NICOPA Curricula Description

Course:

Remote Sensing and Application of Earth and Environment related PA

(First Version)

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Short Name of the University/Country code Date (Month / Year)	NUU-UZ 2020
TITLE OF THE Curricula/Module	**Code**
Remote Sensing and Application of Earth and Environment related PA	

Teacher(s)	Department
Coordinating: **Associate professor: Ilkhomjon Abdullaev** **Others:**	Department of Geodesy and Geoinformatics NUU

Study cycle	Level of the module	Type of the module
BA/**MA**/PhD	Master	

Form of delivery	Duration	Langage(s)
offline	15 weeks	Uzbek

Prerequisites	
Prerequisites: To know: Geodesy, Land Surveying, GIS, Photogrammetry, Remote Sensing Possess: Application of GIS and Remote Sensing	**Co-requisites (if necessary):**

ECTS (Credits of the module)	Total student workload hours	lecture	practice	Individual work hours
4	162	28	44	90

	Aim of the module (course unit): competences foreseeen by the study programme
This course aims at application of remote sensing, techniques and skills for getting information from imagery and ability to solve complex tasks based on remote sensing. Emphasis is placed on gaining a practical understanding of the principles behind each technique and a consideration of their appropriateness in different applications. The knowledge obtained as a result of mastering the discipline is necessary for solving practical problems in the field of professional activity, designing and developing in Land Surveying and precision agriculture.	

Learning outcomes of module (course unit)	Teaching/learning methods	Assessment methods
To know: - Demonstrate detailed, integrated knowledge of the application and history of remote sensing; - Discuss the nature of electromagnetic radiation and its interaction with the earth's surface and atmosphere; - find/obtain RS datasets, download them, and prep them for use in remote sensing analysis. - find and interpret metadata; explore and interpret datasets lacking metadata. - Demonstrate a critical understanding of the differences between remote sensing systems and be aware of their characteristics and limitations;	Lectures, presentations, practical lessons, independent study of the material	Participation in discussions, Course project, Written test Verbal exam Quiz
To be able to: - Explain the principles of calibration and image processing for satellite and airborne sensors - Evaluate and analyse image data from satellites using advanced image processing methods - competently be able to process and interpret remotely sensed images - Evaluate data quality in remote sensing products - Advanced skills in analyzing, integrating and managing spatial data - Identify specific applications where remote sensing may be used as a tool for monitoring and research, collect systematically, understand, analyse critically and apply the results of a significant field of science - Ability to critically evaluate existing theories and technologies and identify the needs for improvement		
Possess: - Competently interpret, process and evaluate remotely sensed images and be able to use remote sensing to achieve self-defined goals; - Critically identify specific applications where remote processing may be used as a tool for monitoring and research; - Define and use appropriately basic concepts related to satellite orbits; - Discuss with critical insight appropriate image processing techniques for specific purposes; - Apply knowledge of image processing principles strategically to new problems.		

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
Introduction to Remote Sensing	2	0	0	2	0	0	**4**	**8**	*Basic approaches and concepts of Remote Sensing, Energy sources and electromagnetic radiation principles, Electromagnetic energy,Electromagnetic spectrum, Energy interactions in the atmosphere, Scattering, Transmission and absorption, Energy interactions with the earth surface, Reflectance, Spectral reflectance for various features types*
Interaction of electromagnetic radiation	4	0	0	4	0	0	**8**	**10**	Interactions with the Earth's surface, Interaction of electromagnetic radiation with real materials, typical spectral reflectance, Optical RS (Visible and Near-Infra Red region), Active RS (Microwave region), Spectrometers, Spectrometer types, Working principles of Imaging spectrometer, Spectral measurements in field, Data acquisition, Spectral reflectance measurements of materials in field, Spectral library
Passive Remote Sensing	2	0	0	4	0	0	**6**	**8**	Platforms for EO data acquisition (satellite, airplane, UAV), Satellite and sensors, Spectral resolution, Spatial resolution, Temporal resolution, Radiometric resolution, Data acquisition, Different aerial camera systems, Multispectral scanner systems, Hyperspectral imaging, thermal imaging, Free available data products
Active Remote Sensing	2	0	0	4	0	0	**6**	**8**	Microwave remote sensing, Principles of radar imaging system, Space borne and airborne sensors, Scattering from earth surface, Polarization in radar systems, Laser scanning, Definitions and Concepts,

									Airborne laser scanning, Terrestrial laser scanning, Mobile laser scanning, Microwave special application (Georadar), LIDAR and application
Digital Image Processing	2	0	0	4	0	0	**6**	**8**	*Pre-processing of remotely sensed data (basis of image correction, registration), Data access, inspection and pre-processing, Radiometric correction, Radiometric enhancement (image filtering and visual properties adjusting), Geometric processing, Image transformation, Process steps, Methods and Tool(s) for process*
Image Classification	4	0	0	4	0	0	**8**	**8**	Visual interpretation, Interpretation fundaments, Features for the visual interpretation of images, Concept of image classification, Pixel-based classification, Unsupervised classification, Supervised classification
Object-based image analysis	2	0	0	6	0	0	**8**	**10**	Concept of OBIA, Segmentation, Image objects and object features, Object-based classification, Methods and algorithms, Tools and approaches for OBIA, Accuracy assessment
Land Cover/Land Use and Change Detection	4	0	0	4	0	0	**8**	**10**	Qualitative and quantitative aspects of land cover, Visual interpretation of land change in remotely sensed data, Time relevant properties of remotely sensed data archives, Quantitative change detection techniques, Multi-temporal image classification, Land change detection software specific approaches
Application of Remote Sensing in Agriculture	2	0	0	4	0	0	**6**	**10**	*Basics on Agricultural Remote Sensing, Crop identification and mapping by remote sensing,NDVI,Classification technics and algorithms, Remote Sensing data in precision agriculture*

Application of Remote Sensing in Natural resource management	4	0	0	8	0	0	**12**	**10**	*Monitoring soil degradation by Remote Sensing, Remote sensing of desertification*, Monitoring of *Water resource,* Remote Sensing in *Forest monitoring and management*
Total	**28**	**0**	**0**	**44**	**0**	**0**	**72**	**90**	

Assessment strategy	**Weight in %**	**Deadlines**	**Assessment criteria**
Running control 1	15	7 week	Test and/or Quiz
Running control 2	15	13 week	Test and/or Quiz
Final exam	70	15 week	Course project development

Compulsory literature/ Author	**Year of issue**	**Title**	**No of periodical or volume**	**Place of printing. Printing house or internet link**
Lillesand T. M., Ralph W. K., Jonathan W. C.	2007	Remote sensing and image interpretation		tbd
Franklin, S E.	2001	Remote sensing for sustainable forest management		tbd
tbd				

ANOTATION /course summery

This course gives all about remote sensing and satellite imagery, starting out with an introduction to remotely sensed data and the electromagnetic spectrum before learning about satellite and aerial imagery capture and data products. You'll learn how to find and download satellite imagery online and how to use it in two different common types of analysis: NDVI and a trained classification. In the second lesson, you'll learn how to use some basic tools to support image analysis using Raster Calculator and Spatial Analyst.

List of **themes and short description**

Themes	Contact work hours
Introduction to Remote Sensing Aim of the lesson is to introduce the concepts of Remote Sensing and clarify the relationship between these concepts: energy interactions in the atmosphere and energy interactions with the earth surface features. The materials focus on the analysing the interaction and independence between sources of electromagnetic energy, the effects of the atmosphere, and the spectral sensitivity of the sensors available to detect the energy. The spectral characteristics of different types of surface will be given.	**4**
Interaction of electromagnetic radiation This lesson aims at introducing interaction between electromagnetic radiation with matter. The key concepts of reflectance, transmittance, absorption and scattering will be presented. Interaction of electromagnetic radiations with real materials and common types of features on the earth will be described. Learning material focuses on correlation between reflectance and surface features: spectral signatures, factors which control the spectral responses will be presented with examples and illustrations. Furthermore the chapter will provide the student with a set of procedure for working with spectrometers in laboratory and field for spectral measurements.	**8**
Passive Remote Sensing Aim of the lesson is to recapitulate and deepen the basics, fundamentals and principles of data gathering. It provides an overview of different sensors and platforms - such as unmanned aerial vehicles (UAV), airplane, and satellite - for the acquisition of passive EO data. Data and subsequently the sensors will be characterised based on the different types of resolutions (spatial, spectral, temporal, and radiometric). Further, the data acquisition process and the different types of sensors (frame cameras, scanners) will be analysed. Examples for widely used sensors and their applications will be given.	**6**
Active Remote Sensing This lesson aims at introducing basics of active remote sensing. It covers the basics of imaging system and polarmetric of radar. The differences in type of sensor and availability of space-borne and airborne sensor. The characteristics of scattering and reflection of microwave energy in various type of surface. An Introduction to Lidar system concepts. The exercises and case studies allow students to explore a range of practical techniques. It demonstrates some special application of microwave like georadar.	**6**
Digital Image Processing This lesson aims at introducing basic and advanced techniques of digital image processing. It covers the fundamental concepts required to understand and apply commonly used and more advanced algorithms for pre-processing of remotely sensed data, image manipulation and characterisation. The exercises and case studies allow students to explore a range of practical techniques. Methods and tools to support these processes will be presented.	**6**
Image Classification This lesson aims at introducing basic and advanced techniques of digital image processing. It covers the fundamental concepts required to understand and apply commonly used and more advanced algorithms for classification of remotely sensed data. It focuses on an image classification knowledge, techniques and skills for getting information from imagery and ability to solve complex tasks based on remote sensing. Emphasis is placed on gaining a practical understanding of the principles behind each technique and a consideration of their appropriateness in different applications. The exercises and case studies allow students to explore a range of practical techniques.	**8**
Object-based image analysis The lesson aims at introducing basic and advanced techniques of OBIA. It covers the fundamental concepts required to understand and apply commonly used and more advanced algorithms for segmentation and classification of remotely sensed data. It focuses on an image classification knowledge, techniques and skills for getting information from imagery and ability to solve complex tasks based on remote sensing. Emphasis is placed on gaining a practical understanding of the principles behind each technique and a consideration of their appropriateness in different applications. The exercises and case studies allow students to explore a range of practical techniques.	**8**
Land Cover/Land Use and Change Detection The lesson aims at introducing concepts of mapping land coves/land use by using RS data and how basic and advanced techniques of digital change detection can be applied to detect and monitor changes on the land surface. It builds on fundamental concepts related to principles of remote sensing	**8**

and basics of image processing and extends knowledge and skills of students into a temporal dimension. Topics are illustrated with examples and case studies. It provides knowledge and understanding on how to create land cover maps at different level and how to monitor changes. From a practically oriented perspective, the theoretical foundations will be expanded by making own experiences on creating map using RS.	
Application of Remote Sensing in Agriculture This lesson aims at providing the principles, potentials and challenges of Earth Observation (EO) technologies in the context of crop type mapping and crop condition monitoring. It combines theoretical and practical sessions. It focuses on how to apply geospatial data to increase the crop productivities, more efficient use of fertilizers, reduction in pesticides so that we will have fewer impacts in the environment. The further objective of the education is to present the processes from data gathering to the thematic information gaining and application for decision making. Image analysis and data integration is one of the most important components of the course. An overview of the images classification and analysis tools, algorithms are given and illustrated by numerous examples.	**6**
Application of Remote Sensing in Natural resource management Aim of the lesson is to presents different application possibilities of remote sensing in natural resource management. The main focus remains on land cover (soil, water and forest) classification on different levels of detail. Additional contents are soil erosion mapping, modelling, water and forest management topics like as monitor water bodies, flooding, deforestation,.. Starting with the presentation of existing and free available data products the lesson provides some basics about different (active and passive) remote sensing data and analysis techniques. For the exercises and case studies, the main focus lies on the added values of multi-temporal data sets such as Sentinel-2 and Landsat for soil, water and forest mapping. Next, to the analysis methods and EO data, the module also makes the importance of high-quality reference data a subject of discussion.	**12**