

СӘТБАЕВ  
УНИВЕРСИТЕТИ



SATBAYEV  
UNIVERSITY

Mining and Metallurgical Institute named after O.A. Baikonurov

Department of Metallurgical processes, Heat engineering and Technologies of special materials  
Mining and Metallurgical Institute

Director  
of MMI named after O.A.  
Baikonurov

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2023

**MET 3122 Metallurgical Engineering**  
**Металлургическая инженерия (на английском языке)**

**6B07203 - Metallurgy and Mineral processing**  
**5 credits, 2/0/1/2**

**Autumn semester, 2023- 2024**

Almaty, 2023

## 1. Information about trainer

Information about the trainer	Time and place Lessons		Contact information		
	Lessons	Office hours	Whats'Up	Social Network Account	e-mail
Mamyrbaeva K.K., Ph.D	<i>Lecture</i> Friday 11.05-10-13.00 On line	Friday 13.05-13.55	870731615 51		<a href="mailto:k.mamyrbaeva@satbayev.university.kz">k.mamyrbaeva@satbayev.university.kz</a> <a href="mailto:Gulzira70@mail.ru">Gulzira70@mail.ru</a>

## 2. Program Objectives:

The basic objective of the course is to introduce students with the principles of various types of unit process used for extracting industrially important metals.

Topics covered Metals, Classification, Properties of metals, Ores, ore minerals, Basics of Mineral Beneficiation (Comminution, Sizing, Concentration (Gravity Separation, Magnetic and Electrostatic separation, Flotation), dewatering and e.g., Principles of metal extraction (Laws of thermodynamics, kinetics, Principles of Unit processes: Calcination, Sintering, Pelletizing and Briquetting). Basics of Pyro-metallurgical (roasting, smelting, extraction of metals), Hydrometallurgical processes, (principles and types of leaching, recovery of metals from PLS), Principles of electrometallurgy. Powder metallurgy, Corrosion and e.g.

## 3. Description of the course:

The course is intended for students of the educational program "6B07203-Metallurgy and Mineral Processing".

## 4. Program Outcomes:

after successful completion of the course students should be able to:

- **understand and know terms** about metals, extractive metallurgy processes.
- **understand and know terms** of different pyrometallurgical operations and methods of thermodynamic analyses of pyro- and hydrometallurgical processes.
- understand and know terms of different hydrometallurgy and electrometallurgy operations.
- **be able to:**
- Calculate main parameters of metallurgy processes and analyze them, draw flow sheets of extraction of different metals.
- Use principles of calculating and predict the directions of different unit processes, unit principles and parameters of powder metallurgy, corrosion and etc.
  - demonstrate the ability to solve different exercises on metallurgy, characterization and proper material selection.
  - demonstrate the ability to identify, formulate and solve metallurgy and material science problems.

## 5. Calendar and thematic plan

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Week	Topics of lectures	Topics of practical lessons	References	Task	Deadline
1	Introduction	<b>1 pr. lesson</b>	1 basic [1-5], [74-81], 3 basic [1-18], 1 қос. [1-28] EMCD 1-lecture		Week 1-2
2	Unit properties of metals	<b>1 pr. lesson</b> Exercises on Physical and chemical properties of metals and non-metals	1 basic [74-79], 3 basic [1-18], [200-208], EMCD 2-lecture	Lecture 1, 1-practic. Speaking "The periodic table of chemical elements"	Weeks 2, 3
3	Ores, ore minerals	<b>2 pr. lesson</b> 2.1 Exercises on Ore minerals, properties of minerals	1 basic [80-100], 3 basic [1-18], [200-208], EMCD 3-lecture	Lecture 2, Speaking "Physical and chemical properties of metals and non-metals" 1- SSA	Week 3
4	Methods of mineral beneficiation. Sizes reduction technologies Concentration	<b>2 pr. lesson</b> 2.2 Exercises on Concentration	1 basic [109-128], 2 [176-199], 3 basic [176-199], EMCD 4-lecture	Lecture 3, 2-practic. Speaking "mineral beneficiation" 2- SSA	Week 4
5	Thermodynamic principles of metal extraction	<b>3 pr. lesson</b> 3.1 Thermodynamic principles of metal extraction. Ellingem diagram. Kinetics of metallurgical processes. Exercises	1 basic [6-73], 3 basic [19-65], [101-134], EMCD 5-lecture	Lecture 4, Main terms about Thermodynamics Kinetics 2- SSAT	Week 5

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6	Pyrometallurgy - Pyrometallurgical processes. Roasting Processes	<b>3 pr. lesson</b> 3.2 Roasting processes. Smelting processes. Exercises	1 basic [129-139], 2 basic [135-145, 215-234] EMCD 6- lecture	Lecture 5, 3-practic. Speaking about Kinetics 3- SSW	Week 6
7	Pyrometallurgy - Smelting. Iron and Steel making		1 basic [129-149], 2 basic [145-175, 215-234] EMCD 7- lecture	Lecture 6, Speaking about Pyrometallurgy 3-prac. 4- SSA	Week 7
8	Midterm –1 MC			Lecture 1-7 1 Midterm control	
9	Hydrometallurgy. Leaching. Leaching methods	<b>4. pr. lesson</b> 4.1 Measurement of quantities of hydrometallurgical processes	1 basic [337-418], 3 basic [324-344], EMCD 9- lecture	Lecture 8, 4-prac. Terms about Hydrometallurgy	Weeks 9, 10
10	Hydrometallurgy. Recovery of metals from Solutions.	<b>4. pr. lesson</b> 4.2 pr.lesson Extractive metallurgy of non- ferrous metals - copper, nickel, etc. radioactive metals (U, Pt, etc.)	1 basic [168-204], 3 basic [398-423], EMCD 10-lecture	Lecture 9, Terms about Hydrometallurgical processes 4-prac. 5- SSA	
11	Electrometallurgy	<b>6. pr. lesson</b> Extraction of metals by electrolysis (Al, Mg). Exercises		Lecture 10, Terms about Electrometallurgy 5-practic. 3- SSW	Week 11
12	Metallic Corrosion. Corrosion Protection		3 basic [419- 464], 2 add. [61- 98] EMCD 12-lecture	Lecture 11, Speaking about Electrometallurgy	
13	Powder metallurgy	<b>7. pr. lesson</b> Methods of metal powder production in PM. Exercises	1 basic [205-226], 3 basic [424-451], EMCD 13-lecture	Lecture 12, Speaking about Metallic Corrosion 6-practic. 2- SSWT	Weeks 13, 14
14	Manufacturing Processes		1 basic [282-336],	Lecture 13,	Weeks 14

			3 basic [236-270], EMCD 14-lecture	Speaking about Powder metallurgy 4 SSW	
15	Endterm (2 MC)		9-14 lectures	9-14 lectures 2 control – 2 MC	Week 15
	Final exam		1-7, 9-14 lectures	Exam	Accordin g to the exam schedule

## 6. Literature:

<ol style="list-style-type: none"> <li>1. H.S. Ray, R. Sridgar, K.P. Abraham. Extraction of nonferrous metals. East-West Press PVT LTD. New Delhi, 2013. P. 531.</li> <li>2. <a href="#">Daniel A. Brandt</a> , <a href="#">J.C. Warner</a> Metallurgy Fundamentals: Ferrous and Nonferrous Sixth Edition, Textbook. 2021</li> <li>3. SME Mineral Processing and Extractive Metallurgy Handbook 2019 г. ISBN-13: 978-0873353854 ISBN-10:0873353854</li> <li>4. J. Drzymata Mineral Processing. Wroclaw University of Technology, 2007. 502 P.</li> </ol>	<ol style="list-style-type: none"> <li>1. Alain Vignes Extractive Metallurgy 1: Basic Thermodynamics and Kinetics ISBN: 978-1-118-61967-4 March 2013 Wiley-ISTE 344 Pages</li> <li>2. <a href="#">Alain Vignes</a> Extractive Metallurgy 2: Metallurgical Reaction Processes: Metallurgical Reaction Processes: First published:28 February 2013. Online ISBN:9781118616932 DOI:10.1002/9781118616932</li> <li>3. <a href="#">Alain Vignes</a> Extractive Metallurgy 3: Processing Operations and Routes. - 2011 г.</li> </ol>
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## 7. Competence framework

### Tasks and brief methodological instructions for their implementation:

#### Student Self-assessments (SSA):

The Student Self-assessment (semester assignments) provides for the performance of 2 assignments during the semester, covering the past material of the discipline. Assignments must be completed in writing and submitted as they are completed according to the deadlines. Based on your written work, an average score will be displayed. Timeliness of work execution and delivery will be taken into account.

#### General requirements and guidelines for implementation:

a) to SSA: volume – till 250 words. Execution in accordance with the required standards. Content - according to the personal recommendations of the teacher. Literature search is carried out independently, with the involvement of Internet sources, scientific journal literature and classic textbooks;

b) for presentation works: volume - 7-15 slides. Execution in accordance with the required standards. Content - according to the personal recommendations of the teacher. The literature search is carried out independently, with the involvement of Internet sources, scientific journal literature and classic textbooks.

#### Collaboration with a teacher (SSAT):

The tasks of the SSAT are an independent solution of problems on the topic covered under the guidance of a teacher. They are compulsory for all students to complete as a current independent work. When preparing your homework, you should use the knowledge gained from textbooks and lessons. Based on the work performed by you, an average score will be displayed. Timeliness of execution and delivery of tasks will be taken into account. Tasks for the joint work of a student with a teacher represent an independent solution of training, situational tasks and tasks related to working with diagrams, diagrams, etc. on the topic covered under the guidance of a

teacher. Assignments are given during lectures and practical classes. They are compulsory for all students to complete as a current independent work. When preparing your homework, you should use the knowledge gained from textbooks and lessons. Based on the work performed by you, an average score will be displayed. Timeliness of execution and delivery of tasks will be taken into account.

General requirements and guidelines for implementation:

a) to training tasks: to solve the proposed tasks, the teacher in the lecture material highlights the methods of solution, on the office clock, standard solutions of individual problems are analyzed;

b) to tasks related to diagrams, diagrams, etc.: to solve the proposed tasks, the teacher disassembles typical diagrams, diagrams, etc.

**Practical exercises** are the development and preparation of programs for solving specific problems. Tasks are presented on the site in the portal. The execution of tasks is formalized accordingly and provides for the use of the appropriate material posted on the UMKD. Timeliness of work execution and delivery will be taken into account.

Midterm control: is carried out at 8 and 15 weeks of the course and accordingly covers the material of lectures 1-7 and 9-14.

Exam: The final exam covers and summarizes all of the course material. The exam is conducted in writing and covers different types of assignments: written questions covering the lecture material passed, a practical solution to a specific problem. The duration of the exam is 2 academic hours. No additional tasks for the exam to improve the grade in case it is low will not be given. There will also be no retake of the exam. The exam is written, the ticket contains three practical tasks, which include: training, working with diagrams, nomograms and graphs, test tasks and situational. Reference material is allowed for the exam.

### 8. Evaluation criteria:

Assessment by letter system	Numerical equivalent of assessment Criterion	Criterion
<b>A</b>	<b>95 – 100</b>	Complete theoretical answers with the provision of additional information that is absent in the lecture material. Thorough, accurate, timely and correct solution of training tasks. Creative and timely implementation of abstract and presentation works. Timely calculations for practical training.
<b>A -</b>	<b>90 – 94</b>	Complete theoretical answers according to the lecture materials. Timely execution of training assignments with minor stylistic errors. Timely implementation in the required volume on a given topic of abstract and presentation works. Timely calculations for practical training.
<b>B +</b>	<b>85 – 89</b>	Theoretical answers in accordance with the lecture materials, but without giving specific examples. Disclosure of the topic for all tasks of the course, but the lack of involvement of literary sources. Exam answers without examples. Timely calculations for practical training.
<b>B</b>	<b>80 – 84</b>	Incomplete disclosure of questions on the exam on certain questions. Disclosure of the topic for all tasks of the course is not complete. Timely calculations for practical training. Difficulties with solving ad hoc tasks.
<b>B -</b>	<b>75 – 79</b>	Incomplete disclosure of questions on the exam on certain questions. Disclosure of the topic for all tasks of the course is not complete. Timely calculations for practical training. Difficulties with solving ad hoc tasks.
<b>C +</b>	<b>70 – 74</b>	Incomplete disclosure of questions on the exam on certain questions. Superficial disclosure of the topic for all assignments of the course, errors in the design of assignments by standards. Timely calculations for practical training. Inability to

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		solve situational tasks.
<b>C</b>	<b>65 – 69</b>	Attendance at a low level. Not all the tasks of the course are performed well. Lack of creativity and individuality when completing assignments. Incomplete answers on the exam.
<b>C -</b>	<b>60 – 64</b>	Attendance of classes at a low level. Not all of the course assignments completed. Incomplete answers on the exam
<b>D +</b>	<b>55 – 59</b>	Attendance at low level classes. Poor or incomplete completion of all tasks of the course. Incomplete or not entirely correct answers on the exam.
<b>D</b>	<b>50 – 54</b>	Attendance at an extremely low level. Poor performance and not all tasks of the course. Incomplete or not entirely correct answers on the exam.
<b>F</b>	<b>0 – 49</b>	Non-attendance of classes. Lack of completion of training tasks. Incomplete and incorrect answers on the exam. Failure to perform certain practical works. Poor performance of abstract and presentation tasks

*\* It is possible to receive bonus points for completing additional tasks*

Criteria for evaluating practical work (training, situational tasks, working with diagrams, etc.): completeness of solving the problem, accuracy and originality of calculations, completeness of presentation of the experimental results obtained and timely delivery.

Criteria for evaluating abstract and presentation works: creativity in writing an abstract, the ability to show the features of the topic being presented, presentability and communication at the defense.

The criteria for setting the examination mark: correctness and completeness of answers, accuracy and precision of presentation.

The final exam covers and summarizes all of the course material. The exam is conducted in writing - this is a practical solution to specific problems using the lecture material received. The duration of the exam is 2 academic hours. No additional tasks for the exam to improve the grade in case it is low will not be given. There will also be no retake of the exam.

### 9. Schedule of submission of mandatory assignments

№	Control types	Max point In week	Weeks															Total max points
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Activity in discussing lectures	1,0		*	*	*	*	*	*		*	*	*	*	*	*		6
2.	Activity in practical training	3		*		*		*			*		*		*			18
3.	Student selfdependent work (semester)	3,0			*			*					*			*		12
4.	Midterm	8,0								*								8
5.	Student Selfdependent work of a student with a teacher	6,0					*								*			8
6.	Endterm	8,0															*	8
7.	Final exam	40																40
	<b>Total</b>																	100

### 11 Late submission policy

The student must come prepared for lectures and practical (laboratory) classes. Timely protection and full performance of all types of work (practical and independent) is required. The student should not be late and miss classes, be punctual and mandatory. It is planned to reduce the maximum score by 10% for untimely work. If you are forced to skip the intermediate certification for good reasons, you should warn the teacher in advance before it, so that you can pass the boundary control in advance. Skipping an exam for a disrespectful reason deprives you of the right to take it. If you miss the exam for a good reason, a special permit is issued and the date, time and place of the exam are assigned.

## **12 Academic Conduct and Ethics Policy**

Be tolerant, respect the opinions of others. Formulate objections in the correct form. Plagiarism and other forms of dishonest work are unacceptable. Prompting and cheating during exams, passing the exam for another student are unacceptable. A student caught falsifying any course information will receive a final "F" grade.

*Activeness* in lectures and practical classes is mandatory and is one of the components of your final score / assessment. Many theoretical questions supporting the lecture material will be presented only at lectures. Therefore, skipping a class can affect your academic performance and final grade. However, attending classes in itself does not mean an increase in points. Your constant active participation in the classes is necessary. A mandatory requirement of the course is to prepare for each lesson. It is necessary to review the specified sections of the textbook and additional material not only in preparation for practical classes, but also before attending the corresponding lecture. Such training will facilitate your perception of new material and will contribute to your active acquisition of knowledge within the walls of the university.

**Support:** For advice on implementing the independent work, their submission and defending, as well as for additional information on the material covered and all other questions arising on the course being read, contact the teacher during their office hours or via electronic means of communication during working hours.

### **During the process of learning:**

Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence, the student is obliged to notify the teacher within a day and explain the plan for self-study of the study material:

- mandatory reading of the presented materials before the lesson;
- submission of tasks on time;
- 20% non-participation in the audience (for a valid reason with the supporting documents) - rating "F (Fail)";
- plagiarism and cheating during the execution of the task are not allowed;
- mandatory use of electronic gadgets in the classroom that is welcome, but it is unacceptable to use them in the exam.

Within the framework of training in the discipline, any corruption manifestations in any form are unacceptable. The organizer of such actions (teacher, students or third parties on their behalf) are fully responsible for violating the RK laws.

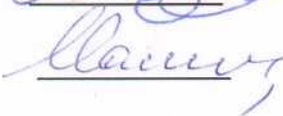
*Considered at a meeting of the Department of MPHaTSM*  
Minutes №1, «28» August 2023

**Head of MPHTSM**



**T.A. Chepushtanova**

**Compiled by Associate professor**



**K.K. Mamyrbayeva**