Name and code of discipline	DIGITAL TECHNOLOGIES IN APPLIED GEOLOGY: MODELING OF GEOLOGICAL OBJECTS AND PROCESSES.		Academic year, semester 2023-24 academic year year, 2nd semester
Labor intensity of the course	**10 credits** Total -300 hours.	Class structure	Lectures-30 hours. Practical. class – 6 0 hours SRS – 2 10 hours.
Teacher information	Kasymov Meymanbek, Associate Professor, Dr., Docent, Head of the Water, Oil and Gas Resources and Georisks Department, office No. 28, room No. 20, 32 . tel.500-826685, k_mei@mail.ru		
Purpose and objectives of the discipline	The purpose of these disciplines is to familiarize students with modern digital methods and technologies used in applied geology for the study of geological objects and processes. Students acquire skills in digital processing of geological data and development of geological models.		
Course Description	The discipline “Digital technologies in applied geology: modeling of geological objects and processes” studies and applies modern information and computer technologies in the field of geology in the following main areas: • comprehensive forecasting of mineral resources in a GIS environment; • automated provision of construction of geological maps based on generalization of legends and scale maps; • comprehensive processing and interpretation of geological and geophysical data; • preparation in the GIS environment of electronic geological maps for publication. The challenges of digital technologies focus on creating digital models of geological objects and processes, which allows geologists and other experts in the field to more accurately and efficiently analyze and understand geological phenomena. This includes the use of geographic information systems (GIS), computer modeling, processing of large volumes of geological data, and other advanced analysis and visualization techniques to better understand the nature of rocks, mineral deposits, and other aspects of geology.		
Prerequisites	“Mathematics”, “ Statistics ”, “Informatics”, “General Geology”, Geology of Oil and Gas , “ Mathematical Methods”		
Summary of the discipline	Lecture 1. Introduction to GIS. Basic concepts of geoinformatics. The concept of information technology and information systems. The concept of geoinformatics and geographic information systems. Definition of GIS based on four subsystems: collection, storage and editing, analysis, data output Lecture 2. Map – a model of representing reality. Map characteristics: scale, resolution, accuracy, extent. Some concepts of the theory of the Earth's figure: geo-id, quasi-geoid, ellipsoid of rotation, general earth ellipsoid, reference ellipsoid, DATUM. Measurements on the Earth's surface, GPS. Lecture 3. Subsystem for collecting and entering information. Input Devices. Means of recognition and vectorization. Georeferencing of data. Interpolation and extrapolation, organization of samples. Databases and DBMS. Types of DBMS: hierarchical, network, relational, object-oriented. Storage and editing subsystem. Lecture 4. Analysis subsystem. The simplest spatial analysis. Classification and quantitative assessment of spatial distributions of objects. Principles of typification and zoning in geology. Surfaces. Methods of representing surfaces. Model TIN. TIN structure. Creation of TIN. Triangulation and topology. Advantages and disadvantages of TIN. GRID model. Lecture 5. Classification. Encoding and recoding of attributes. Statistical surfaces, the phenomena of boundary dissolution and aggregation, the use of neighborhood and adjacency functions, orientation towards general and target analysis, the use of filters for processing and preparing for classification of raster data. Classification based on quantitative attributes. The concept of neighborhood. Filters. Reclassification of surfaces: slope, aspect, mutual visibility, calculation of volumes. Buffer zones. Lecture 6. Spatial distributions. Point, linear and polygonal distributions. Square analysis. Nearest neighbor analysis. Polygon distributions. Line distributions. Gravity model. Overlay operations. Overlays in vector systems. Vector overlay “point in a polygon” and		

"line in a polygon", overlay of polygons. Overlays in raster systems. Using the superimposition operation in problems of typification, zoning and forecasting of geological conditions.

Lecture 7. Cartographic modeling. Describing and prescriptive models. Block diagrams of models, their use for implementation and verification of models. Output of maps and analysis results. Cartographic output. Principles of graphic design. Cartograms. Anamorphoses. Non-cartographic output: tables and graphs, interactive output.

Lecture 8. GIS design. Models of the project life cycle, main stages, priorities. Linear and spiral life cycle models. General parameters of systems and assessment of labor intensity. Conceptual and technical design. Creation of prototypes. Spatial information products. General issues of GIS database design. Verification and approval of the project.

Lecture 9. Technology for automated publication of sets of geological maps. Composition and form of computer representation of reporting cartographic information and mapping.

Lecture 10. Predictive assessment of territories for mineral resources using GIS technologies. Goals, objects and forecasting criteria. Conditions and principles of forecasting. Forecasting methodology. Main technological stages of forecasting.

Lecture 11. GIS and remote sensing. Methodological and methodological aspects of the use of space survey materials in the compilation and preparation for publication of geological maps. QuantumGIS, MapInfo, Google Earth and ArcGIS.

Lecture 12. Geological monitoring of territories, collection and analysis of information. Electronic databases. Information and analytical systems for subsoil use. Geological information funds. State bank of digital geological information.

Main literature

1. V. A. Belkina, S. R. Bembel, A. A. Zaboeva, N. V. Sankova. Fundamentals of geological modeling: textbook. – Tyumen: – TyumGNGU, 2015. – 168 p.
2. Ababkov K.V., Suleymanov D.D., Sultanov Sh.Kh., Kotenev Yu.A., Varlamov D.I. Fundamentals of three-dimensional digital geological modeling: Tutorial. – Ufa: Publishing House "Oil and Gas Business", 2010. – 199 p.
3. Zakrevsky K.E. Geological 3D modeling. – M.: OOO "IPTS Maska", 2009. – 376 p.
4. Bugaevsky L.M., Tsvetkov V.Ya. Geographic information systems: Textbook. manual for universities. – M., 2000. – 222 p.
5. Geoinformatics: Textbook. for students universities/ E.G. Kapralov, A.V. Kashkarev, V.S. Tikunov, etc.; Ed. V.S. Tikunova. – M.: ed. Center "Academy", 2005. – 408 p.
6. Michael N. DeMers. Geographic information systems. Fundamentals/Trans. from English – M.: Data+, 1999. – 491 p.
7. Tikunov B.S. Modeling in cartography. – M.: Publishing house Mosk. University, 1997.- 405 p.

additional literature

1. Belkina V.A., Zaboeva A.A., Sankova N.V. Fundamentals of computer technologies for solving geological and hydrogeological problems (in the ISOLINE environment). Guidelines for laboratory work of students of specialty 130101.65 "Applied Geology". – Tyumen: BIK "Tyumen State Oil and Gas University", 2014. – 44 p.
2. Shubina M. A. Using GIS technologies to analyze materials from remote sensing of natural objects: a textbook for students, S-P, 2023, 104s
3. Badyanov V.A. Methods of computer modeling in problems of oilfield geology. - Tyumen. Shadrinsk: Publishing house "Shadrinsky House of Printing", 2010 - 135 p.
4. Baranov V.E., Kurelenkov S.Kh., Sheveleva L.V. Applied reservoir modeling: Textbook. – Tomsk: Center for professional retraining of oil and gas specialists, 2007. – 104 p.
5. Information technologies in geology: textbook / M. V. Korotaev, N. V. Pravikova, A. V. Apletalin; Moscow State University. Moscow: 2012. 296 p. : https://lib.dvfu.ru:8443/lib/item?id=chamo:664529&theme=FEFU

Information at the rate

Rating (points)	Letter grade	Digital equivalent of assessment	Assessment according to the traditional system (4-point)
87 - 100	A	4.0	Great
80 - 86	B	3.33	Fine
74 - 79	C	3.0	

68 - 73	D	2.33	Satisfactorily
61 - 67	E	2.0	
41 - 60	FX	0	Unsatisfactory
0 - 40	F	0	

Scoring Policy

To assess students' knowledge, a point-rating system for assessing students' educational achievements is used. The grading policy is based on the principles of objectivity, transparency, flexibility and high differentiation. The assessment is carried out through the AVN (electronic testing) system in three stages: 2 milestones (1st and 2nd modules) and a final one. The score is assigned automatically upon completion of the test. In total, you can get 100 points for the discipline, of which the current work (modules 1 and 2) is worth 30 points, the final form of control is worth 40 points. The minimum number for admission to the test is 28 points.

The student has the right to appeal the grade. There is a system of fines: in case of late submission of a task; not attending classes; reward system for: timely delivery of assignments, absence of absences from classes; completing additional tasks. The teacher has the right to further increase or decrease the final scores as an incentive or penalty.

Course Policy

Students must follow the following requirements, rules of conduct in class, relationships with the teacher, and with other students. Fulfillment of which ensures high efficiency of the educational process and is mandatory for students. Below is a list of minimum requirements and rules.

a) Compulsory attendance at classes;
b) Activity during practical (seminar) classes;
c) Preparation for classes, homework and SRS.

Unacceptable:

a) Being late and leaving classes;
b) Using cell phones during classes;
c) Cheating and plagiarism;
d) Late delivery of assignments.

Student Rights

In case of disagreement with the actions or assessment of the teacher, the student has the right and opportunity to appeal to academic advisors, the head of the department, and the appeal commission.

Structure and content of classroom work in the discipline/module

No.	**Discipline/module section**	**Lectures**	**Practical classes**	**Current Forms control**
1	Introduction to GIS. Basic concepts of geoinformatics . Spatial elements	2	4	14
2	A map is a model of representing reality. Graphical representation of objects and their attributes	4	6	20
3	Subsystem for collecting and entering information. Storage and editing subsystem	4	8	20
4	Analysis subsystem. Surfaces	2	4	20
5	Classification	2	4	20
6	Spatial distributions. Overlay Operations	2	4	20
7	Cartographic modeling. Output of maps and analysis results	2	4	20
8	GIS design	2	4	20
9	Technology for automated publication of geological maps	2	4	12
10	Predictive assessment of territories using GIS	4	10	20
11	GIS and remote sensing	2	4	12
12	Geological monitoring	2	4	12
	Total:	30	60	210

The syllabus was discussed and recommended at the department meeting
" " _____ 202___ Protocol No. _____

Head Chairs oh