrometallurgical production.

BRIEF DESCRIPTION OF THE COURSE
Characteristics of technologies for producing electric steel and ferroalloys. Thermodynamics of metallurgical melts. Surface phenomena in metallurgical processes. Kinetics of metallurgical reactions.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
A student (bachelor) must:
know: basic concepts and laws of electrometallurgical theory; features of thermodynamics and kinetics of processes of electrometallurgical treatment of metal melts; features and mechanism of processes occurring on the metal-slag interface in the bath of an electric steelmaking unit; ways and methods of improving pyro - and hydrometallurgical processes based on theoretical concepts.
be able to: perform calculations on thermodynamics and kinetics of electrometallurgical processes; analyze a variety of processes, as well as justify the choice of the most appropriate parameters; evaluate the speed of individual stages of electrometallurgical processes and identify limiting links of processes; analyze and summarize the results of research of metallurgical processes, justify the reliability and identify the reasons for their deviations from the expected ones; manage the basic pyro - and hydrometallurgical processes both at the current level and in terms of strategic planning.

Processes and apparatuses in non-ferrous metallurgy
CODE – MET524
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, PHY111, PHY112, MAT101, MAT102, MET619, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to master the basics of knowledge and skills necessary for solving theoretical and practical problems of hydro-mechanical, thermal, mass transfer processes and powder metallurgy, which allow to justify the choice of technological process.
The purpose of the course: students should know the basic laws of technological processes in metallurgy, the device and principles of operation of devices used in the implementation of these processes.

BRIEF DESCRIPTION OF THE COURSE
The discipline "Processes and devices in non-ferrous metallurgy" studies existing and new processes and devices for the production of non-ferrous metals and their chemical compounds.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Students will get the knowledge necessary for solving theoretical and practical problems of hydro-mechanical, thermal, mass transfer processes and powder metallurgy, which will allow them to justify the choice of the technological process and its equipment.
Students will be able to analyze and calculate technological processes, perform structural, energy, and thermal calculations of processes and devices, and use reference literature to justify the choice of a stationary (stable) process and equipment.

Metallurgical furnace
CODE – MET578
CREDIT – 5 (2/0/1)
PREREQUISITE – MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline "Metallurgical furnaces" is to form students ' systematic knowledge of the main types of fuel and its Gorenje, classification and General characteristics of the furnaces, based on materials used in the furnace industry, the course program provides for the study of elements and structures of a number of furnaces used in non-ferrous and ferrous metallurgy.
The objectives of the course are: the acquisition of students ' knowledge about the theory of metallurgical furnaces and practical calculations of thermal aggregates, a positive result of training on 3D atlases of furnaces.

BRIEF DESCRIPTION OF THE COURSE
Classification of furnaces and operating modes. Thermal characteristics of furnaces. Heat balance and fuel consumption. Fire-resistant and heat-insulating materials, construction elements of furnaces. Insulation material. Construction elements of the furnace and materials. Recycling of secondary energy resources. Thermal engineering basics of various methods of waste gas heat utilization. Metallurgical furnace. Fuel furnaces of ferrous metallurgy. Fuel furnaces of non-ferrous metallurgy. Furnaces of ferrous metallurgy with heat generation due to burning out of metal impurities. Non-ferrous metallurgy furnaces with full or partial use of chemical energy of raw materials. Thermal and temperature modes of operation of the furnace for firing sulfide concentrates in the fluidized bed. Thermal and temperature modes of operation of furnaces for melting on matte (autogenous processes). Electric oven. Special furnace. Furnaces of titanium production.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
In the result of mastering the discipline a student should:
know about the types of fuel and its combustion; on the classification of furnaces and their modes of operation; heat the furnaces; materials and elements of furnaces;
be able to: classify furnaces by technological and design features; perform material and heat balances; perform furnace calculations.
have skills: basic theory of furnaces; calculations of furnaces and graphic design of the corresponding calculations using the AutoCAD program, the use of 3D atlases of metallurgical furnaces.
have the following competencies: to choose a thermal unit; to choose materials for the construction of furnaces.

Types of coatings on metals and their production processes
CODE – MET579
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, PHY111, PHY112, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form knowledge, skills and abilities in the field of theory and technology of obtaining coatings on metals.
Objectives of the course: to transfer the basic theoretical knowledge of the course "Types of coatings on metals and their production processes"; to teach to solve typical problems on the processes of obtaining coatings on metals and methods of quality control; to form students ' analytical thinking skills in the field of coating technology, depending on the source materials used and methods for obtaining coatings on metals.

BRIEF DESCRIPTION OF THE COURSE
The course "Types of coatings on metals and processes for their production" examines the classification of coatings on metals, methods and technological features of obtaining coatings on metals, methods of quality control of coatings on metals and applications of coatings on metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: classification of coatings on metals; information about the properties, structure and purpose of coatings on metals; the main methods of obtaining coatings on metals; the main types of equipment for obtaining sputtered, plasma, organic and electroplated coatings on metals;
be able to: evaluate the quality of coatings; solve typical problems in the field of coatings on metals;
possess the skills of: comparative analysis of coatings and methods of obtaining them depending on the specified purpose and purpose of coatings; formulation of conclusions about the effectiveness of processes for obtaining coatings on metals, based on the analysis of the technological process and the properties of the resulting coatings.

Enrichment of gold and uranium ores
CODE – MET526
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE127

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is: to master the theory and practice of methods for extracting gold and uranium from poor and off-balance ore raw materials; to train specialists who can most efficiently implement technological processes for the enrichment of gold and uranium ores, as well as conduct research on these processes.
The objectives of the discipline: obtaining students ' fundamental knowledge in the field of enrichment and processing of gold and uranium ores; performing calculation tasks; making design decisions.

BRIEF DESCRIPTION OF THE COURSE
The course is devoted to the study of technological processes for the enrichment and processing of gold and uranium ores, the design of equipment used and methods for processing concentrates and productive solutions.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
know: spatial representation of apparatus structures;
be able to: navigate the processes of enrichment and processing of gold and uranium ores, as well as technologies for processing concentrates and productive solutions; use scientific and technical literature for acquaintance and analysis of new technologies and devices.

Modeling of enrichment processes
CODE – MET527
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
In enrichment, the purpose of the discipline is to teach students the methods of modeling technological processes and schemes.
Course objectives: to study methods of mathematical modeling; to learn how to make regression equations; to master statistical planning of experiments.

BRIEF DESCRIPTION OF THE COURSE
"Modeling of enrichment processes" is a generalization of students ' knowledge in special disciplines, as well as a mathematical description of technological processes for conducting experiments and studying them on a model.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
know the methods of mathematical modeling in relation to the processes of mineral processing, methods of analysis and mathematical description of the fractional composition of mineral raw materials, separation characteristics of the main concentrators and enrichment schemes;
be able to make regression equations, use methods of mathematical modeling of experiments to optimize the main parameters of the technological process; master statistical planning of experiments; planning of multi-factor experiments using the "steep ascent" method and the simplex method; comparison of different paths to the optimal when planning experiments; basic rules for planning experiments.
This knowledge can be used in the study of mineral raw materials for enrichment in the preparation of technological regulations, in scientific research.
At processing plants, studies using simulation methods allow us to determine the optimal technological indicators.

The alloys of non-ferrous and ferrous metals
CODE – MET528
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET596, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline is to study the main provisions of obtaining alloys of non-ferrous and ferrous metals: aluminum, magnesium, beryllium, titanium, copper, Nickel, chromium, manganese, vanadium of refractory metals, rare earth and radioactive metals and alloys based on them. The course "Alloys of non-ferrous and ferrous metals" provides knowledge about the physical, mechanical, chemical and technological properties of non-ferrous and ferrous metals and alloys based on them, introduces students to modern methods of obtaining them.

BRIEF DESCRIPTION OF THE COURSE
Basic processes of melting of non-ferrous and ferrous metal alloys includes questions of theoretical, technological and constructive nature in the field of traditional and new processes of metallurgy. Acquisition of competence in the analysis of metal production technologies, development of technological schemes and designs of metallurgical units and conducting technological calculations.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: technologies for production of non-ferrous and ferrous metal alloys.
be able to: work with modern equipment that produces alloys of non-ferrous and ferrous metals.

Lead and zinc metallurgy
CODE – MET529
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "metallurgy of lead and zinc" – the formation of students ' knowledge about the technological features of lead and zinc metallurgy; modern processes of production of these metals, ensuring the integrated use of raw materials, environmental protection, resource, energy conservation and waste elimination.

BRIEF DESCRIPTION OF THE COURSE
Technological schemes and physical and chemical bases of processes for obtaining lead and zinc from ores, concentrates and industrial products are considered. Modern pyro - and hydrometallurgical methods of obtaining lead and zinc, the main technological schemes and hardware design of the processes of production of these metals are highlighted. Processes of preparation of raw materials for metallurgical processing, processes of reducing melting in mine furnaces, processes of roasting, leaching, cleaning of solutions from impurities, fire refining, electrolytic refining in water media with the production of commercial lead and zinc are studied. New technologies in the production of lead and zinc are considered.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: raw sources of lead and zinc, as well as their minerals; methods of preparation of lead and zinc-containing raw materials for metallurgical processing and the main technological schemes of their processing to obtain commodity metals;
be able to: select the optimal technology for processing lead - and zinc-containing raw materials from existing methods in specific conditions; propose a basic technological scheme for processing lead-and zinc-containing raw materials that provides a comprehensive extraction of all valuable components (Pb, Zn, Te, Bi, Au, Ag, Co, Cd, etc.); select equipment and the necessary equipment material; take into account environmental issues when choosing the technology, select and calculate the main and auxiliary equipment required in lead and zinc metallurgy.

Heat and mass transfer of metallurgical processes
CODE – MET580
CREDIT – 5 (2/0/1)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form knowledge about the basic provisions of mass and heat transfer; about the basic concepts and ratios of momentum transfer, heat, and matter.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students get skills to perform practical work; to study the main provisions and problems of mass and heat transfer in specific metallurgical processes.

BRIEF DESCRIPTION OF THE COURSE
General information about mass transfer processes, basic concepts and definitions. Ways to Express phase compositions. Balance between phases. The equation of mass transfer. Material balances of mass transfer processes. Mechanism of mass exchange processes. The driving force of mass transfer processes. The speed of mass transfer processes. General information about heat exchange processes, basic concepts and definitions. Heat transfer surface, stationary and non-stationary heat transfer processes, methods of heat transfer. Heat balances. The equations of heat transfer. The main heat transfer equation. Temperature field and temperature gradient. The average temperature difference. Heat transfer by thermal conductivity, radiation, and convection.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: mechanisms of mass-exchange and heat-exchange processes; driving forces of mass-exchange and heat-exchange processes; principles of operation and schemes of mass-and heat-exchange devices;
be able to: make equations and models of mass and heat exchange processes; determine the limiting stages in the processes of mass and heat exchange;
master the skills of: calculating the coefficients of mass and heat transfer; determining the surface of mass and heat transfer.

Processes and devices of powder metallurgy
CODE – MET581
CREDIT – 5 (2/0/1)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Develop knowledge in the field of obtaining powders of metals and alloys, as well as to familiarize yourself with the designs of technological devices and equipment used to produce metal powders.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students gain skills in performing practical work; to familiarize them with the basic technological schemes for obtaining powders, the principles of equipment operation, methods of calculation and selection of technological parameters.

BRIEF DESCRIPTION OF THE COURSE
Production of metal powders by mechanical methods (cutting and crushing). Production of metal powders by mechanical methods (grinding and grinding). Sputtering and granulation of molten media. Obtaining iron powders by reduction methods. Preparation of tungsten and molybdenum powders by reduction methods. The carbonyl method of production of powders of metals. Production of metal powders by electrolysis of aqueous solutions. Production of metal powders by electrolysis of molten media. Production of metal powders by cementation. Production of metal powders by chemical and metallurgical methods. Obtaining powders in plasma, autoclave method, the method of "evaporation-condensation". Obtaining powders of refractory compounds. Production of metal powders. Properties of metal powders and methods for their determination.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: principles of hardware and technological design of basic and auxiliary technological processes and operations for obtaining metal powders; methods of industrial production of metal powders; principles of equipment operation, methods of calculation and selection of technological parameters of processes and equipment for powder production;
be able to: analyze technological processes related to the production of powders, including those involving moving phases; make thermal and material balances of devices for obtaining powders and calculate their basic dimensions;
possess the following skills: determining the properties of metal powders; calculating effective conditions for obtaining powders of a given composition.

Enrichment of polymetallic ores
CODE – MET531
CREDIT – 5 (1/1/1)
PREREQUISITE – MET505, MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is to teach students the theory and practice of polymetallic ore dressing processes and to train specialists who are able to carry out the most efficient technological processes of dressing, as well as to conduct research and perform calculations of polymetallic ore dressing processes.

BRIEF DESCRIPTION OF THE COURSE
Non-ferrous metal ores are complex raw materials and a source of not only color, but also rare, precious, rare-earth metals, sulfur, barite, fluorite, quartz, feldspars and other elements and minerals essential to various sectors of the economy of Kazakhstan. The course is devoted to the study of a variety of technological schemes, reagent modes and methods of enrichment of polymetallic ores.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
know the raw material base of non-ferrous metallurgy of the Republic of Kazakhstan and the technological processes of extraction, processing and enrichment of polymetallic ores;
be able to navigate the variety of technological schemes, reagent modes and methods of enrichment of polymetallic ores;
have the skills of laboratory research of polymetallic ores for enrichment; use scientific and technical literature for acquaintance and analysis of new technologies and devices.

Enrichment of rare metal ores
CODE – MET532
CREDIT – 5 (2/1/0)
PREREQUISITE – MET505, MET499

PURPOSE AND OBJECTIVES OF THE COURSE
Information about ores and minerals containing rare, radioactive, and precious metals. The main properties and applications of these metals are given. The methods and technological schemes of primary enrichment and finishing of rough concentrates obtained during processing of ores of indigenous and alluvial deposits containing lithium, caesium, beryllium, zirconium, hafnium, titanium, tantalum, niobium, rare earth metals, and uranium are considered. Methods of neutralization of solutions and pulps containing uranium, as well as specific safety issues are described.

BRIEF DESCRIPTION OF THE COURSE
Types and deposits of rare metal ores. Technical characteristic and their classification according to the chemical and mineralogical composition. Pre-processing of ores and placers of rare metals. Ore preparation operations for processing ores and placers of rare metals. Technology for processing and complex use of the main types of ores and placers (tungsten and tungsten-molybdenum, tin and tin-polymetallic ores, titanium-zirconium ores and placers, tantalum-niobium ores and placers, etc.)

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the student must:
have an understanding of the properties of individual elements, minerals in the form of which theseelements occur in nature and ores containing these minerals;
be able to: analyze technological modes and schemes for processing rare metal ores; choose the most promising areas for improving technological processes, modes for effective and comprehensive use of rare metal ores; choose the mode of ore enrichment of a certain composition and make up the enrichment scheme;
know the technology of enrichment and integrated use of the main types of rare metal ores, dewatering and organization of complete water circulation in processing plants.

Modeling of metallurgical processes
CODE – MET558
CREDIT – 5 (2/0/1)
PREREQUISITE – MAT101, MAT102, PHY111, PHY112, MET500, CSE677

PURPOSE AND OBJECTIVES OF THE COURSE
Study of methodology for modeling metallurgical processes

BRIEF DESCRIPTION OF THE COURSE
The concept of models and modeling, systems and their characteristics. Theories and similarity criteria for modeling processes. Identification method. Methods for developing information databases. Visualization and animation of models.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: methods of mathematical description of chemical and physical processes, dynamics of liquids and gases, heat transfer;
be able to: create process algorithms for research and development of technology; use knowledge to solve modern issues of metallurgy.

Design of metallurgical units in ferrous metallurgy
CODE – MET573
CREDIT – 5 (2/0/1)
PREREQUISITE – MAT101, MAT102, PHY111, PHY112, MET500, MET596, CSE677

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline is to study the design of metallurgical units for producing cast iron and steel.
The objectives of the discipline are: to study the basics of developing the technical design of metallurgical units, layouts and layouts of main and auxiliary units; to master the methodology for calculating the needs for equipment and labor, as well as technical and economic indicators of units; to be able to correctly design and place in industrial buildings.

BRIEF DESCRIPTION OF THE COURSE
The main advanced designs of melting, heating and thermal furnaces; methods of calculation, design of aggregates and optimization of their technological parameters

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: the device, operating principle and rules of technical operation of equipment for the preparation of raw materials for metallurgical processes, blast furnaces, oxygen converters, continuous casting machines, non-furnace steel processing units, electric furnaces, furnaces for the production of ferroalloys
be able to: apply the knowledge gained in solving theoretical and practical problems; design furnace units for producing steel and cast iron; use software to develop drawings of units.

Processing of uranium and rare metal raw materials in Kazakhstan
CODE – MET592
CREDIT –5 (2/0/1)
PREREQUISITE – MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Acquire knowledge in the field of chemistry and technology of uranium, as well as in the field of technological methods for obtaining rare and scattered elements from ore and man-made raw materials, due to their chemical properties.

BRIEF DESCRIPTION OF THE COURSE
Prospects for the use of nuclear energy for peaceful purposes, world reserves of uranium, its mineral sources. Properties of uranium, forms of its presence in aqueous solutions. Methods for preparing ores for hydrometallurgical processing. Radiometric and mechanical enrichment of uranium ores, their acid and carbonate leaching. Extraction of uranium from poor and off-balance-sheet ores. Chemistry of REE. Methods for extracting REE from various types of mineral raw materials. Separation of REE. Methods for processing production solutions and obtaining chemical compounds of uranium. Technological schemes for obtaining uranium. Directions of development of research and development work in the field of processing of uranium ores.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: about methods of processing uranium-containing raw materials depending on their mineralogical and chemical compositions; understand the features of hardware design of processes; apply the knowledge obtained in solving practical problems.
be able to: consciously creatively approach the assessment and selection of methods for processing raw materials, the complexity of its use, waste disposal for the extraction of rare and scattered elements.

Theory and practice of metal refining
CODE – MET617
CREDIT – 5 (2/1/0)
PREREQUISITE – MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: students acquire knowledge in the field of physical and chemical bases of the most important methods of separation and purification of metals and their practical application.

BRIEF DESCRIPTION OF THE COURSE
Methods of separation, concentration and purification of metals (extraction, ion exchange, electrolysis and electrodialysis, crystallization from solutions and melts, purification and separation of metals using methods of vacuum and gas-phase metallurgy, etc.), hardware design of processes, engineering calculation of methods for cleaning metals. Examples of the use of methods of separation and refining of metals in the practice of metallurgical production (production of especially pure metals and compounds, production of refractory, rare and radioactive metals, etc.). Special attention is paid to the regularities of technological processes of separation and refining of metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should be able to navigate the methods of cleaning and concentrating metals; predict the distribution of components in heterogeneous systems depending on their properties, make a reasonable choice and engineering calculation of methods for cleaning metals at the design stage.

Assay and control of concentrating processes
CODE – MET560
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499, MET507

PURPOSE AND OBJECTIVES OF THE COURSE
Familiarity and development of production control methods at processing plants that help to maintain the rhythm of technological processes at the maximum possible productivity and set quality indicators of enrichment.

BRIEF DESCRIPTION OF THE COURSE
Basic concepts about the process of testing minerals, products of their enrichment, control of technological processes at processing plants. List of controlled parameters. Methods and technical means of sampling from stationary materials and from moving masses. Determination of the minimum amount of sample from the mass of the tested batch. Minimum mass of the point sample. Minimum sample weight for analysis: chemical, granulometric, fractional. Sample preparation. Control of enrichment processes. Technological and commodity balance. Organization of testing and control.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: the basic scientific principles of the process of testing and control of technological processes of mineral processing; have the skills of sampling, processing samples, calculating balances, removing and using information from automatic control and management systems;
be able to calculate testing parameters, select testing and control equipment, and know the operation of process control systems.

Ore beneficiation research
CODE – MET574
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499, MET502

PURPOSE AND OBJECTIVES OF THE COURSE
Know the methods for determining the material and mineralogical phase composition of valuable composites to select the most effective technological method and enrichment scheme, as well as the reagent regime.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies methods for selecting technological samples, preparing them for research on enrichment, drawing up schemes for cutting samples, the material and mineralogical composition of ore using various methods of analysis, the use of planning experiments, the method of conducting circuit experiments, the procedure for conducting semi-industrial and industrial tests, the method of compiling research reports.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should be able to analyze the data obtained by chemical, mineralogical and phase analyses and on their basis correctly choose effective methods of enrichment, technological scheme of enrichment, set experiments to select high indicators.

Fundamentals of metallurgical production design
CODE – MET575
CREDIT – 5 (2/0/1)
PREREQUISITE – MAT101, MAT102, PHY111, PHY112, MET500, MET596, CSE677

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching of discipline – the formation of students ' knowledge in the field of scientific principles, technological design and construction of metallurgical facilities subject to the requirements of modern normative documents, operating procedures regulating the high level of standardization and unification of model projects and new design solutions for the organization of the planning and development of the territory of the industrial area in the city structure, metal object, industrial buildings and civil structures.
The main task of studying the discipline is to acquire knowledge about the basics of technological and architectural design of metallurgical facilities.

BRIEF DESCRIPTION OF THE COURSE
Engineering of steel objects is an area of knowledge, concepts and ideas about industrial design, which aims the development and/or preparation of design-estimate documentation for construction of new entities and/or modification of existing smelting facilities in their expansion, modernization, technical upgrading, reconstruction, restoration, capital repair, conservation and postoptimization. The design of metallurgical facilities must be carried out in accordance with the provisions of current legislation and state regulations in the field of architectural, urban planning and construction activities.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying of discipline students should:
know the regulatory documentation, the structure of the design documentation, the influence of external climatic and physical-technical conditions on the design object, activities for designing iron and steel facility subject to the requirements of labour protection and the environment, the basic elements of building structures.
to be able to link technology issues with architecture and construction, to prove the feasibility of construction of new or reconstruction of existing productions, to produce technological and design calculations, layout of main and auxiliary equipment, to choose rational space-planning decisions the planning and development area of the industrial area in the city structure, metal object, industrial buildings and civil structures.

Dust collection and purification of gases in non-ferrous metallurgy
CODE – MET563
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline "dust Collection and cleaning of gases in non-ferrous metallurgy" is to form students ' knowledge about the theoretical principles of operation, design features and performance indicators of devices and schemes of installations for dust capture and chemical gas cleaning.

BRIEF DESCRIPTION OF THE COURSE
The course "dust Collection and cleaning of gases in non-ferrous metallurgy" examines the processes occurring in various gas cleaning devices, the design of dust collectors (cyclones, filters, scrubbers, etc.), the conditions and features of their operation, as well as methods of their calculation. The advantages and disadvantages of each dust collecting device are considered, and their application areas are analyzed. We study the schemes used for cleaning gases from dust and harmful gaseous components in various workshops of ferrous and non-ferrous metallurgy enterprises.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: the main methods of dust collection and gas cleaning; classification of dust collecting devices and their efficiency; features of operation of dust collectors and gas cleaning devices;
be able to: analyze the main sources of dust and dusty gases at metallurgical enterprises; evaluate and compare the performance of various dust collectors; select and calculate the necessary dust collecting device for cleaning gases from dust and harmful gaseous components.

Technology of refractory and heat-insulating materials
CODE – MET594
CREDIT – 5 (2/0/1)
PREREQUISITE – MET596, MET622

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Develop knowledge in the field of fire-resistant, heat-insulating and building materials, their properties and application.
The objectives of the course: to transfer the basic theoretical knowledge of the course; to help students get skills to perform practical work; to carry out appropriate calculations of the physical and working properties of refractory and thermal insulation materials.

BRIEF DESCRIPTION OF THE COURSE
Classification of refractory materials. Raw materials for production. Refractory products. Schematic diagram of production and structure of refractories. Structure of refractories. Working properties of refractory materials: fire resistance, gas permeability, dimensional stability, heat resistance, chemical resistance and slag resistance. Physical properties of refractories: thermal expansion coefficient, heat capacity, thermal conductivity, electrical conductivity. Characteristics of some refractory materials (silica, aluminosilicate, chamotte, high-alumina, magnesia-based, and others). Thermal insulation materials, natural and artificial, their characteristics and requirements. Classification and properties of building materials: bricks, concrete, crushed stone, sand, lacquers, paints.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: production schemes and applications of fire-resistant and heat-insulating materials; working and physical properties of fire-resistant and heat-insulating materials; applications of fire-resistant and heat-insulating materials in metallurgy.
be able to: determine the required type of fire-resistant materials depending on the technological process; make requirements for fire-resistant and heat-insulating materials;
possess the following skills: calculation of thermal conductivity of refractory and heat-insulating materials; calculation of heat loss through layers of refractory and heat-insulating materials.

Modern ecological schemes and forecasting in metallurgy
CODE – MET618
CREDIT – 5 (2/0/1)
PREREQUISITE – MET500, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Develop knowledge in the field of creating environmentally friendly metallurgical industries, existing low-waste and environmentally friendly technologies for the production of ferrous and non-ferrous metals.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students get skills to perform practical work; to evaluate the environmental and economic efficiency of various options for cleaning, processing, recycling and preventing damage to metallurgical production.

BRIEF DESCRIPTION OF THE COURSE
The main factors of influence of metallurgy on the environment. Consumption of primary and secondary resources. Save materials and energy. General principles of creating an environmentally friendly metallurgy and its requirements. The formation of ecological strategy for plants of a full cycle. Classification of man-made resources. Payment for environmental pollution. Environmental damage assessment. Ecological and economic efficiency. The main tasks, objects, methods and classification of the environmental monitoring system. Environmental management system. Environmental certification. The main provisions of the series of standards and certification for compliance with ISO 14000 standards.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
In the result of mastering the discipline a student should:
facts: about the current impact of metallurgical production on the environment; about the ways of saving materials and energy; the principles of creating environmentally friendly production;
be able to: conduct a comparative analysis of existing low-waste and environmentally friendly technology of complex processing of polymetallic raw materials; to apply methods of assessing environmental and economic efficiency of the developed technologies;
to own skills: the calculation of the environmental balance; calculation of payment for nature use and environmental pollution.

Design of concentrating factory
CODE – MET564
CREDIT – 5 (2/1/0)
PREREQUISITE – MET505, MET507

PURPOSE AND OBJECTIVES OF THE COURSE
Design of processing plants-to prepare a specialist for further creative work in design institutes, organizations and in production, who has a deep understanding of the scientific principles and methods of design of processing plants.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies General information about the design and design of mining and metallurgical enterprises, initial data for design, selection and justification of quality indicators of enrichment and productivity of factories and individual workshops. Selection and calculation of technological and water-sludge enrichment schemes, selection and calculation of main and auxiliary equipment. Organization of design of buildings and structures, General principles of equipment layout. Repair, storage and tailings facilities, master plan. CAD elements in the design of processing plants.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Students in the course of studying the discipline must-learn modern design and layout solutions of advanced domestic and foreign factories; progressive directions in the design, reconstruction and expansion of existing enterprises; new design methods (CAD); methods of selection, justification and calculation of technological schemes (using computers), main and auxiliary technological equipment; - learn to use theoretical knowledge and practical skills in the technology of raw material enrichment, as well as the necessary regulatory documents for the selection and justification of technological schemes for enrichment.

Digitalization of mining and processing and metallurgical plants
CODE – MET576
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499, MET505, MET507

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering the principles of construction, the basics of the theory of calculation and design of digital control systems for typical technological processes at mining and processing and metallurgical enterprises, to be guided by modern technical means of digitalization.
The tasks of the discipline are as follows.
To teach students to navigate the modern technical means of digitalization, methods of construction of control systems of technological processes in mining and processing and metallurgical enterprises. To show the role of digitalization of technological process management in the development of technical, social and economic processes.

BRIEF DESCRIPTION OF THE COURSE
The article deals with the theory of building digital systems for various levels of production management in the mining and metallurgical industry. The analysis of the structure, functional and enabling components of digitalization is given, and the methodological foundations of building digital technologies are highlighted. Special attention is paid to the role of digital technologies in improving the economic management mechanism in the mining and metallurgical industry, as well as building its information support. Digital technologies will optimize processes to reduce the risk of injury to people working in dangerous areas. Complex tasks related to mining (mine development planning, geological modeling, process management and maintenance) can be managed by intelligent analytical software packages and controlled in an integrated way, which will allow you to make decisions in real time, taking into account the entire technological process of the mining industry.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, students must:
have an idea of: modern theoretical foundations, basic principles and mathematical methods of synthesis of process control systems, trends in the development of science and technology in the field of studying the dynamic properties of objects and building digitization systems using modern technical and software tools of microprocessor technology;
know: the main provisions of methods of calculation, selection, design and adjustment of digitization elements of typical technological processes;
be able to: make verification calculations, navigate the digitization schemes of typical technological processes;
acquire practical skills: in the field of calculation and design of digitalization systems by various technical objects.

Metallurgy of ferroalloys
CODE – MET533
CREDIT – 5 (2/0/1)
PREREQUISITE – MET500, MET619

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching of discipline – the study of physico-chemical methods of production of ferro-alloys, to explore how the design and operation of ferro-alloy units a study of the major charge materials and the requirement to them and ways of preparing raw materials for smelting

BRIEF DESCRIPTION OF THE COURSE
Prospects for the development of Ferroalloy metallurgy. The nature and classification of electrical methods of heating and melting. The main groups of ferroalloys produced in Ferroalloy shops.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the bachelor must:
know: metals belonging to the group of alloying, modifying and reducing metals; classification of ferroalloys; the role of ferroalloys in modern technology; features of ferroalloys production technology; fundamentals of metallurgy; practical application of ferroalloys in the process of obtaining special steels of high quality; physical and chemical bases of specific electrothermal processes in the production of specific ferroalloys; specific processes for obtaining ferroalloys with refractory metals; methods of refining metals to obtain carbon-free ferroalloys.
be able to: in specific conditions, from existing methods to choose the optimal technology for processing charge materials; evaluate the initial mineral raw materials according to the requirements of the technical conditions for obtaining a specific Ferroalloy; offer a basic technological scheme for processing metallurgical waste to obtain the target finished product; choose equipment in accordance with the specifics of the Ferroalloy industry; choose the necessary methods and equipment for obtaining a specific type of Ferroalloy; take into account the issues of environmental protection when choosing the technology.
acquire the skills and ability to make appropriate metallurgical calculations, be able to organize the search for new scientific and technical solutions, be able to analyze new processes and make practical conclusions based on the knowledge obtained.

Metallurgy of copper and nickel
CODE – MET534
CREDIT – 5 (2/1/0)
PREREQUISITE – CHE495, CHE127, MET500, MET619, MET503

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the theoretical foundations and technologies for obtaining copper and Nickel by traditional and modern methods.

BRIEF DESCRIPTION OF THE COURSE
Theoretical bases of traditional and modern technological processes of copper and Nickel production. Designs of metallurgical aggregates and principles of their operation. Mode parameters and process indicators.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know the theory and technology of production of copper and Nickel; the design and principle of operation of the main units, operating parameters and technical and economic indicators.
be able to: apply knowledge in the work at modern metallurgical plants and in the field of scientific research; make technological calculations to determine and evaluate process indicators; analyze the characteristics of raw materials and the effectiveness of the technologies used.

Advanced metallurgy and product design
CODE – MET582
CREDIT – 5 (2/0/1)
PREREQUISITE – MET500, MET620, MET621, MET622

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form systematic knowledge, skills and abilities in the field of metallurgical processing, advanced metallurgy and design of metallurgical products, final metallurgical products.
Course objectives: to transfer basic theoretical knowledge for the course "Technology of producing finished metal products"; to learn to solve typical tasks in the field of steelmaking metallurgy; to form students ' skills of analytical thinking in the field of steelmaking metallurgy, depending on the type of metal, alloy and methods of producing and design of finished steel products, the knowledge in the field of finished steel products.

BRIEF DESCRIPTION OF THE COURSE
The course examines the processes and technologies of the 2nd stage-refining of rough metals, production of steel and alloys, methods of processing scrap metal; processes and technologies of the 3rd stage – processing of metals by pressure in order to obtain metal products of a given design; processes and technologies of the 4th stage-additional processing of rolled products; production of hardware; processing of diesel slags, as well as methods of modern design using 3D modeling of products. Technologies for obtaining finished metallurgical products.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: about technologies of advanced metallurgy; about hardware equipment of processes and technologies of advanced metallurgy;
be able to: perform analytical calculations to determine the composition of alloys; calculate thermodynamic indicators related to the processes of advanced metallurgy;
possess skills: analysis of the production situation in the processes of advanced metallurgy;
choosing the design of metallurgical products depending on the type of technological process and the source metal or alloy.

Metallurgical systems research
CODE – MET583
CREDIT – 5 (2/1/0)
PREREQUISITE – PHY111, PHY112, CHE127, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is to develop students ' theoretical knowledge and practical skills in the field of research of metallurgical processes and systems.
The purpose of the course is to provide students with knowledge about the current state and development of physical and chemical methods of research of metallurgical systems and processes; methods for measuring temperatures, viscosity, density, electrical conductivity and surface tension of melts, measuring the vapor pressure of metals and their compounds, and methods for quality control of metal products. on the basics of thermodynamic and kinetic analysis of pyrometallurgical and hydrometallurgical processes;

BRIEF DESCRIPTION OF THE COURSE
The course "Research of metallurgical systems" examines the main methods of research of metallurgical processes, including the physical and chemical properties of solid and molten metals, metal vapors and their compounds, the basics of thermodynamic and kinetic analysis of metallurgical processes.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: theoretical foundations of modern physical and chemical methods of analysis; the most important dependences of physical and chemical parameters of solid and molten metals, metal vapors and their compounds.
be able to: conduct physical and chemical research using modern equipment and the required accuracy of measurements; choose experimental research methods depending on the tasks; work with high-temperature installations, equipment for studying the properties of metal and ion melts.
possess: basic modern methods of setting, research and solving problems in the study of metallurgical systems; skills of physical and chemical calculations in relation to the systems and processes of non-ferrous and ferrous metallurgy; adapt the methods of research of metallurgical products to the conditions of practice of metallurgical plants and plants.

Enrichment of mining chemical and non-metallic raw materials
CODE – MET536
CREDIT – 5 (2/1/0)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
Get acquainted with the main types of mining and chemical raw materials, substances and mineralogical compositions of ores, the main types of technological schemes of enrichment.

BRIEF DESCRIPTION OF THE COURSE
The discipline deals with the processing of mining and chemical raw materials, the equipment used, the principles of selecting processing schemes and evaluating technical and economic indicators, analyzing the material and mineralogical composition of the ore to choose the most effective technological scheme of enrichment. General information about mining and chemical raw materials and raw material base is provided. The demands of consumers for products of enrichment. Current state in the field of enrichment and processing, prospects for further development of this industry.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should know the technological characteristics of the main types of mining and chemical raw materials; the technological basis for the enrichment of these ores, technological schemes, equipment used in the processing of ores; features of the mineral composition of ores, methods for extracting them into concentrates, features and rational technological schemes for their processing.

Concentration of ferrous metals ores
CODE – MET537
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the training course "Enrichment of ferrous metal ores" is to form a sufficient complete and correct understanding of one of the most important stages in the General technology of using ferrous metal ores – their enrichment and further processing. To acquaint with the main processes occurring during the enrichment and processing of ferrous metal ores, the designs and features of the main devices used for this purpose.

BRIEF DESCRIPTION OF THE COURSE
Material composition of ore raw materials. The theoretical basis and features of beneficiation of different ores of ferrous metals. Principles and conditions of separation of ore minerals from aggregates with non-metallic ones, ore beneficiation and its definition. Classification of ore dressing methods and processes based on separating forces. Schemes and devices for enrichment of magnetite, titanomagnetite and other ores of complex composition, oxidation of iron ores and quartzites, brown ironstone, manganese and chrome ores, carbonate iron and manganese ores. Experience of factories for processing ferrous metal ores. Ways of complex use of mineral raw materials of ferrous metals.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, the bachelor must know the basic physical properties of ferrous metals and basic minerals of ferrous metals, their structural and mechanical features, the main processes of enrichment of ferrous metals: magnetic, gravitational, flotation and other methods, methods of ore preparation, devices used for the enrichment of ferrous metals and their operation; General principles of designing factories for the enrichment of ferrous metals; the main technological indicators of enrichment.

Casting production of metals and alloys
CODE – MET538
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
Study of theoretical and technological processes that occur during the melting of foundry alloys and the formation of the structure and properties of castings from ferrous and non-ferrous metals.

BRIEF DESCRIPTION OF THE COURSE
Here we consider the properties of the most mass-used metals and cast alloys, discuss the conditions and methods of preparing alloys determined by these properties, explain the basics of filling the mold with molten, consider the laws of crystallization of alloys in real conditions, discuss the processes of solidification of cast blanks and their impact on the crystallization and properties of alloys in cast blanks.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must:
know: properties of metals and elements that make up alloys, for a conscious choice of methods and conditions for preparing alloys, the choice of melting units; - laws of influence of crystallization conditions and chemical composition to understand and control the final structure of alloys in cast blanks.
be able to: select and calculate the optimal, both from a technological and economic point of view, charge for smelting cast alloys, develop technological processes for smelting, alloying, refining and modifying the most common cast alloys, manage the methods of forming the quality of cast shaped castings, describe the technological processes for manufacturing cast products from cast iron, steel and non-ferrous metal alloys.

Metallurgy of radioactive and related metals
CODE – MET539
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, CHE127, MET500, MET619

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the main technologies for obtaining radioactive and related metals.

BRIEF DESCRIPTION OF THE COURSE
Theoretical and applied issues related to the processing of raw materials containing radioactive elements, as well as technologies for the production of pure radioactive and related metals, in particular uranium and RMZ.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, the student must:
know: physical and chemical properties, applications, characteristics of the technology for obtaining radioactive and related metals, sources and main processes of raw materials processing.
be able to: analyze methods for obtaining radioactive and related metals.

Production of special alloys
CODE – MET584
CREDIT – 5 (2/0/1)
PREREQUISITE – MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: to Form knowledge about the properties of special-purpose alloys; about the main methods of production of special alloys; about the physical basis and use of methods for obtaining alloys and materials with specified properties.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students get skills to perform practical work; to familiarize students with the theory and technology of obtaining special-purpose alloys.

BRIEF DESCRIPTION OF THE COURSE
The course examines the classification of special alloy and the structure of alloys, mechanical mixtures, the type of chemical compounds and solid solutions. The course also covers the basics of theory and technology of production of various high-temperature alloys and their properties. Methods of direct synthesis and reduction, deposition from the gas phase and electrolysis, using plasma and mechanical doping are considered. The authors consider the structure and diagrams of state of alloys for special purposes. The necessary information about iron-carbon, titanium and copper, aluminum and magnesium, zinc, hard and magnetic, heat-resistant and heat-resistant alloys, as well as special steels and their application is given.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: properties and structure of special alloys; main methods of production of special alloys; marking and application of special alloys;
be able to: choose and justify the technological scheme for obtaining a specific alloy; make a comparative analysis of various methods for obtaining special materials and alloys;
possess the skills of: calculating the mass fraction of metals in alloys; calculating the density of alloys; calculating the volume fraction of metal alloys.

Technology of firing and melting processes
CODE – MET585
CREDIT – 5 (2/0/1)
PREREQUISITE – CHE495, PHY111, PHY112, MET619, MET596

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is to form students ' systematic knowledge about the basics, technological features and hardware design of the main pyrometallurgical processes - roasting, smelting of ore and secondary raw materials and refining of metals.
The purpose of the course is to provide students with: theoretical knowledge of the main pyrometallurgical processes; theoretical knowledge of the processes of firing of sulfides, metal oxides: oxidizing, sulfidating, sulfatizing, chlorinating, etc.; theoretical knowledge of the melting processes; practical skills in conducting thermodynamic analysis of the firing and melting processes, practical skills in performing technological calculations of the firing and melting processes.

BRIEF DESCRIPTION OF THE COURSE
The course "technology of roasting and melting processes" examines the theoretical foundations and hardware design of the processes of roasting and melting of ore, secondary raw materials and metal refining.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: theoretical bases of firing and melting processes; main technological equipment of firing and melting processes; current situation and development of processes at operating metallurgical enterprises; working principle and features of the structure of equipment for their implementation; methods of selection and calculation of melting and firing processes.
be able to: analyze existing and projected processes; justify the choice of the type of firing and melting, equipment depending on the composition of the initial metal-containing raw materials; evaluate the speed of individual stages, identify speed-limiting links of simple and complex processes of firing and melting; predict the indicators of processing of ore and man-made raw materials.
possess the skills: perform technological calculations for firing and melting, apply the knowledge gained in practice.

Dewatering and dust collection
CODE – MET541
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499, MET505, MET507

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the theoretical basis and practice of dewatering and dust collection processes used in processing plants, as well as familiarization with the equipment and design of devices used for these purposes.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies the theoretical foundations of dewatering and dust collection processes, the design and operation of devices used for drainage, centrifugation, thickening, filtering, drying and dust collection. Methods for selecting and calculating the main auxiliary equipment and dewatering schemes are considered.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Expected results: after taking this course, the student should:
know the place and role of dewatering and dust collection processes in mineral processing schemes, the theoretical basis of the processes; the design and operation principle of the main devices used in practice.
be able to determine the parameters that characterize the dewatering process, the principles of regulation and calculation of the performance of the main devices.

Geotechnological methods of enriching
CODE – MET542
CREDIT – 5 (1/1/1)
PREREQUISITE – MET499, MET505, MET507

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: The formation of systematized knowledge, skills and abilities in the field of geotechnological methods of enrichment.
Course objectives: to transfer the basic theoretical knowledge of the course; to form students' skills in solving some technological problems in the field of geotechnology of metals.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies the methods of geotechnological mining, in order to determine the possibility of translation into a mobile state of the extracted useful components. The questions of physical and chemical bases of geotechnological processes are considered. The schemes of geotechnological processing of uranium, gold, manganese, iron ores and non-metallic minerals are studied, as well as the processes of processing products of geotechnologies are considered.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should:
know: information about the history of the emergence and formation of geotechnology; classification of geotechnology methods and its application in enrichment;
be able to: make technological calculations for the implementation of various types of leaching of ore raw materials; produce thermodynamic justification of leaching of ore raw materials using Purbe diagrams;
possess the following skills: in the field of choosing geotechnological methods for processing complex ore raw materials; in the field of preliminary planning of the location of wells in the ore field.

Defense of the diploma work/diploma project
CODE – ECA103
CREDIT – 6
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the thesis (project) is:
1) systematization, consolidation and expansion of theoretical knowledge and practical skills in the specialty and their application in solving specific scientific, technical, economic and industrial tasks, as well as cultural tasks;
2) development of skills for conducting independent work and mastering the methodology of scientific research and experimentation in solving the problems and questions being developed;
3) finding out the student's readiness for independent work in the conditions of modern production, science, technology, culture, as well as the level of his professional competence.

BRIEF DESCRIPTION
The order of presentation of diploma work (project) is determined by Rules of carrying out of current control of progress, intermediate and final state certification of students in educational institutions approved by the MES RK. The defense of the thesis (project) is held at an open meeting of the state attestation Commission with the participation of at least half of its members. The defense of the thesis (project) is organized in a public form, with the presence of students and teachers of the graduating Department. The research supervisor, representatives of the organization on the basis of which the diploma research was conducted, and other interested persons can also be invited to the defense. The duration of the defense of one thesis, as a rule, should not exceed 30 minutes per student. To protect the thesis, the student makes a report to the state attestation Commission and those present for no more than 15 minutes. All those present can participate in the discussion of the thesis (project) in the form of questions or speeches. After the discussion, the Secretary of the Commission reads out the review (if the supervisor is present, he can speak in person) and the review. If there are comments in the review and / or review, the student must give a reasoned explanation of their essence. According to the results of the defense of the thesis (project), an assessment is made according to the point-rating letter system. This takes into account the level of theoretical, scientific and practical training, the review of the supervisor and the reviewer's assessment. The results of the defense of the thesis are made out by the minutes of the meeting of the state attestation Commission individually for each student and are announced on the day of the defense.

Content