TITLE OF THE Curricula/Module

WEB -TECHNOLOGIES (AGRO SDI, GEOPORTALS, GEOSERVICES, GEOANALYTICAL SYSTEMS)

NKSU /Kazakhstan

2021

1. Discipline passport

1.1 The scope of the discipline in credits and academic hours. form of control

Table 1

Total		Distribution of hours by occupation					Preparing and passing the exam	Control form, form of conducting
Loans	Clock	Lectures	Practical	laboratory / studio	IWST	IWS		
5	150	30	30	-	15	60	15	Exam, WF

1.2 Objective of the discipline and expected learning outcomes

Purpose of the discipline: formation of students' professional knowledge about modern methods, systems and technologies for obtaining, processing and interpreting remote sensing data. Mastering the theoretical and practical foundations for the use of remote sensing data for information support for land monitoring. The development of the discipline is aimed at acquiring knowledge about the physical foundations of the production of aerial and space surveys, the geometric properties of images, technologies for photogrammetric processing and decoding of images, and the acquisition of skills in using remote sensing data.

Expected learning outcomes:

1.3 Demonstrate knowledge, abilities, skills in the field of mastering the basics of organizing and conducting scientific research in the field of remote sensing data processing and the main areas of scientific research in the Republic of Kazakhstan and abroad.

1.4 Course policy

- ✓ strictly observe the Rules of Academic Integrity of M. Kozybaev NKSU: there is no place for plagiarism, cheating and other forms of deception;
- ✓ not be late for classes;
- ✓ not to miss classes, in case of absence due to illness, provide a certificate;
- ✓ come to classes in business attire;
- ✓ actively participate in the educational process;
- ✓ independently and on time to do homework;
- ✓ be tolerant, open and friendly to fellow students, teachers and employees of the North Kazakhstan State University named after M. Kozybaeva;
- ✓ promote teamwork and participate in discussions;
- ✓ be punctual and obligatory (late arrivals, absences, behavior in the classroom, late submission of work, absence from the exam);
- ✓ comply with the code of honor of the student of the North Kazakhstan State University named after M. Kozybaeva.

1.4 Prerequisites

Electrodynamics

1.5 Post-requisites

No

2. Classroom lessons, their content and volume in hours

Table 2

№ weeks	Type of educational activity	Themes and content of training sessions	Number of hours	Forms and methods of teaching
1	**Module 1: Physical features of radar imagery**			
	lecture	Subject 1.1: The principle of radar imagery.	**2**	*Informational and illustrative, verbal*
	practical	Subject 1.1: Radar data SENTINEL-1 and the possibility of their processing for decryption	**2**	*Information-receptive, partly search.*
2	**lecture**	Subject 1.2: Radio wave survey parameters.	**2**	*Information-receptive, partly search.*
	practical	Subject 1.2: European program GMES and a promising constellation of remote sensing satellites Sentinel	**2**	*Information-receptive, partly search.*
3	**Module 2: Modern and advanced radar systems**			
	lecture	Subject 2.1: Comparative overview of modern radar systems	**2**	*Informational and illustrative, verbal*
	practical	Subject 2.1: Satellites DES Sentinel 2, 3A, Radarsat.	**2**	*Information-receptive, partly search.*
4	**lecture**	Subject 2.2: Comparative overview of modern radar systems	**2**	*Informational and illustrative, verbal*
	practical	Subject 2.2: Satellite ERS TerraSAR..	**2**	*Information-receptive, partly search.*
5	**Module 3: Advanced Directions in the Processing and Application of Radar Data**			
	lecture	Subject 3.1: SAR- data as a spatial basis.	**2**	*Informational and illustrative, verbal*
	practical	Subject 3.1: Radar data - as a spatial basis	**2**	*Information-receptive, partly search.*
6	**lecture**	Subject 3.2: Measuring the heights of terrain objects, building high-precision DTM	**2**	*Informational and illustrative, verbal*
	practical	Subject 3.2: Measuring the heights of terrain objects, building high-precision DES и DEM.	**2**	*Information-receptive, partly search..*
7	**lecture**	Subject 3.3: Monitoring of deformations of various objects, identification of subsidence.	**2**	*Informational and illustrative, verbal*
	practical	Subject 3.3: Interferometric processing of radar data.	**2**	*Information-receptive, partly search.*
8	**lecture**	Subject 3.4: Determination of the speed of fast moving objects.	**2**	*Informational and illustrative, verbal*
	practical	Subject 3.4: Polarimetric interferometry (Pol-inSAR).	**2**	*Information-receptive, partly search.*
9	**Модуль 4: Overview of Radar Processing Software**			

	lecture	Subject 4.1: Geocoding, radiometric calibration and normalization of radar images.	**2**	*Informational and illustrative, verbal*
	practical	Subject 4.1: Software SARscape.	**2**	*Information-receptive, partly search.*
10	**lecture**	Subject 4.2: Data focusing to zero Doppler frequency.	**2**	*Informational and illustrative, verbal*
	practical	Subject 4.2: Software ERDAS Imagine Interferometry.	**2**	*Information-receptive, partly search.*
11	**lecture**	Subject 4.3: Interferometric processing of radar data with output of a map of displacements of the earth's surface.	**2**	*Informational and illustrative, verbal*
	practical	Subject 4.3 Software NEST.	**2**	*Information-receptive, partly search.*
12	**lecture**	Subject 4.4: Polarimetry and polarimetric interferometry.	**2**	*Informational and illustrative, verbal*
	practical	Subject 4.4: Software Toolbox.	**2**	*Information-receptive, partly search.*
13	**Module 5: Space monitoring in agriculture**			
	lecture	Subject 5.1: Creation and updating of various-scale topographic and thematic maps.	**2**	*Informational and illustrative, verbal.*
	practical	Subject 5.1: Radar survey of soils.	**2**	*Information-receptive, partly search.*
14	**lecture**	Subject 5.2: Creation of high-precision digital terrain models.	**2**	*Informational and illustrative, verbal.*
	practical	Subject 5.2: Radar survey of vegetation.	**2**	*Information-receptive, partly search.*
15	**lecture**	Subject 5.3: Monitoring the condition of agricultural land.	**2**	*Informational and illustrative, verbal.*
	practical	Subject 5.3: Geoportal.	**2**	*Information-receptive, partly search.*
Total hours by classroom type	**Lectures**		**30**	
	practical		**30**	

3. Student's independent work

3.1. Tasks for independent work of the student

Table 3

№ SIW	Module name	The task SIW	Form of control	Duration of execution in		Deadline
				weeks	hours	
SIW 1	**Module 1: Physical features of radar imagery**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	1 sunday
SIW 2	**Module 1: Physical features of radar imagery**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	2 sunday
SIW 3	**Module 2: Modern and advanced radar systems**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	3 sunday
SIW 4	**Module 2: Modern and advanced radar systems**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	4 sunday
SIW 5	**Module 3: Advanced Directions in the Processing and Application of Radar Data**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	5 sunday
SIW 6	**Module 3: Advanced Directions in the Processing and Application of Radar Data**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	6 sunday
SIW 7	**Module 3: Advanced Directions in the Processing and Application of Radar Data**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	7 sunday
SIW 8	**Module 3: Advanced Directions in the Processing and Application of Radar Data**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	8 sunday
SIW 9	**Module 4: Review of software products for processing radar imagery.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	9 sunday

SIW 10	**Module 4: Review of software products for processing radar imagery.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	10 sunday
SIW 11	**Module 4: Review of software products for processing radar imagery.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	11 sunday
SIW 12	**Module 4: Review of software products for processing radar imagery.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	12 sunday
SIW 13	**Module 5: Space monitoring in agriculture.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	13 sunday
SIW 14	**Module 5 Space monitoring in agriculture.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	14 sunday
SIW 15	**Module 5: Space monitoring in agriculture.**	Prepare for ***physical dictation*** on lecture topics	physical dictation	**1**	**4**	15 sunday
TOTAL HOURS			**60**			

3.2. Independent work of a student under the guidance of a teacher

For independent work of a student under the guidance of a teacher, 15 academic hours are allocated.

Within the framework of the SIWS hours, consultations are held on certain sections of the discipline in order to improve the quality of mastering programs, on doing homework, term papers, semester and control papers, reports and other types of SIW assignments, current and midterm controls.

3.2.1 Consultation schedule

Consultations are held individually in accordance with the schedule of independent work of students under the guidance of a teacher. The schedule is on the stand of the Department of Physics

3.2.2 The rights and obligations of students to SIWS.

1. To actively perceive the teacher's information received during the period of the introductory lessons on the academic discipline.
2. Independently, on the basis of the teacher's recommendations, study teaching aids, literary sources, do homework, control and coursework, etc.
3. Analyze and systematize your difficult situations, identify the reasons for difficulties in understanding and assimilating educational material, performing other educational activities. To be able to translate unsolvable difficulties into a system of questions for the teacher (to rank them, arrange, formalize), to build their own versions of answers to these questions.
4. Contact a teacher for advice on performing independent work (IWS), their delivery and protection, as well as for additional information on the material covered and all other emerging questions about the course being taught.
5. The student has the right not to be present in the classroom according to the schedule of consultations if the completion of assignments SIW does not cause him any difficulties. A visit to the SROP is mandatory during current and midterm controls.

4. Evaluation rules. Evaluation tools and evaluation criteria for the types of controls.

4.1. Evaluation rules.

- To assess the educational achievements of students, a point-rating letter system for assessing accounting is used with their transfer to the traditional rating scale.

Point-rating letter system for assessing the accounting of educational achievements of students with their transfer to the traditional scale of assessments and ECTS

Letter system score	Digital equivalent	Points (% content)	Assessment according to the traditional system
A	4	95-100	Excellent
A-	3,67	90-94	
B+	3,33	85-89	well
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	
C	2,0	65-69	satisfactorily
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
FX	0,5	25-49	unsatisfactory
F	0	0-24	

- In the course of current and midterm control of academic performance, educational achievements are assessed on a 100 point scale for each completed task or answer (response in current classes, midterm control, homework, independent work, etc.).
- The rating of the admission rating is determined by the arithmetic mean of the grades for the current and midterm controls received during the academic period.
- The final grade for the discipline includes assessments of the admission rating and final control. The assessment of the admission rating is 60% of the final assessment of knowledge in the discipline, and the assessment of the exam is 40% of the final assessment of knowledge in the discipline.

4.2. Evaluation tools and evaluation criteria by type of control

Control type, duration	**Evaluation tool**	**Evaluation criteria**	**Max score**
Current control 1, 1 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 2, 2 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 3, 3 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50

		All formulas are written	50
	Total		**100**
Current control 4, 4 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 5, 5 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 6, 6 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 7, 7 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 8, 8 week Midterm control 1, 8 weeks	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 9, 9 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 10, 10 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 11, 11 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 12, 12 week	physical dictation	Accurate and Logically Correct Statement of Basic	50

		Definitions	
		All formulas are written	50
	Total		**100**
Current control 13, 13 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 14, 14 week	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Current control 15, 15 week; Midterm control 2, 15 weeks	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
	physical dictation	Accurate and Logically Correct Statement of Basic Definitions	50
		All formulas are written	50
	Total		**100**
Final control, session	**Exam** *(the task 1)*	Accurate and Logically Correct Statement of Basic Definitions	**40**
		All definitions, formulas are written	**40**
		A connection has been established between the studied and previously studied material on the discipline, as well as with the material of other subjects.	**20**
	Total		**100**
	Exam *(the task 2)*	The equation is correctly written, the formula	**50**
		Laws, theorems, equations are explained in detail	**50**
	Total		**100**
	Exam *(the task 3)*	The equation is correctly written, the formula	**50**
		Laws, theorems, equations are explained in detail	**50**
	Total		**100**

5. Teacher requirements

1) Turn off your mobile phone during classes.

2) Without fail, "work off" missed classes.

3) During the SIWS, the student can consult with the teacher, consult with the senior in the group on specific issues or work in tandem with any student of the group.

6. Map of educational and methodological provision of the discipline

6.1. List of references

Table 5

№	Title, year and place of publication
	Main literature
1.	© 2017 г. Балдина Е.А., Трошко К.А., лаборатория аэрокосмических методов, Географический факультет МГУ имени М.В. Ломоносова (http://www.geogr.msu.ru/cafedra/karta/materials/radiolocation/files/1razd/1.1.osnovy_osob.html)
2.	Бабокин М.И., Ефимов А.В., Зайцев С.Э., Костров В.В. Обнаружение сдвигов на земной поверхности с помощью РСА интерферометра при переднебоковом обзоре // VIIВсероссийские Армандовские чтения: Современные проблемы дистанционного зондирования, радиолокации, распространения и дифракции волн: Всероссийская научная конференция (27.06–29.06. 2017 г., Муром). –Муром: Изд.-полиграфический центр МИ ВлГУ, 2017.
3.	Ниониашвили М.И., Крючков И.В., Лесников Г.А., Нефедов С.И., Семенов А.Н.Обзор современных радиолокаторов с синтезированной апертурой космического базирования и анализ тенденций их развития // Вестник МГТУ им. Н.Э. Баумана. Сер. «Приборостроение». 2012. С.94-114.
4.	Prats-Iraola P., Scheiber R., Rodriguez-Cassola M., Mittermayer J., Wollstadt S., De Zan F., Brautigam B., Schwerdt M., Reigber A., Moreira A.On the Processing of Very High-Resolution Spaceborne SAR Data // IEEE Transactions on Geoscience and Remote Sensing. 2014. Vol.52. No.10. Pp.6003-6016.
5.	Reigber A., Scheiber R., Jäger M., Prats-Iraola P., Hajnsek I., Jagdhuber T., Papathanassiou K.P., Nannini M., Aguilera E., Baumgartner S., Horn R., Nottensteiner A., Moreira A.Very-High-Resolution Airborne Synthetic Aperture Radar Imaging: Signal Processing and Applications // Proc. of the IEEE. 2013. Vol.101. No.3.Pp.759-783.
	Additional literature
6.	www.panametrics.nt-rt.ru
7.	www.sarmap.ch
8.	http://www.cosmo-skymed.it/en/index.htm

6.3. Methodological support of the discipline

Table 6

№	Name	Location (department, library, electronic library)
3.	УМКД по дисциплине «Использование изображений SENTINEL 1-2-3 для мониторинга сельскохозяйственных полей»	Library, Electronic library, department "Physics" 311/5