**Course Name: Geoinformatics in Natural Resource Management**

**Number of credits: 4 ECTS**

**Period: Autumn semester**

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| Coordinator | **Dr. Akhlaq Amin Wani** |
| Credits | 4 (2+2) ECTS |
| Lecturers | **Dr. Akhlaq Amin Wani, Dr. Aasif Ali Gatoo, Dr. Shah Murtaza Mushtaq** |
| Level | Doctoral |
| Host institution | Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K) |
| Course duration | 18 Weeks |

**Summary**

This is a 4 ECTS course which is provided as Optional (Major) course to Doctoral students of Forest Resource Management students. This course is aimed to develop and understanding among the students on basics of geoinformatics and its application for sustainable management of natural resources

**Target student audiences**

PhD (Forest Resource Management) students

**Prerequisites**

Basic knowledge in computers and remote sensing/GIS.

**Aims and objectives**

The course prepares students for careers as leaders in understanding Remote Sensing (RS) and Geographical Information System (GIS) and Applications of RS and GIS in monitoring and managing forest resources.

**General learning outcomes:**

On completion of this course, the students would:

Gain a wider understanding of basic principles of remote sensing and GIS

It will enable the students to explore and handle different satellite datasets for specific applications in forests and vegetation landscapes.

The students will enhance abilities and skills for mapping and monitoring of changes associated with forest and urban green spaces for effective policy making and management.

**Overview of sessions and teaching methods**

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| **Unit** | **Syllabus** |
| **Unit 1:** | Brief introduction to Remote sensing and GIS, Data structure, type and model: Raster and Vector data structure, vector data type, point, line and polygon. Data hierarchical models and overlays. Spatial analysis of vector based and raster based data in the software. Digital elevation models, Global positioning system and differential GPS. |
| **Unit 2:** | Optical, thermal and microwave remote sensing, LiDAR remote sensing. Satellite image interpretation and recognition elements: tone, color, texture, pattern, shape, size and associated features. Introduction of ERDAS, Arc GIS and PolSar-Pro, ENVI softwares, Digital image processing, image rectification, geometric corrections, Image enhancement techniques, Digital image classification, supervised and unsupervised classification. Vegetation Indices, Vegetation Index (VI), Normalized Differential Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI) etc. |
| **Unit 3:** | Applications of Multispectral, Hyperspectral, thermal and microwave remote sensing. Case studies on application of remote sensing and GIS in natural resource management. |
| **Practical** | Spectral characteristics of vegetation, water and soil; Study of Topo-sheets, Forest watershed delineation using GPS, Satellite remote sensing; Study of satellite imageries; Digital image interpretation, Digital image processing in ERDAS software, image classification in ERDAS, preparation of thematic maps in Arc GIS, Watershed delineation and clipping using ERDAS and Arc GIS. Mapping of forest with PolSarPro software, Biomass estimation using RS techniques. |
| **Individual Assignment** | Individual exercise on Image interpretation:   * Satellite data handling (multiple data sets) * Individual LULC mapping project |
| **Group Assignment** | Group exercise on map generation:   * Exercise on watershed delineation using GPS and DEM in ARC GIS * Mapping with PolSar Pro * Demonstrative project on biomass mapping using RS techniques |
| **Self Study** | Understanding the basic and modelling of geoinformatics on provided teaching materials and related literature.  Preparation/processing of geographical data to be used in class activities |

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| **Learning methods** | * In class lecture * Online tutorials * Lab/Field exercises * Project-Based Learning * Individual Assignments * Group Assignments * Presentations |

**Course outline**

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|  | **UNIT 1** |
| **Week1** | Brief introduction to Remote sensing and GIS, Data structure, type and model: Raster and Vector data structure, vector data type, point, line and polygon. |
| **Week2** | Data hierarchical models and overlays. |
| **Week3** | **Practical:** Preparation maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping. |
| **Week4** | Spatial analysis of vector based and raster based data in the software.. |
| **Week5** | Digital elevation models, Global positioning system and differential GPS |
| **Week6** | **Practical:** Spectral characteristics of vegetation, water and soil; Study of Topo-sheets, Forest watershed delineation using GPS |
| **Week7** | **Mid Term Exam** |
|  | **UNIT 2** |
| **Week8** | Optical, thermal and microwave remote sensing, LiDAR remote sensing |
| **Week9** | **Practical:** Satellite remote sensing; Study of satellite imageries; Digital image interpretation, Digital image processing in ERDAS software, image classification in ERDAS, preparation of thematic maps in Arc GIS |
| **Week10** | Satellite image interpretation and recognition elements: tone, color, texture, pattern, shape, size and associated features. |
| **Week11** | Introduction of ERDAS, Arc GIS and PolSar-Pro, ENVI softwares |
| **Week12** | Digital image processing, image rectification, geometric corrections, Image  enhancement techniques |
| **Week13** | Digital image classification, supervised and unsupervised classification. |
| **Week14** | Vegetation Indices, Vegetation Index (VI), Normalized Differential Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI) etc. |
| **Week15** | **Practical:** Watershed delineation and clipping using ERDAS and Arc GIS. Mapping of forest with PolSarPro software, Biomass estimation using RS techniques. |
|  | **UNIT 3** |
| **Week16** | Applications of Multispectral, Hyperspectral, thermal and microwave remote sensing. |
| **Week17** | Case studies on application of remote sensing and GIS in natural resource management. |
| **Week18** | **Practical Exam/Assignment submission/Presentation** |
|  | **End Tem Exam** |

**Literature**

**Compulsory**

Joseph G. 2005. Fundamentals of Remote Sensing-Second edition. Universities Press.

Lillesand TM and Kiefer WR. 1994. Remote Sensing and Image Interpretation, Fourth edition. John Wiley & Sons, Inc., USA.

Campbell JB. 2002. Introduction to Remote Sensing-Third edition. Taylor and Francis, London.

**Recommended**

Environment System Research Institute.1999. GIS for Everyone. Redlands, CA:ESRI.

Jackson MJ. 1992. Integrated Geographical Information Systems. International Journal of Remote sssSensing, 13(6-7): 1343-1351.

Obi Reddy, GP and Sarkar D. 2012. RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.

Prithvish Nag. 1995. Digital Remote Sensing. IBD, Dehradun.

Surender Singh and Patel. 1999. Principles of Remote Sensing. Scientific Publishers, Jodhpur, India.

Prem C. Pandey, Laxmi K. Sharma 2021. Advances in Remote Sensing for Natural Resource Monitoring. John Wiley; Sons, Ltd. OI:10.1002/9781119616016.

Chang-Wook Lee, Hyangsun Han, Hoonyol Lee and Yu-Chul Park (Eds.) 2021.

Artificial Intelligence Methods Applied to Urban Remote Sensing and GIS. <https://doi.org/10.3390/books978-3-0365-1603-5>. <https://www.mdpi.com/books/book/4081-artificial-intelligence-methods-applied-to-urban-remote-sensing-and-gis>.Adler, F. R., & Tanner, C. J. (2013). Urban Ecosystems. Cambridge University Press.

**Course workload**

The table below summarizes course workload distribution:

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| --- | --- | --- | --- |
| **Activities** | **Learning outcomes** | **Assessment** | **Estimated workload (hours)** |
| **In-class activities (32 hours)** | | | |
| Lectures | Understanding theories, concepts, methodology and tools in Geoinformatics in Forest Resource Management. | Class participation | 16 |
| Moderated in-class discussions | Understanding various policy and management contexts and common problems in communication in Geoinformatics in Forest Resource Management. | Class participation and preparedness for discussions | 05 |
| Reading and discussion of assigned papers for seminars and preparation for lectures | Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature | Class participation, creative and active contribution to the discussion | 05 |
| Group presentation | Ability to interpret data, to analyze the audience, and use the concepts, tools to understand Geoinformatics in Forest Resource Management. | Quality of group assignments and individual presentations | 06 |
| **Practical (Lab and Field) (64 hours)** | | | |
| Practical | Ability to perform lab experiments and use field based equipment after demonstration of tools and procedures by the instructor. | Class/Field participation for data generation and preparedness for field project works | 64 |
| **Independent work (51 hours)** | | | |
| Self-Study | Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature |  | 25 |
| Individual Assignment/Presentation | Ability to individually interpret data, analyze the audience, and use the concepts, and tools, to understand Geoinformatics in Forest Resource Management. |  | 10 |
| Group Assignment/Presentation | Ability to interpret data, analyze the audience, and use the concepts, and tools, to understand Geoinformatics in Forest Resource Management. | Quality of group assignments and individual presentations | 16 |
| ***Total*** |  |  | ***147 Hours*** |

**Grading**

The students’ performance will be based on the following:

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| **Mode of assessment** | **% of marks** |
| Quiz 1 | 5 |
| Mid Term (Objective and Written) | 20 |
| Practical/Assignments (Discussion) | 25 |
| Quiz 2 | 5 |
| End Term (Objective and Written) | 45 |
| **Total** | **100** |

**Evaluation**

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| **% secured** | **Grade** |
| <55% | Fail |
| 55% and Above | Pass |