

MINISTRY OF EDUCATION AND SCIENCE  
REPUBLIC OF KAZAKHSTAN



SATBAYEV  
UNIVERSITY



2019y.

**SYLLABUS**  
**GPH105 Gravity Exploration**  
(название дисциплины)

**For speciality**  
**5B070600-Geology and Exploration of Mineral Deposits**  
**3 credits**

**Semester: 7, 2019 - 2020**

**Almaty, 2019**

Ф КазНУТУ 703-08. Силлабус

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«APPROVED BY  
»

Abetov A.E. \_\_\_\_\_  
Name and signature  
«\_\_\_\_» \_\_\_\_\_ 2019y.

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**Institute of Geology and Petroleum and Gas**

**Geophysics Department**

**1. Information about the teachers:**

**Senior Lecturer:** Umirova Gulzada  
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Saturday 14-16 in 531 ГУК

**Assistant (laboratory classes)**  
Ismailova Gulvira Alibekovna  
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Saturday 14-16 in 525 Main Corpus  
Email: gulvira.ismailova@mail.ru

**2. Course Objective:**

Introducing to students the theoretical fundamentals of gravimetric method, equipment, fieldwork technique, data processing and geological interpretation of gravity anomaly field.

**3. Course Description:**

Gravimetric exploration is one of the fundamental methods in solving of geological tasks such as geo-mapping, prospecting for mineral potential structure targets, detailed dimensional researches of identified structures, which the deposits are coincided to, and deposit prospecting. Newton's Theory of gravity, acting as the mathematical base of gravity exploration, serves as the fundamental of the science of the regularity of spatial distribution of any physical fields. Therefore, the study of the Gravity Exploration course is necessary not only to master the method itself, but also to facilitate understanding of the laws of gravitational, magnetic and electric fields induced by geological bodies.

**4. Prerequisites:**

- Higher mathematics,
- Physics,
- Theory of the field,
- Geodesy,
- Geology.

**5. Post requisites:**

- Integration of geophysical methods

**6. Literature:**

Basic literature	Additional literature
[1] Murray A.S., Tracey R.M. Best practice in gravity surveying. Australian Geological Survey Organisation, 43 pp.	[4] Соколова Т.Б., Бульчев А.А., Лыгин И.В., Старовойтов А.В., Тевелев Ал.В., Шалаева Н.В. Интерпретация геофизических материалов. Учебное
[2] Миронов В.С. Курс гравirazведки. – М:	

Недра, 1980.	пособие – Тверь: Издательство ГЕРС, 2011. – 208 с.
[3] Н.П. Грушинский, Н.Б.Сажина. – М: Недра, 1982	[5] 2 К.Е.Веселов. Гравиметрическая съемка. – М. Недра, 1986.
[4] Г.К.Умирова. Применение геофизических методов при поисках полезных ископаемых. – Астана: Издательство Фолиант, 2015	[6] Умирова Г.К. Гравиразведка. – Алматы: КазНТУ, 2012 г.

### 7. Calendar-thematic plan:

Week	Lecture topic	Theme of lab class	Link to literature source	Task	Deadline
1	Introduction. The importance of gravity exploration for the economics of Kazakhstan Scope of tasks to be solved by gravity exploration.	Introducing the device, measurements and defining of constants of the quartz astatic gravimeter.	[7] 5-11p. [2] 10-14 p.	Brief historical outline	
2	Brief Theory of Earth gravitational field. Gravity force. Gravity potential. Second derivatives of gravity force.	Defense of Lab class, theme discussion, the game based on a theme task	[7] 2 11-17 p. [2] 14-20 p.	Ways to calculate gravity force. Absolute and relative calculations of gravity force	Lab class and task are defended on the second week
3	Figure-of-the-earth study– the primary task of gravity exploration.	Calculation of the normal field using «Surfer» software	[7] 17-23 p. [2] 20-25 p.	Asymptotic formula of gravity potential	On the fourth week.
4	Normal values of gravity force and second derivatives. Centurial and periodical variations of gravity force	Defense of Lab class, theme discussion, the game based on a theme task	[7] 23-28 с. [2] 25-29 с.	Geodesic support of the gravimetry. Concept of the geoid and coordinate system types.	Lab class and task are defended on the fourth week
5	Measuring of gravity force. Methods of relative measurings of	Processing of the gravimetric trip, levelling, gravimetric mapping using “Surfer”	[7] 28-30 p. [2] 29-33 p.	Modern gravimeters	Sixth week

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Week	Lecture topic	Theme of lab class	Link to literature source	Task	Deadline
	gravity force	software			
6	Corrections to measured values of the gravity and second derivatives of the gravitational potential.	Defense of Lab class, theme discussion, the game based on a theme task	[7] 104-113 p. [2] 33-38 p.	Prey's anomaly, isostatic anomaly	Lab class and task are defended on the sixth week
7	Designing, organization and technique of gravimetric survey executing	Analytic solution of the direct task for simple geometric shape bodies, or using the Gamburtzev palette	[7] 113-127 p. [2] 38-41 p.	Types of gravimetric maps in various gravity anomalies	Eighth week
8	<b>First Interim Certification</b>			Multivariate test	
9	Physical fundamentals for geologic interpretations of gravitational anomalies	Defining of the intermediate layer density through gravimetric measurements on surface. Graphical calculation of $V_{xz}$	[7] 128-137 p. [2] 41-46 p.	Solution of the inverse task for gravity regular geometric shape bodies	Lab class and task are defended on the eighth week
10	Interpretation of gravimetric survey results	Defense of Lab class, theme discussion, training	[7] 137-183 p. [2] 46-53 p.	Rock density. Interrelationship of density with porosity and humidity	Tenth week
11	Internal structure of the Earth. Theory of isostasy	Transformation of the gravitational field by converting the potential of gravity into third derivatives of the potential of gravity.	[7] 184-199 p. [2] 53-59 p.	Examples of inverse task solutions	Lab class and task are defended on the tenth week
12	Field separation techniques	Defense of Lab class, theme discussion, the game based on a theme task	[7] 184-199 p. [2] 53-59 p.	Ways to calculate the isostatic correction	Twelfth week
13	Field separation techniques (continuing)	Some principles of identifying and tracking discontinuities on the gravity maps	[3] 309-324 p.	Ways to calculate terrain correction	Lab class and task are defended on the twelfth week
14	Methods of direct	Defense of Lab	[7] 200-266 c.	Applying the	Lab class

Week	Lecture topic	Theme of lab class	Link to literature source	Task	Deadline
	and inverse task solution.	class, theme discussion, consolidation of the theory	[3]357-397 p.	gravity exploration for regional task solution	and task are defended on the fourteenth week
15	<b>Final second certification</b>			Multivariate test	Fifteenth week
	<b>Exam</b>			Exam papers	As per schedule

\* The calendar/topics subject to review based on holidays

### 8. Assignments and brief guidelines for their accomplishment:

#### ✓ **Student's Individual Work (SIW):**

SIW is carried out according to individual variants issued by teacher and covers several topics: quantization and discretization of information, measures of discrete information, presentation and transformation of digital information. The work done should include theoretical material and solution of examples.

#### ✓ **Teacher Collaboration Works (TCW):**

Weekly TCW are conducted based on the topics of lectures and practical exercises.

It is drawn up as per the standard and delivered to lecturer during the course training. One work (TCW) is devoted to issues of encoding and encryption of information. It is performed as per individual variants issued by teacher. The work performed should include theoretical material and application of the theory to the solution of a practical problem, an analysis of the resulting solution.

#### ✓ **Practical Work:**

Practical work is the solution of specific assignments. Each practical work is followed by its file. The Lab work № (week number), has certain tasks and performance instructions (presented on website). Work topics are mentioned below.

Lab Work № 1. Introducing the device, measurements and defining of constants of the quartz astatic gravimeter. (1 hour).

Lab Work № 2. Calculation of the normal field using «Surfer» software. (1 hour).

Lab Work № 3. Processing of the gravimetric trip, levelling, gravimetric mapping using “Surfer”. (1 hour).

Lab Work № 4. Analytic solution of the direct task for simple geometric shape bodies, or using the Gamburtzev palette. (1 hour).

Lab Work № 5. Defining of the intermediate layer density through gravimetric measurements on surface. Graphical calculation of  $V_{xz}$ . (1 hour).

Lab Work № 6. Transformation of the gravitational field by converting the potential of gravity into third derivatives of the potential of gravity. (1 hour).

Lab Work № 7 Some principles of identifying and tracking discontinuities on the gravity maps (1 hour).

MC 1 – Multivariate test №1 in written form (as per 7 weeks training material)

MC 2 - Multivariate test №1 in written form (as per during the whole course training material)

✓ **Экзамен:**

The final exam covers and summarizes entire course material. The examination is carried out in writing covering various assignments: written questions covering lectures passed, practical solution of a specific assignment. Exam duration 2 academic hours. The written answer must be neatly written, contain the correct, complete and clear statement of theoretical material with examples, the correct and optimal solution of practical problems strictly in accordance with the task formulated in the exam paper.

**9. Criteria for work evaluating:**

Letter Grading System	Numeric Equivalent	Criteria
A	95 – 100	Correct, complete, unambiguous answer
A -	90 – 94	Not enough complete/unambiguous answer
B +	85 – 89	1 mistake
B	80 – 84	1 mistake, not enough complete/unambiguous answer
B -	75 – 79	1 mistake, not enough complete and ambiguous answer
C +	70 – 74	2 mistakes
C	65 – 69	2 mistakes, not enough complete and ambiguous answer
C -	60 – 64	2 mistakes, not enough complete and ambiguous answer
D +	55 – 59	3 mistakes
D	50 – 54	3 mistakes, not enough complete and ambiguous answer

*\* Bonus points are available in case of additional tasks completion*

**10. Late Submission Policy:**

It is required to timely defend laboratory class, complete accomplishment of laboratory work, SIW and TCW. Maximum score may be reduced on 10% for untimely completed work.

**11. Class attendance policy**

The student should not be late and miss classes, should be accurate and compulsory. Each missed lesson is registered in a log. In case if you are missing certifications or exams with a reasonable excuse then you have to inform teacher in advance, before certification or exams will take place.

**12. Politics of Academic Conduct and Ethics:**

Be tolerant, respect the opinions of others. Formulate objections in correct form. Plagiarism and other forms of dishonest work are unacceptable. Prompting and cheating during exams, passing the exam for another student is unacceptable. A student found to falsify any course information will receive a final grade of “F”. Any form of corruption is not allowed. A person engaged in corruption (teacher, student or third parties on their behalf) is fully responsible for violation of the laws of the Republic of Kazakhstan..

*Considered at a faculty meeting (Geophysics), Protocol № 1 since « 14 » 2019.*

**Written by: Senior Lector Umirova Gulzada Kubashevna \_\_\_\_\_ (signature)**