Geoinformatics Program

Department of Geoinformatics

University of Kashmir, Srinagar- I90006, J&K

Course Structure and Syllabi for

Master of Science in Geoinformatics

Choice Based Credit System

Effective from academic session 2019

Choice based Credit System (CBCS) Scheme and course structure for
M.Sc. Geoinformatics
1st semester effective from academic session 2019 and onwards

1 S T S E M E S T E R

Course Code	Course Name	Paper Category	Hours per week			Credits
			L	T	P	
GI19101CR	Computers and Geoinformation Management	Core	3	0	0	3+0+0=3
GIP19101CR	Practical-Computers and Geoinformation Management	Core	0	0	2	0+0+1=1
GI19102CR	Fundamentals of Remote Sensing	Core	3	0	0	3+0+0=3
GIP19102CR	Practical-Fundamentals of Remote Sensing	Core	0	0	2	0+0+1=1
GI19103CR	Fundamentals of GIS	Core	3	0	0	3+0+0=3
GIP19103CR	Practical-Fundamentals of GIS	Core	0	0	2	0+0+1=1
GI19104CR	Seminar and hands-on	Core	2	0	0	1+1+0=2
GI19105DCE	Digital Cartography and Geoinformation Visualization	Elective (DCE)	3	1	0	3+1+0=4
GI19106DCE	Applications of Remote Sensing and GIS	Elective (DCE)	3	1	0	3+1+0=4
GI19107OE	Introduction to Remote Sensing	Open Elective (OE)	2	0	0	2+0+0=2
GI19108GE	GIS Basics	Generic Elective (GE)	2	0	0	2+0+0=2
Total credits	**21**	**2**	**6**	**26**		
L= Lecture; T= Tutorial; P= Practical						

General Instructions for the Candidates

1. The two-year (4 semesters) PG programme is of 96 credit weightages i.e., 24 credits / semester (24x4=96).
2. A candidate has compulsorily to opt for 14 credits from the core component in each semester.
3. A candidate has to obtain a minimum of 8 credits (2-3 papers) from the Discipline Centric Electives (DCE) offered by his/her own Department.
4. A candidate has compulsorily to obtain a minimum of 2 credits from Generic Elective (GE) or Open Electives (OE) or a combination of both offered by the departments other than his/her own.
5. A candidate can earn more than the minimum required credits (i.e, more than 96 credits for four semester programme) which shall be counted towards the final

GI19101CR: COMPUTERS AND GEOINFORMATION MANAGEMENT

Credits: 3

Course Outcome:

- Develop basic skills and understanding of the computer operations.
- Development of basic computer programming skills.
- Geospatial data handling and management.

Unit I: Programming and Problem Solving in C

Introduction to number systems and conversions. Basic flowcharts with examples. 'C' character set, keywords, data types, constants, variables, Operators: arithmetic, logical, relational, assignment and conditional operators. Expressions and statements in C, Symbolic constants. Basic programs in C. Control statements: If statements, If-Else and Switch-Case statement with examples. Loops in C: While, Do-While and For Loop with examples. Introduction to: Arrays, Structures, Functions and Pointers.

Unit II: Geospatial Data Handling

Ideal computer configuration for satellite data analysis and geospatial modelling. Role of computers in GIS and remote sensing data analysis. Metadata: introduction, importance and standards. Remote sensing data types: Signed, unsigned, float, double, complex. Data compression techniques: Advantages and disadvantages. Data conversion in remote sensing and GIS: Necessity, advantages and disadvantages.

Unit III: Geospatial Data Management

Overview of data management in GIS, Common geospatial data types: Geodatabase, Feature class, Raster and vector. Basic raster analysis in GIS: Resampling, arithmetic operations, clip. Vector analysis: Fishnet and its applications. Designing sampling intensity. Spatial analysis operations: Data extraction and zonal statistics.

Books recommended:

- Maguire, D. J. 1989. Computers in Geography, Addison-Wesley Longman Publishing Co.
- Mather, P. M. 1991. Computer applications in geography. John Wiley & Sons, Inc.
- Drozdek, A. 2001. Elements of data compression. Brooks/Cole Publishing Co.
- Jeffrey, A. H., Mary, P. & Fred, R. M. 2002. Modern database management. Prentice Hall, USA. Balagurusamy, E. 2002. Programming in ANSI C. Tata McGraw-Hill Education.
- Current review and comparisons of different hardware and software published frequently, particularly for the DOS environment in magazines such as Byte and PC Magazine.

GIP19101CR: PRACTICAL-GEOSPATIAL DATA HANDLING AND MANAGEMENT.

Credits: 1

- Computers: Handling and maintenance
- Hands on MS Office (MS Word, MS Excel, MS Power point)
- Control statements: If, If-Else and Switch-statements.
- Loops: While, Do-While and For Loops,
- Data conversions: Basic import and export operations in GIS
- Data management schemes/methods in GIS

GI19102CR: FUNDAMENTALS OF REMOTE SENSING

Credits: 3

Course Outcome:

- Developing an understanding of the current state of knowledge in Remote Sensing.
- To expose the students to the principles of electromagnetic radiation, satellite systems platforms and sensors.
- Interpretation of digital images and how to effectively extract desirable information from images.

Unit I: Concepts and Overview of Remote Sensing

Remote sensing: Definition, history and scope. Overview of remote sensing systems: Typical Remote Sensing system and its components, sensor resolution (Spatial, spectral, temporal and radiometric), Electromagnetic radiation (EMR) and Electromagnetic Spectrum (EMS): parts of electromagnetic radiation, theories of electromagnetic radiation, radiation laws, atmospheric windows. Interactions of EMR with atmosphere, interaction of EMR with earth's surface features; vegetation, water, and soils. Spectral signatures of common land-cover types and criterion of choosing spectral signatures.

Unit II: Sensors and Data Interpretation

Important satellite systems; LANDSAT, SPOT, IRS, MODIS, IKONOS, ASTER. Types of Scanners: OM Line scanners, CCD Line and Area scanners. Photo-grammetry: types and characteristics of aerial photographs (scale, resolution, projection, overlaps), measurement of scale and height, relief displacement, stereoscopy. Stereo imaging: principles, and sensors for stereo-imaging (ASTER). Principles of visual image interpretation: elements of visual image interpretation, importance and factors governing the interpretability. Use of ancillary information for satellite data interpretation. Ground Truth Collection: importance, methods, and equipment, GT proforma

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Unit III: Digital Image Processing

Digital Image processing (DIP): Introduction to DIP. Digital data and data storage formats (BSQ, BIL, BIP), Image formats like Binary, IMG, GeoTIFF and HDF etc. Image statistics, like mean, range, variance, standard deviation, histogram and scatterplots. Pre-processing of satellite data like geometric and radiometric distortions. Color composites: band combination, false color composite and true color composites, band math operations Image enhancement techniques: linear, non-linear, and histogram equalization.

Books recommended:

- Lillesand, T., Kiefer, R. W., & Chipman, J. 2014. Remote sensing and image interpretation. John Wiley & Sons.
- Jensen, J. R. 1996. Introductory digital image processing: a remote sensing perspectiv*e* (No. Ed. 2). Prentice-Hall Inc.
- Cracknell, A. P and Hayes, L.W.B. 1993. Introduction to Remote Sensing, Taylor and Francis London.
- Colwell, R. N. 1983. Manual of remote sensing. American Society of Photogrammetry.
- Jensen, John R. 2004. Introductory Digital Image Processing, Prentice Hall

GIP19102CR: PRACTICAL-FUNDAMENTALS OF REMOTE SENSING

Credits: 1

- Tutorial on different modules of ERDAS Imagine image processing software
- Introduction to different image and remote sensing data formats
- Import and export utility of ERDAS Imagine
- False color composite, True Color composite
- Preparation of satellite data for analysis like rotate, subset, layer stacking.
- Pre-processing of satellite data like image registration and geo-correction.
- Visual interpretation of different earth features from the images
- Image processing operations like, image enhancements and math operations.
- Use of image statistics in satellite image interpretation
- Spectral response of different earth features from multi-spectral image data

GI19103CR: FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM

Credits: 3

Course Outcome:

- Impart the basic knowledge of the principle concepts of geo-spatial data handling with GIS
- Develop competence in the use of geospatial tools for, analysis and use of thematic, spatial and spatiotemporal data.

Unit I: Overview of GIS

GIS basics: Introduction, Definition, historical perspective, Components of GIS. Types of GIS. Concept of data/information and knowledge, Importance and Applications of GIS; Geographic data sources (Remote Sensing, GPS, Maps and Field observations). Spatial and non-spatial data: introduction, importance and integration.

Unit II: Databases and Data Models

Data models: Concept and types, Raster data model, Vector data model, Advantages and disadvantages of raster and vector data models, issue related to data model conversation. Applications of data models; Digitization, data errors, and data editing. Concept and applications of Topology in GIS.

Unit III: Geospatial Data Analysis

Geospatial analysis: Introduction, vector-based analysis (Non- topological and topological functions with examples of each type), Raster based analysis (Local operations, neighbourhood operations, extended neighbourhood operations, regional operations with examples of each type).

Books recommended:

- Burrough, P. A. 1996. Principles of Geographic Information Systems for land resources assessment, Oxford: Clarendon Press.
- Demer, Michael, N. 2000. Fundamentals of Geographic Information Systems, JW and Sons.
- Chang, K. 2004. Introduction to GIS, McGraw-Hill, Dubuque, Iowa.
- Clarke, K. C. 2003. Getting Started with Geographical Information Systems, Prentice Hall, Upper Saddle River, New Jersey.
- De Mers, M. N. 2002. Fundamentals of Geographic Information Systems**.** John Wiley and Sons, New York.
- Chrisman, N. 2002. Exploring Geographic Information Systems**,** J W and Sons

GIP19103CR: PRACTICAL-GEOSPATIAL ANALYSIS

Credits: 1

- Familiarization with GIS software systems-ARCGIS
- Data input; digitization, scanning
- Data editing of spatial and non-spatial data
- Use of attributes and other tabular data
- Database creation, linking, joining and registration
- Geo-processing of geospatial data like buffering, proximity analysis etc.
- Data query and preliminary data analysis
- Map making, layouts and production

GI 19104 CR: SEMINAR AND HANDS-ON

Credits: 2

Course Outcome:

- To make students understand the applications of various platforms, instruments/analysers
- To build the communication skills, and scientific paper reading/writing of the students

Unit I: Tutorial and hands-on

- Hands on Google Earth.
- Creation of geospatial database of ground data pertaining to land use land cover
- Process of Map Making
- GPS operation
- Air Quality sensors

Unit II: Seminar

- Seminars and Group discussions on the topics pertaining to geomatics like Disaster vulnerability, Smart-city planning, resource assessment, glaciology etc.

Web links:

- Google Earth Pro
- Trimble Terrasync Reference Manual (GPS)

GI19105DCE: CARTOGRAPHY AND GEOINFORMATION VISUALIZATION

Credits: 4

Course Outcome:

- Expose students to the basic and advanced techniques of digital cartography for visual exploration and presentation of the geo-information data.
- Develop map design, composition and editing skills
- Teach techniques for Integration of thematic, spatial and non-spatial data at various scales

Unit I: Map Making

Maps: Introduction, types of maps, uses of maps. Cartography: analogue and digital cartography, cartographic generalizations. Map composition: map design and layout, map scale, legend, annotations. Coordinate systems, Geoid and datums. Map projections: introduction, properties and aspects of map projections, classification of map projections.

Unit II: Data Sources and Visualization

Data sources for mapping: remote sensing, field observations, GPS, maps and other ancillary data. Survey of India (SOI) map index, Use and users of geo-spatial data, National geospatial data policy, Data products w.r.t land surface processes, disasters, EIA and geology. Visualization techniques: Visual exploration for different features/surfaces, virtual reality and scenario mapping.

Unit III: Statistical Data Analysis

Measurement Scales: nominal, ordinal, interval, and ratio. Measures of central tendency: mean, median, mode, Measures of Dispersion: range, Variance, standard deviation, coefficient of variation, skewness and kurtosis. Regression and correlation analysis. Basic concepts of time series data analysis.

Unit IV: Geospatial data updating and dissemination

Map updating using GPS and Remote Sensing data. Assessing the accuracy of maps. Geospatial data dissemination: maps, graphics, animations, multi- media, internet and posters. Quantitative representation of spatial and non-spatial data. Digital and cartographical and landscape models.

Books recommended:

- Ormeling, F., & Kraak, M. J. 2010. Cartography: Visualization of Geospatial Data. Prentice Hall.
- Robinson, Arthur H., JoelL. Morrison, Phillip C. Muehrcke, A. Jon Kimerling, and Stephen C. Guptill 1995. Elements of Cartography, John Wiley and Sons, New York.
- Laurini, R., & Thompson, D. 1992. Fundamentals of spatial information systems. Academic press. London.
- Longley, Paul A., M.F. Goodchild, D.J. Maguire, and D. W. Rhind 2005. Geographic Information Systems and Science, John Wiley and Sons, New York.
- DeMers, Michael N 2008. Fundamentals of geographic information systems, John Wiley & Sons Richard K. Brail, and Richard E. Klosterman 2001. Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools, ESRI Press.
- Lo, C. P. & Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.

GI19106DCE: APPLICATIONS OF REMOTE SENSING AND GIS

Credits: 4

Course Outcome:

- Familiarize students with the basic and advanced applications of geoinformatics
- Expose students to basic methodologies of remote sensing and GIS for environmental monitoring

Unit I: GIS Applications and Case Studies

Utility mapping using GIS, Wildlife habitat analysis, Land suitability analysis, Geoinformatics for Environmental impact analysis (EIA), Disaster vulnerability analysis (seismic microzonation, landslide hazard zonation), Geoinformatics for Land information System (LIS).

Unit II: Geospatial Modeling and Applications

Geospatial Modeling: introduction, importance and techniques. Land degradation modeling, watershed prioritization. Hydrological modeling, flood vulnerability zonation. Environmental modeling: Integrated Environmental analysis and assessment of tourism carrying Capacity, Eco-zonation mapping. Crop growth modelling in GIS environment.

Unit III: Remote Sensing Applications

Role of Remote Sensing in Landslide mapping, Flood mapping and Agriculture monitoring. Land use/land cover mapping and monitoring, Urbanization (urban land use, urban sprawl). Role of Remote Sensing in Fishery and wildlife application.

Unit IV: Advanced Applications of Remote Sensing

Vegetation applications (Deforestation, forest fire,nNet primary productivity estimation, Leaf area index). Cadastral mapping. Geological applications (lithology, structure). Water resources assessment (snow and glaciers, ground water exploitation) Environmental evaluation and monitoring (wetlands, desertification)

Books recommended:

- DeMers, M. N. 2003. Fundamentals of geographic information systems. J. Wiley.
- Chrisman, N. 2002. Exploring Geographic Information Systems**,** J W and Sons, New York.
- Cracknell, A. P and Hayes, L.W.B. 1993. Introduction to Remote Sensing, Taylor and Francis London.
- Colwell, R. N. 1983. Manual of remote sensing. American Society of Photogrammetry.
- Jensen, John R. 2004. Introductory Digital Image Processing, Prentice Hall.

GI19107OE: INTRODUCTION TO REMOTE SENSING

Credits: 2

Unit I: Overview of Remote Sensing

Remote sensing: Definition, history and scope. Overview of a typical remote sensing system and its components. Electromagnetic radiation (EMR) and Electromagnetic Spectrum (EMS). Interactions of EMR with earth's surface features; vegetation, water, and soils.

Unit II: Sensors and Satellite systems

Sensor resolution (Spatial, spectral, temporal) and its importance. Characteristics of important satellite systems: LANDSAT and IRS. Applications of satellite data in earth observation. Elements of image interpretation. Hands on satellite data.

Books recommended:

- Lillesand, T., Kiefer, R. W. & Chipman, J. 2014. Remote sensing and image interpretation. John Wiley & Sons.
- Jensen, J. R. 1996. Introductory digital image processing: a remote sensing perspective (No. Ed. 2). Prentice-Hall Inc.
- Qihao W. 2017. Advances in Environmental Remote Sensing, CRC Press.
- Principles of remote sensing. A handbook from ITC Netherlands.
- Gupta, R. P. 2003. Remote Sensing Geology, Springer-Verlag
- Available at: http://www.itc.nl/library/papers_2009/general/PrinciplesRemoteSensing.pdf

GI19108GE: GIS BASICS

Credits: 2

Unit I: Fundamentals of GIS

Definition and scope of GIS, historical perspective, Components of GIS, types of GIS. Concept of data/information and knowledge, A few applications of GIS; Geospatial data sources (Remote Sensing, GPS, Maps and Field observations).

Unit II: Geospatial data analysis

Spatial and non-spatial data: introduction, importance and integration. Data models: Raster and Vector data models. Hands on GIS software: Creation of GIS database (point, line and polygon).

Books recommended:

- Chang, K. 2004. Introduction to GIS, McGraw-Hill, Dubuque, Iowa.
- Lo, C. P. & Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.
- De Mers, M.N. 2002. Fundamentals of Geographic Information Systems. John Wiley.
- Heywood I, Sarah C and Steve C. 2011. An Introduction to Geographical Information Systems. Prentice Hall.

Choice based Credit System (CBCS) Scheme and course structure for M.Sc. Geoinformatics 2nd semester effective from academic session 2019 and onwards

2 ND SEMESTER

Course Code	Course Name	Paper Category	Hours per week			Credits
			L	T	P	
GI19201CR	Fundamentals of Microwave Remote Sensing	Core	3	0	0	3+0+0=3
GIP19201CR	Practical-Fundamentals of Microwave Remote Sensing	Core	0	0	2	0+0+1=1
GI19202CR	Advanced Remote Sensing and Image Processing	Core	3	0	0	3+0+0=3
GIP19202CR	Practical-Advanced Remote Sensing and Image Processing	Core	0	0	2	0+0+1=1
GI19203CR	Advanced Geoinformatics	Core	3	0	0	3+0+0=3
GIP19203CR	Practical-Advanced Geoinformatics	Core	0	0	2	0+0+1=1
GI19204CR	Mapping from space	Core	1	0	2	1+0+1=2
GI19205DCE	DBMS and Geospatial Databases	Elective (DCE)	3	1	0	3+1+0=4
GI19206DCE	Disaster, Risk and Hazard Assessment	Elective (DCE)	3	1	0	3+1+0=4
GI19207DCE	Remote Sensing for Urban and Regional Planning	Elective (DCE)	3	1	0	3+1+0=4
GI19208GE	Applications of Remote Sensing	Elective (GE)	2	0	0	2+0+0=2
GI19209OE	Applications of GIS	Elective (OE)	2	0	0	2+0+0=2
Total credits			**23**	**3**	**8**	**30**
L= Lecture; T= Tutorial; P= Practical						

GI19201CR: FUNDAMENTALS OF MICROWAVE REMOTE SENSING

Credits: 3

Course Outcome:

- Develop an understanding of the radar remote sensing principles.
- Promote complimentary use of optical and microwave remote sensing products.
- Expose the students to new applications in the field of microwave remote sensing.

Unit I: Introduction

Microwave region of Electromagnetic spectrum, Historical perspective of microwave remote sensing. Details of the Space-borne and air-borne radar systems: ERS/JERS-1/ALOS/A-SAR/AIRSAR SAR systems. Advantages and disadvantages of radar remote sensing viz-à-viz optical remote sensing. Definition and concept of SLAR, Synthetic Aperture Radar (SAR). SAR viewing geometry: slant range, ground range, azimuth, look-angle, incidence angle, Local incidence angle. Backscattering coefficient and sigma naught expression of SAR. Radar equation.

Unit II: Sensor and Target Characteristics:

Concept of wavelength and frequency in SAR, Radar penetration, SAR polarization, Dielectric constant, SAR dependence on dielectric constant w.r.t. angle and frequency. SAR sensitivity to surface roughness, Roughness-frequency dependence, Roughness-incidence angle dependence. Speckle: Definition and causes of speckle in SAR images, speckle, Multi-looking, Topographic influences on radar imaging: shadow, foreshortening and layover, methods for minimizing the topographic influences.

Unit III: Radar Backscattering Modeling:

Backscattering of earth's features, Introduction to radiative transfer theory, some common modelling approaches like discrete, continuous, first orders scattering, and second order scattering. Examples of these modelling approaches viz. cloud model and MIMICS model. Scattering mechanisms of SAR signals with surface (bare soil) and volume (vegetation). Interferometry: concept and application, baseline, repeat pass interferometry. Applications: Cryosphere: snow parameters (extent, depth, density, SWE), Glacier ELA, AAR, glacier velocity and glacier depth changes; Forestry: Woody biomass and tree height estimation; Hydrology; flooding, soil moisture determination

Books recommended:

- Allan, T. D. 1983. Satellite microwave remote sensing.
- Ulaby, F.T., Moore, R.K., Fung, A.K., Microwave Remote Sensing, vol. I, II and III. Massachusetts, Adison Wilsey.
- Trevett, J. W. 2013. Imaging radar for resources surveys. Springer Science & Business Media Hall, London
- Sharkov, E. A. 2003. Passive microwave remote sensing of the Earth: physical foundations. Springer Science & Business Media.

- Lillesand, T., Kiefer, R. W., & Chipman, J. 2014. Remote sensing and image interpretation. John Wiley & Sons.
- Sabins, F. F., Freeman W. H. 1987. Remote sensing principles and interpretation, Taylor & Francis San Francisco.

GIP19201CR: PRACTICAL-FUNDAMENTALS OF MICROWAVE REMOTE SENSING

Credits: 1

- Exploratory microwave data analysis
- Conversion of Intensity to sigma naught image
- Speckle removal algorithms
- SAR backscattering coefficient and signature of the common earth features
- Comparison of the optical and microwave remote sensing for LULC

GI19202CR: ADVANCED REMOTE SENSING AND IMAGE PROCESSING

Credits: 3

Course Outcome:

- Develop skills for advanced remote sensing and image processing of satellite data.
- Impart know-how on the methods of extracting information from the satellite data.
- Demonstrate the usefulness of satellite data for real world applications

Unit I: Advances in Remote Sensing

Remote sensing in 21st century. Extra-terrestrial/Planetary Remote Sensing, Geophysical Remote Sensing and its applications. Thermal remote sensing: introduction and applications. Hyper spectral remote sensing: introduction and applications. Concepts of LiDAR and UAV. Integration of multi-sensor data: introduction, technique, constraints and applications.

Unit II: Image Processing Techniques

Uni-variate and multi-variate statistics in Digital Image Processing. Filtering: introduction, high pass filter, low pass filters, density slicing, edge enhancement and detection filters. Band math and ratioing: image indices (VI, NDVI, PVI, SAVI). Principal component analysis (PCA): introduction, technique and applications.

Unit III: Classification of Satellite Data

Image classification: Supervised and Unsupervised approaches, Parametric and Non-parametric classifiers, Per-and Sub-pixel Classification, Stages of supervised classification. Feature selection and feature reduction. Classification algorithms: ISODATA, K-means, Maximum likelihood, Mean distance to means, Parallelepiped, Mahalanobis. Limitations of statistical classifiers. Classification Accuracy Assessment: testing samples, error matrix, errors of commission and omissions, Kappa statistics.

Books recommended:

- Rencz, A. N. 1999. Manual of Remote Sensing for Earth Sciences, J W and Sons.
- Richards, J.A. and Jia, X. 2005. RS Digital Image Analysis: An Introduction, Springer Verlag.
- Lillesand, R.M. and R.W. Kiefer, 1994. Remote Sensing and Image Interpretation, *3rd Ed*, NY: John Wiley and Sons, Inc.
- Sabins, F. F., Freeman W. H. 1987. Remote sensing principles and interpretation, Taylor & Francis San Francisco.
- Campbell, J.B, 2011. Introduction to remote sensing, Taylor and Francis, London.
- John, A. Richards 1993. Remote Sensing Digital Image Analysis, Springer-Verlag.
- Jensen, J.R. 1996. Introductory Digital Image Processing, A Remote Sensing Perspective, Upper Sanddle River, Prentice Hall.

GIP19202CR: PRACTICAL-ADVANCED REMOTE SENSING AND IMAGE PROCESSING **Credits: 1**

- Advanced image processing techniques viz., Principle component analysis of remote sensing data
- Mosaicing of images, Image Fusion
- Digital Image Classification: Unsupervised and Supervised, Change Detection Analysis
- Accuracy assessment of thematic maps
- Development of spectral indices using optical remote sensing data
- Individual/Group-wise assignment

GI19203CR: ADVANCED GEOINFORMATICS **Credits: 3**

Course Outcome:

- Imparting advanced concepts of geo-informatics,
- Development of skills in the use of geo-information technology for modelling land surface processes and other critical applications.

Unit I: Contemporary Issues in Geoinformatics

Emerging trends and scope of Geoinformatics. Technological advancements in Geoinformatics, Information Technology and Sensor technology. Data standardization: Data standards, data quality, Scale issues in RS and GIS. GIS design methodology, design and implementation, technical, manpower and institutional issues.

Unit II: Recent advancements in GI Science

Enterprise Geographic Information System (GIS): definition trends, implementation and its applications. GPS data use and importance in geospatial analysis. Data integration in GIS: Socio-economic GIS, integration and application of socio-economic and environmental data, fundamentals of multi-criteria analysis. GIS based decision support system: fundamentals and applications.

Unit III: Sampling and Interpolation

Sampling theory: Geographic data sampling methods Interpolation: Introduction, importance, data sources for interpolation, types of interpolation, Methods for interpolation (thesein polygons, inverse distance weighted, splines and krigging). Uses of interpolation, Issues involved with interpolation of spatial data. Surface mapping: Concept, types of surfaces and application. Digital Elevation Model (DEM): Definition, methods of development, and applications of DEM.

Books recommended:

- Burrough, P. A. 1996. Principles of Geographic Information Systems for land resources assessment: Oxford: Clarendon Press.
- Chang, K. 2004. Introduction to GIS, 2nd Edition. McGraw-Hill, Dubuque, Iowa.
- Lo, C. P. and Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.
- DeMers, M.N. 2002. Fundamentals of Geographic Information Systems**,** 2nd Edition. John Wiley and Sons, New York.

GI19203CR: PRACTICAL-ADVANCED GEOINFORMATICS **Credits: 1**

- Geospatial data editing, and attributes
- Use of Model Builder for Geospatial Analysis.
- Spatial data analysis
- Census and other socio-economic data analysis.
- Spatial modelling in GIS environment particularly land degradation, and hydrological modelling.
- Individual/Group-wise assignment on spatial modelling

GI19204CR: MAPPING FROM SPACE **Credits: 2**

Individual/Group assignment on mapping and analysis of infrastructure / natural resources / utilities using satellite data and GIS to train the student on digital mapping using GIS/RS. The students shall be exposed to the field validation / ground truth of the generated maps and post-field correction of the maps using various indices / matrices.

GI19205DCE: DBMS AND GEOSPATIAL DATABASES **Credits: 4**

Course Outcome:

- To make an understanding about the working of database management system.
- To define queries in the standard language SQL, stored tables and queries.
- To learn about the aspects of data base design and its applications.

Unit I: Fundamentals of Database Management System

Database concepts. Steps in database design: Prototype model and Waterfall model. Database management system (DBMS): Network DBMS, Hierarchical DBMS, Relational DBMS, Codd's rules, Comparison between these DBMS. Editing and Storing GIS databases. Concept of keys in a database.

Unit II: DBMS Concepts

Theoretical and mathematical understanding of database querying: Relational Algebra. Basics of SQL, data types and constraints in SQL. Data definition language, data manipulation language, data control language in SQL. GIS Data modelling using Entity Relationship Diagrams. Framing the ER models for: Village Information system, Tourist Development Authority, Rural Development, Water Resource Information System.

Unit III: Regional and global databases I

Global land use datasets. Global ecosystem maps. Datasets related to vegetation: Global forest datasets-AVHRR global forest resource assessment, AVHRR NDVI dataset, Hansen (2013) global forest change database. Global NPP datasets. BALANS land cover data Agriculture datasets-FAOSTAT and its components. Vegetation map of India. Harmonized world soil database.

Unit IV: Regional and Global databases II

Global topographic data: GOTOPO, SRTM, ASTER, Carto DEM. GEOnet names server, Gridded population of the world, Global glacier inventories: RGI, WGI, GLIMS. ICIMOD glacier inventory. World lake database. National Wetland Inventory Assessment. Wetland Atlas of Jammu and Kashmir. Web-portals for data download: Bhuvan, Earth Explorer, WebGIS, India-WRIS. Global climate datasets: ECOCLIMATE, WorldClim.

Books recommended:

- Elmasri, R., Navathe S. B. 2007. Fundamentals of Database Systems, Pearson Education.
- Benynon-Davies, P. 2002. An introduction to Informatics in Organizations. Information Systems: Palgrave (formally Macmillan).
- Date, C. J. 2000. An introduction to Database Systems, Reading, M. A. Addison-esley.
- Ramakrishnan, R. and Gehrke J. 2003. Database Management Systems, Boston, M. A, McGraw.
- Teorey, T.J. 1994. Data base Model Design: The fundamental Principles, San Mateo, CA, Morgan Kaufmann.

GI19206DCE: DISASTER, RISK AND HAZARD ASSESSMENT **Credits: 4**

Course Outcome:

- To learn about the application of geoinformatics for disaster management.
- To develop and devise logistic action plans for the post disasters with the help of GIS analysis.

Unit I: Disaster Management

Differentiate hazard, disaster, risk and vulnerability. Disaster vulnerability of J&K State, Preparedness and mitigation measures for various disasters. Disaster management with respect to earthquakes, flood and landslides**,** Natural disasters (earthquakes, floods, landslides, GLOFS, avalanches), anthropogenic disasters; Disaster vulnerability assessment of a location and vulnerable groups.

Unit II: Remote sensing for disaster assessment

Satellite remote sensing for disaster assessment, real time disaster analysis and management, identification of flood prone areas using remote sensing and other ancillary data, post disaster analysis of inundated areas, earthquake-hit areas and post-flood crop loss estimation etc. Forest fire identification and zonation using remote sensing data.

Unit III: Geoinformatics for disaster assessment

Flood control, drought management, cyclones, avalanches, land use planning. GPS for early warning system for disasters. GIS for Risk assessment, Recent trends in Geoinformatics for disaster management. Seismic microzonation using geological, geophysical and socio-economic data

Books recommended:

- Aki, K. and Richards P.G. 2002. Quantitative Seismology, University Science Books, S, C A.
- Bolt, B.A. 1992. Inside the Earth, W.H. Freeman, SanFrancisco.
- Alcira K., Margaret A., Anee C. 2003. Building safer cities, NYork UN. Press.
- Pascale Zarate 2008. Collaborative Decision Making: Perspectives and Challenges, James and
- James Science Publisher.
- Fowler, C.M.R. 1990.The Solid Earth: An Introduction to Global Geophysics, C. Press.
- Demer, Michael, N. 2000. Fundamentals of Geographic Information Systems: John Wiley and Sons, Inc.
- Iyer, H.M. and Hirahara K. (Eds.) 1993. Seismic Tomography Theory and Practice, C and H, NY.
- Kyoji S., Paolo C. 2008. Landslides-Risk reduction, Kluwer Academic Publishers. Lay, T. and T.C. Wallace 1995. Modern Global Seismology, Academic Press, San Diego.
- Eve C., Denis S., Steve T. 2000, Risk management and Society

GI19207DCE: REMOTE SENSING FOR URBAN AND REGIONAL PLANNING

Credits: 4

Course Outcome:

- To use different high-resolution satellite data products for urban planning.
- To develop a credible remote sensing and GIS system for urban area related problems.

Unit I: Introduction to Urban Planning

Principles of urban area development and land use planning. Importance of Urban and regional planning. Urbanization trends in Jammu and Kashmir with special reference to the Srinagar and Jammu city centres. Impact of urbanization on different natural resources of Jammu and Kashmir with reference to some case studies. Master planning for urban land use. Unplanned urbanization and resource mis-management.

Unit II: Remote Sensing for Human Settlement Analysis

Urban area identification and interpretation using high and moderate resolution remote sensing data, Various classification systems; Residential area classification; Space use classification system; Urban land use classification systems, interpretation, monitoring and change detection analysis using satellite imagery. Mapping urban land use and urban sprawl with remotely sensed data.

Unit III: Socio-economic GIS

Census operation in India, census data and field observations, Demographic and social patterns, Socio economic and residential area evaluation. Remote sensing for population studies and settlement, slum settlement detection. Updating of population data, Traffic and parking survey with high spatial resolution satellite data, Role of Geoinformatics in Transportation Planning. Geoinformatics for cadastral based land information system.

Unit IV: GIS for Urban Resources and Services Planning

Eco-zonation of ecologically fragile landscapes. Urban facility mapping, Advancement of Geoinformatics in services sector particularly Utilities. Urban land evaluation and suitability analysis, Urban hazards and risk management. Seismic micro zonation of urbanized areas.

Books recommended:

- Hashim, N. and Rainis, R. 2003. Urban Ecosystem Studies in Malaysia: A Study of Change. Universal-Publishers.
- Lillesand, R.M. and R.W. Kiefer, 1994. Remote Sensing and Image Interpretation, 3rd Ed, NY: John Wiley and Sons, Inc.
- Branch, M. C. 1971. City Planning and Aerial Information. Cambridge, Harvard Uni. Press.
- Burrough, P.A. 1996. Principles of Geographic Information Systems for land resources assessment: Oxford: Clarendon Press.
- Demer, Michael, N. 2000. Fundamentals of Geographic Information Systems, John Wiley and Sons, Inc.

GI19208GE: APPLICATIONS OF REMOTE SENSING

Credits: 2

Unit I: Remote Sensing Data

Mapping standards for land use, and land cover. satellite data platforms: Google earth and Bhuvan. Low, medium and high-resolution satellite datasets and their applications in earth and environmental sciences.

Unit II: Remote Sensing techniques

Land use and cover mapping, Flood inundation mapping. Identifying landslide prone sites. vegetation mapping, and urbanization.

Books recommended:

- Lillesand, R.M. and Kiefer R.W. 1994. Remote Sensing and Image Interpretation, NY: John Wiley and Sons, Inc.
- Jensen, J.R., 2005. Remote sensing of Environment, Pearson Education.
- Cracknell, A.P and L.W.B. Hayes, 1993. Introduction to Remote Sensing, Taylor and Francis London.

GI19209OE: APPLICATIONS OF GIS **Credits: 2**

Unit I: Geomatics Applications

Utility mapping (Water supplies, roads and power supplies) Solid waste disposal site selection, Wildlife habitat suitability analysis

Unit II: GIS for Hazard Assessment

Role of GIS in hazard assessment. Application of GIS for flood and landslides hazard assessment, GLOF risk assessment

Books recommended:

- Demer, Michael, N. 2000. Fundamentals of Geographic Information Systems, John Wiley and Sons, Inc
- Clarke, K.C. 2003. Getting Started with Geographical Information Systems, 4th Edition. Prentice Hall, Upper Saddle River, New Jersey.
- Lo, C. P. and Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.

Choice based Credit System (CBCS) Scheme and course structure for M.Sc. Geoinformatics 3rd semester effective from academic session 2019 and onwards

3rd S E M E S T E R

Course Code	Course Name	Paper Category	Hours per week			Credits
			L	T	P	
GI19301CR	Field Survey and GNSS	Core	3	0	0	3+0+0=3
GIP19301CR	Practical- Field Survey and GNSS	Core	0	0	2	0+0+1=1
GI19302CR	Advanced GIS Data Analysis and modelling	Core	3	0	0	3+0+0=3
GIP19302CR	Practical-Advanced GIS Data Analysis and modelling	Core	0	0	2	0+0+1=1
GI19303CR	Hydroinformatics	Core	3	0	0	3+0+0=3
GI19304CR	Project	Core	3	0	0	3+0+0=3
GI19305DCE	Glaciology	Elective (DCE)	3	0	0	3+0+0=3
GIP19305DCE:	Practical- Glaciology	Elective (DCE)	0	0	2	0+0+1=1
GI19306DCE	Geomorphology from Space	Elective (DCE)	3	0	0	3+0+0=3
GI19307 DCE	Fieldwork	Elective (DCE)	0	0	2	0+0+1=1
GI19308GE	Mapping in GIS	Elective (GE)	2	0	0	2+0+0=2
GI19309OE	Frontiers in Earth Sciences	Elective (OE)	2	0	0	2+0+0=2
Total credits			**22**	**0**	**6**	**26**
L= Lecture; T= Tutorial; P= Practical						

Seminar: A candidate shall have to deliver one seminar lecture in the subject per semester in the 3rd semester carrying weightage of 1 credit. The topic of the seminar lecture shall be allotted by the concerned teachers/Department to the candidate well in advance.

GI19301 CR: FIELD SURVEY AND GNSS **Credits: 3**

Course Outcome:

- To make students understand the importance of field survey and enable them to collect field data on various aspects of earth system using the survey instruments
- To acquire the skills of interpreting, synthesizing and disseminating field data and other instrument data
- To make use of data from GPS and field into a GIS environment.

Unit I: **Introduction to Surveying and Mapping**

Geographic data collection, spatial location and reference. Issues and challenges in geospatial data collection from remote sensing platforms and ground-based approach. Historical background in the advancements in surveying. Basic principles of surveying, Type of surveys, (a) Surveying techniques, (b) Procedure of field survey, (c) Collection of data, (d) Error adjustments. Ground truth data format for land cover, wetlands, forests, urban built up and glaciers. NNRMS mapping standards.

Unit II: Field Data Collection Techniques

Traditional Field Equipment: - Theodolite, Abney Level, Plane Table. Application of latest technology instruments like GPS, 3D Laser Scanners, EDM, Total Station for field mapping. Compilation of data: Data quality assessment, Digitizing and the creation of a geospatial database. Data interpretation by integration of field and remotely sensed data.

Unit III: Global Navigation Satellite Systems

Geo-positioning basic concepts. Introduction to GNSS, concept, types and components. Concepts of DGPS, GNSS satellite constellations: Russian, European, GAGAN, IRNSS. GPS accuracy, wave frequencies, error corrections. Ground data collection: spatial and non-spatial data for analysis and modelling, GPS signal interferences, Applications of GPS in resources surveys / mapping, crustal deformation and urban land cover.

Books recommended:

- Leick, A. (1995). GPS Satellite Surveying, 2nd end. Wiley, New York. Chicheste Brisbane Toronto Singapore.
- Hofmann-Wellenh of B, Lichtenegger H. (2007). GPS Theory and Practice, Springer (5th eds), Wien New York.
- Kennedy, M. (1996). The Global Positioning System and GIS: An Introduction. Chelsea: MI. Ann Arbor Press, Inc.
- Lo, C. P., & Yeung, A. K. (2002). Concepts and techniques of geographic information systems (pp. 143-191). Upper Saddle River, NJ: Prentice Hall.
- Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote sensing and image interpretation. John Wiley & Sons.

GIP19301CR: PRACTICAL FIELD SURVEY AND GNSS

Credits: 1

- GPS handling and ground data collection through LDM, Camera, measuring tape, etc.
- Total Station operation and survey
- Abney's level operation and data collection
- Accuracy assessment of the satellite-based land use and land cover data.
- DGPS survey of the University Campus/Dal Lake/Mughal gardens/ public parks.
- Validation of the satellite-based Digital Elevation Models with the GPS data.
- Group assignment on survey/field data collection

GI19302CR: **ADVANCED GIS DATA ANALYSIS AND MODELLING**

Credits: 3

Course Outcome:

- Utilize spatial models to make simulations and predictions of real-life phenomena.
- Evaluate models in terms of accuracy, sensitivity, and uncertainty.
- Use a system-based approach for problem solving.

Unit I: Modelling concepts

Modelling frameworks and approaches; Types and classification of models. Distributed and lumped models, empirical models, semi-empirical models, deduction and induction models. Hypothesis testing vs. exploratory data analysis Raster based modelling (Map algebra). Hydrological modelling and Cellular Automata (Agent modelling) in GIS environment.

Unit II: Model Evaluation

Framework for selecting the "best model" for any land surface process, Model boundary conditions, Model validation, calibration and sensitivity analysis, Model uncertainty Analysis, Data quality issues with observational data. Importance of observation networks to understand and predict land surface and climate processes.

Unit III: Modelling Approaches

Geospatial model Input parameters w.r.t. Hydrological, Erosion and Nutrient models. Remotely sensed hydro-meteorological parameters and their uses in modelling. Downscaling and up-scaling of geospatial data. Statistical approaches of representing natural variations.

GIP19302CR: **PRACTICAL ADVANCED GIS - DATA ANALYSIS AND MODELLING** **Credits: 1**

- Floodplain and flood inundation mapping
- Landslide hazard zonation mapping in GIS
- Integration of village level census data in GIS
- Hands on multi-criteria analysis

Books recommended:

- Bailey, T. C. (1994). A review of statistical spatial analysis in geographical information systems. Spatial analysis and GIS, 13-44.
- Fotheringham, A. S., Brunsdon, C., & Charlton, M. (2000). Quantitative geography: perspectives on spatial data analysis. Sage.
- Laurini, R., & Thompson, D. (1992). Fundamentals of spatial information systems (No. 37). Academic press.
- Chou, Y. H. (1997). Exploring spatial analysis in geographic information systems. In Exploring Spatial Analysis in Geographic Information Systems. On Word Press.

GI19303CR: HYDROINFORMATICS **Credits: 3**

Course Outcome:

- To assess and manage the water resources vis-a-vis the application of Geoinformatics.
- To learn to develop site specific strategies or plans for water resource management using the Geoinformatics.
- To enable the identification and management of potential ground water resources.

Unit I: Hydrological Cycle and Processes

Hydrological cycle. Water balance and its components, Hydrographic analysis Hydrometeorology: stream flow, temperature, precipitation and evapotranspiration measurements from instruments and remote sensing; Statistical methods for the analysis of stream flow, temperature, precipitation and other time series data, runoff–flow duration curve, flow mass curve,

Unit II: Remote Sensing for Surface and Ground Water

Remote sensing techniques for water resources assessment: Interpretation of satellite data for water resources, impact of spatial resolution on water resources mapping. Surface water bodies mapping (visual interpretation and digital image processing for mapping irrigation tanks, ponds, reservoirs, lakes etc.). Role of remote sensing for quantifying the hydrological processes. Groundwater interactions in different landscapes, Groundwater potential mapping using remote sensing and GIS.

Unit III: Geoinformatics for Watershed Management

Watershed concept and types, Watershed characterization and hydrological modelling. Concept of Runoff and overland flow, Factors affecting runoff processes. Watershed factors that affect runoff: size, topography, shape, orientation, aspect, geology, soil; interflow and baseflow processes, DEM applications in water resources. Watershed management, planning and conservation principles. Geoinformatics for watershed management and prioritization

Books recommended:

- Te Chow, V. (2010). Applied hydrology. Tata McGraw-Hill Education.
- Engman, E. T., & Gurney, R. J. (1991). Remote sensing in hydrology. Chapman and Hall Ltd.
- Singh, V. P. (1992). Elementary hydrology. Pearson College Division.
- Goodman, A. S. (1984). Principles of water resources planning.
- Patra, K. C. (2001). Hydrology and water resources engineering (pp. 395-410). Pangbourne: Alpha Science International.
- Brubaker, K. (2001). Snow and Glacier Hydrology. Eos, Transactions American Geophysical Union, 82(49), 611-611.
- Marsalek, J., Maksimovic, C., Zeman, E., & Price, R. (Eds.). (2013). Hydroinformatics tools for planning, design, operation and rehabilitation of sewer systems (Vol. 44). Springer Science & Business Media.

GI19304CR: TERM WORK **Credits: 3**

Topics for dissertation research work will be given to the students and they will be asked to make a synopsis presentation which would orient them with respect to the basic aims, objectives and tentative methodology to carry out their proposed work. Further, a mid-semester review presentation will be conducted in order to assess the progress of the students

GI19305DCE: GLACIOLOGY **Credits: 3**

Course Outcome:

- To explore the nature and the dynamics of glaciers
- To understand the Himalayan Cryosphere and problems these glaciers are facing.

Unit-I Glaciology Basics

Glaciers: Glacier Formation, glacier types and facies. Glacier movement. Glacial erosional and depositional features. Origin of ice-ages, Glacial and interglacial periods. Last Glacial Maximum, Younger Dryas, Little ice age. Glacier drainage characteristics. Geochronology of glacial landforms.

Unit-II Glacier dynamics

Cryosphere studies: Pre-requisites for a glacier field expedition, Glacier dynamics (ELA, AAR, velocity); snow:(snow cover, snow depth, snow water equivalence, snow density, Snow depletion curves), Mass balance approaches; geological, hydrological, geodetic, AAR-based. Instrumentation for glaciological studies.

Unit-III: Himalayan Glaciers

Snow and glacier resources of Kashmir. Climate change and glaciers. Snow hydrology, snowmelt runoff modeling (Degree day and energy balance approaches). Black carbon deposition on glaciers and its impacts on melting, and other feedbacks. Impacts of changing Himalayan cryosphere on political stability in south Asia.

GIP19305DCE: PRACTICAL- GLACIOLOGY **Credits: 1**

- Glacier inventory
- Snow cover mapping
- AAR based mass balance
- Geodetic mass balance
- Geomorphic features

Books recommended:

- Bennett, M. R. and Glasser, N. F., 2000.Glacial Geology Ice Sheets and Landforms. Wiley Sharp,
- M., Richards, K. S. and Tranter M., 1998.Glacier Hydrology and Hydrochemistry. Wiley Allan, T. D.
- BennD.I. and EvansJ A D., 1997. Glaciers and Glaciation. Woody's Books USA.
- Hubbard, B. and Glasser N. F. 2005. Field Techniques in Glaciology and Glacial Geomorphology. Wiley

GI19306DCE: GEOMORPHOLOGY FROM SPACE

Credits: 3

Course Outcome:

- To understand the dominant process shaping a particular landscape.
- To be able to identify landforms and perform geomorphological analysis using the remote sensing technology.

Unit I: Fundamentals of Geomorphology

Overview of geomorphology: Geomorphic processes and geomorphic agents, Geomorphological cycle. Morphometric and morphotectonic analysis of basins. Geomorphic evolution of Western Himalaya.

Unit II: **Geomorphic Landforms:**

Introduction to Landforms; Fluvial landforms; Glacial, aeolian and karst landforms Types; Drainage Systems; Drainage Basins, Drainage Patterns.

Unit III: Geomorphological Mapping

Introduction to geomorphic Mapping; Latest tools and methodologies such as field sampling, GPS usage, 3–4D mapping, GIS analysis, digital image analysis, etc. Geomorphic analysis

Books recommended

- Short, Nicholas M. "Geomorphology from space: a global overview of regional landforms." Workshop on the Earth as a Planet. 1986.
- Bloom, A. L. (1998). Geomorphology: a systematic analysis of late Cenozoic landforms (No. 551.79 BLO).
- Burbank, D. W. and Anderson, R.S., 2001: Tectonic Geomorphology Blackwell Sciences
- Easterbrook, Easterbrook, 1994: Surface Processes and Land Forms. Prentice Hall. McCalpin, J., 1996: Paleoseismology Academic Press.
- Pitty, A. F. (1982). The nature of geomorphology (p. 161). London; New York, NY: Methuen.
- VK (geomorphology). Sharma. (1986). Geomorphology: Earth Surface Processes and Forms. Tata McGraw-Hill Publishing Company Limited
- Thorrenberry, W. D., 1997: Principles of Geomorphology New Age International, Delhi.
- Kale, V. S., & Gupta, A. (2001). Introduction to geomorphology. Orient Longman.

GI19307DCE: FIELDWORK **Credits: 1**

Candidates will be taken for field work within state for understanding different land surface process and collection of field data for different applications.

GI19308GE: MAPPING IN GIS **Credits: 2**

Course Outcome:

- To make students familiar with earth observation data analysis.
- To help students in accessing globally available geospatial data repositories
- To expose students to basics of mapping using GIS platforms.

Unit-I: Fundamentals of mapping

National Mapping standards - NNRMS and its importance. Levels of classification from earth observation data. NNRMS standards from land cover and vegetation mapping. Basic components of a map and concept of scale in mapping. Data sources for mapping: remote sensing, field observations, GPS, maps and other ancillary data. Hands-on GIS: Creation of point, line and polygon theme).

Unit-II: Basics of GIS Analysis

Elements of image interpretation. Web-portals for data download: Bhuvan and Earth Explorer. Delineating land use/land cover from earth observation data: opportunities and challenges. Ground truth procedure and ground data collection pertaining to land cover and vegetation. Hands-on GIS: Land cover mapping, Map making and Accuracy assessment.

Books recommended

- Burrough, P. A. 1996. Principles of Geographic Information Systems for land resources assessment, Oxford: Clarendon Press.
- De Mers, M. N. 2002. Fundamentals of Geographic Information Systems. John Wiley and Sons, New York.
- Ormeling, F., &Kraak, M. J. 2010. Cartography: Visualization of Geospatial Data. Prentice Hall.
- Robinson, Arthur H., et al. 1995. Elements of Cartography, John Wiley and Sons, New York.

GI19309OE: FRONTIERS IN EARTH SCIENCES **Credits: 2**

Course Outcome:

- Students will be able to understand the language of geology
- Students will learn knowledge of geologic information

Unit-I Knowing Earth

Introduction: Scope of earth Sciences, Origin of Earth, Structure of earth; Crust, Mantle & Core; Outer spheres: Atmosphere, hydrosphere, biosphere of the earth, Exogenous and endogenous process.

Unit-II Geological time scale

Geological Time Scale: Stratigraphy laws, Lithostratigraphic Units, Chronostratigraphic Unit and Bio-stratigraphic Unit History of Earth: (a) Fossils (b) minerals/rocks; (c) Structures; (d) Paleogeography

Books recommended

- Holmes, A., 1996: Principles of Physical Geology, EUBS, Chapman.
- Judson, S. and Kaufman, M. E., 1990: Physical Geology, Prentice Hall.
- Press, F. and Seiver, R., 1989: The Earth, W. H. Freeman.

Choice based Credit System (CBCS) Scheme and course structure for M.Sc. Geoinformatics 4th semester effective from academic session 2019 and onwards

4TH SEMESTER

Course Code	Course Name	Paper Category	Hours per week			Credits
			L	T	P	
GI19401CR	**Project work**	Core	0	6	0	0+6+0=6
GI19402CR	**Geospatial Statistics**	Core	3	0	0	3+0+0=3
GIP19402CR	**Practical Geospatial Statistics**	Core	0	0	2	0+0+1=1
GI19403CR	**Open Sources GIS**	Core	2	0	2	2+0+1=3
GI19404CR	**Ground truth**	Core	0	0	2	0+0+1=1
GI19405DCE	**Climatology and Climate Change**	Elective (DCE)	3	1	0	3+1+0=4
GI19406DCE	**Recent Advancements In Dip**	Elective (DCE)	3	1	0	3+1+0=4
GL19407GE	**Natural Disasters**	Elective (GE)	2	0	0	2+0+0=2
GL19408OE	**Earth Surface Processes**	Elective (OE)	1	1	0	1+1+0=2
Total credits			14	9	8	26
L= Lecture; T= Tutorial; P= Practical						

GI19401CR: PROJECT WORK Credits: 6

As a part of the curriculum, the students would be assigned research/project work related to the use of remote sensing and Geographic Information System for any of the themes/areas on landuse/landcover mapping, cartography, geomorphology, civil engineering, hydrology, agriculture, urban and regional planning, database development, assessment of earth resources and other general environmental problems. The objective is to expose students to various techniques so that they would consolidate their skills learned in the theory and practical sessions of related to various courses.

GI19402CR: GEOSPATIAL STATISTICS

Credits: 3

Course Outcome:

- To understand the concept and techniques of Geospatial statistics.
- To apply the Geospatial techniques on spatial varying phenomena.

Unit I: Fundamentals of Geospatial Statistics

Introduction: importance and application of Statistics for Earth Sciences. Spatial sampling procedures, non- sampling and sampling errors, sampling design. Design of experiments. Confidence intervals. Hypothesis testing. Analysis of variance. The statistical methodology and models to analyse time series data with special reference to geological, environmental and agriculture sciences. Models and methods for the analysis of dataset with missing values.

Unit II: Techniques and Applications of Geospatial Statistics

Overview of applications and techniques for univariate and multivariate statistics for multi-dimensional satellite data; spatial continuity analysis; estimation; simulation. Overview of spatial statistics, estimation, and modelling with examples. Autocorrelation principles. Variogram analysis. Applications of variogram analysis for continuously varying phenomena like soil moisture, forest structure

Unit III: Statistical Analysis

Descriptive statistics and data analysis, organizing, summarizing and analysing spatial data, histogram analysis, probability distribution, scatter plots and data redundant analysis for multi-dimensional spatial data, correlation in multivariate data, data transformations (logarithmic, indicator, normal-score, rank-order); principal component analysis. Time series analysis and applications of time series analysis for feature extraction from the multi-temporal satellite data, remote sensing applications for wetland monitoring, disaster damage assessment, and urban sprawl

GIP19402CR: Practical Geospatial statistics

- Semi-Variogram analysis
- R statistical software Basics
- Hands on exercise on plotting and graphic software, SURFUR, GNUPLOT,
- Latex/Tex

Books recommended

- Kitanidis (1997). Introduction to Geostatistics. University Press.
- Cressie (1993).Statistics for Spatial Data.Wiley& Sons.
- Gelfand, Diggle, Fuentes, Guttorp (2010). The Handbook of Spatial Statistics. Chapman& Hall/CRC.
- David, M.(1988). Hand book of Applied Advanced Geostatistical Ore Reserve Estimation, Elsevier, Amsterdam, 216pp.
- Gelfand, A.E., Diggle, P.J., Fuentes, M., and Guttorp, P., eds. (2010) Handbook of Spatial Statistics, CRC Press.
- Hald,A. Statistical Tables and Formulas, Wiely, New York,1952.

- Isaaks, E.H. and R.M. Srivastava (1989) An Introduction to Applied Geostatistics. Oxford University Press.
- James E. Burt and Gerald M. Barber. (1996). Elementary Statistics for Geographers, 2nd ed., Guilford Press.
- Metheron,G. (1963). Principals of geostatistics, Economic Geology,58,1246-66.
- Stewart Fotheringham and Peter A. Rogerson. (2009). The SAGE Handbook of Spatial Analysis, SAGE Publications.
- Warrick, A.W.,D. E. Myers and D. R. Nielsen. (1986). Geostatistical methods applied to soil sciences, in Methods of Soil Analysis,Part1,Agronomy monogram No.9, American society for Agronomy, Madison, Wis.

GI19403CR: OPEN SOURCES GIS

Credits: 3

Course Outcome:

- To expose students to free open source platforms for remote sensing and GIS data analysis
- Develop competence among students in the use of geospatial tools available from open source GIS platforms.

Unit I: Geospatial Analysis in QGIS:
QGIS features; menu and toolbars; Map navigation. Vector Analysis: Digitization and Symbology, Geoprocessing-Buffer, Union, Intersect, Clip, Data Import/Export and Querying, On the fly projection. Raster data analysis: Virtual raster, Mosiacing, Terrain analysis, zonal statistics, Projections and transformations. Open street maps. Plugins in QGIS. Map Composition in QGIS.

Unit II: Fundamentals of ILWIS:
Key features of ILWIS. Displaying geographic data in ILWIS, Displaying raster and vector data in ILWIS, Concept of domains in ILWIS. Coordinate systems and georeferencing in ILWIS. Raster and vector data import. Rasterization and vectorization. Resampling, Subset, Resampling and band visualization.

Unit III: Hands-on Open source GIS:
Students will be assigned different group and individual assignments pertaining to use of different geospatial tools available from open source GIS platforms.

Books recommended

- Anita Graser. (2016). Learning QGIS - Third Edition. Packt Publishing, Birmingham UK.
- Kurt Menke, Richard Smith Jr., Luigi Pirelli, John Van Hoesen. (2015). Mastering QGIS - Second Edition. Packt Publishing, Birmingham UK.
- Jesse Russell, Ronald Cohn. (2012). ILWIS. Book on Demand, Berlin Germany.

GI19404CR: Ground truth Credits: 1

Students will carry on ground truth of the assigned research/project work related to the use of remote sensing and Geographic Information System for any of the themes/areas on anduse/landcover mapping, cartography, geomorphology, civil engineering, hydrology, agriculture, urban and regional planning, database development, assessment of earth resources and other general environmental problems.

GI19405DCE: CLIMATOLOGY AND CLIMATE CHANGE

Credits: 4

Course Outcome:

- To give a basic understanding of climate and its variables.
- To understand the process of climate change and its impacts.

Unit I: Atmospheric Science-I

Nature, composition and layered structure of the atmosphere. Factors controlling insolation; heat budget of the atmosphere. Horizontal and vertical distribution of temperature; Inversion of temperature. Cloudbursts, Greenhouse effect and importance of ozone layer.

Unit 11: Atmospheric Science-II

Global atmospheric pressure belts and their oscillation. General wind circulation. Jet stream and index cycle. Monsoon mechanism with reference to jet streams. Synoptic weather forecasting, prediction of weather elements such as precipitation, temperature; hazardous weather elements like thunderstorms, cyclones

Unit III: Climate Models

Introduction to global climate models and regional climate models. Downscaling and upscaling of climate data; IPCCC climate Change scenarios. Climate change impact Studies; glaciers; water resources; food security; Paleo-climate inference from lake sediments, ice-cores; loess-paleosols.

Books recommended

- Lal, D. S. (2003). Climatology. Sharda Pustak Bhawan.
- Critchfield, H. J. (1974). General climatology (No. 551.59 C75 1974).
- McGuffie, K., & Henderson-Sellers, A. (2005). A climate modelling primer. John Wiley & Sons.
- Wallace, J. M., & Hobbs, P. V. (2006). Atmospheric science: an introductory survey (Vol. 92). Elsevier.
- Rohli, R. V., & Vega, A. J. (2008). Climatology. Jones and Barttlett Publishers. Sudbury, MA, USA.
- Ahrens, C. D. (2012). Meteorology today: an introduction to weather, climate, and the environment. Cengage Learning.
- Trenberth, K. E. (Ed.). (1992). Climate system modeling. Cambridge University Press.
- Bonan, G. (2015). Ecological climatology: concepts and applications. Cambridge University Press.

GI19405DCE: RECENT ADVANCEMENTS IN DIP

Credits: 4

Course Outcome:

- To introduce students with advanced topics in digital remote sensing
- To learn in depth insights into theoretical and conceptual underpinnings in satellite remote sensing

Unit 1: Digital Image Processing:

Image Fusion; Band Rationing in Digital Image Processing; Integration of multi-sensor data: introduction, technique, constraints and applications. Basic pattern recognition concepts, boundary detection and representation, textural and contextual analysis, Principles of spectral discrimination.

Unit II: Image classification:

Multivariate image statistics, Optical remote sensing data filters, radar speckle/noise removal techniques. SAR segmentation techniques. Advanced image classification techniques: Knowledge based classifier, Artificial Neural Networks and Fuzzy logic, C-means clustering, Hybrid training. Classification accuracy assessment. Hyper–spectral image analysis and feature based classification.

Unit III: Remote sensing Applications:

Geological mapping (lithology, structural mapping). Use of remote sensing data for snow and glacier mapping, change detection studies (deforestation and LULC), Remote sensing for crustal deformation and hydrological analysis.

Books recommended

- Campbell, J., (2002). Introduction to Remote Sensing. Guilford Press, New York.
- John, A., Richards. (1993). Remote Sensing Digital Image Analysis. Springer-Verlag.
- John, R., Jensen. (2000). Introductory Digital Image Processing, A Remote Sensing Perspective.
- Lillesand, T. M. and Kiefer, R W. (1987). Remote Sensing in Geology. J. Wiley. Prentice Hall.
- Lillesand, T. M. and Kiefer, RW. (2002). Remote Sensing and Image Interpretation, John Wiley.
- Rees, W. G. (2001). Physical Principles of Remote sensing. Cambridge Uni. Press.
- Sabbins, F. F. (1985). Remote Sensing - Principles and Applications.
- Jensen, J.R. (2005). Remote sensing of Environment, Pearson Education.

GL19406GE: NATURAL DISASTERS

Credits: 2

Course Outcome:

- To give students a basic knowledge of natural disasters causes, impact and assessment.

UNIT I: Earthquakes

Definition, types, magnitude and intensity. History of earthquakes in Kashmir. Seismic waves: types. Seismographs and seismograms. Earthquake location: Focus, epicentre and hypocentre; seismic zoning, Earthquake Prediction and precautionary measures,

UNIT II: Other hazards

Landslides: definition, classification, prevention measures/ methods. Landslide prone areas along Srinagar to Jammu national highway. Floods: definition, classification, prevention and precautionary measures. History of floods in Kashmir. Cloudburst: definition, types, causes, prediction.

Books Recommended

- Rossi, P. H., Wright, J. D., Weber-Burdin, E., Pietras, M., & Diggins, W. (1982). Natural hazards and public choice. New York: Academic Press.
- Skinner, B. J., Porter, S. C., Park, J. J., & Levin, H. L. (2004). Dynamic Earth: An introduction to physical geology.
- Bell, F. G. (2003). Geological hazards: their assessment, avoidance and mitigation. CRC Press.
- Keller, E. A., & DeVecchio, D. E. (2016). Natural hazards: earth's processes as hazards, disasters, and catastrophes. Routledge.
- Hyndman, D., & Hyndman, D. (2016). Natural hazards and disasters. Cengage Learning.
- Sheridan, S. (2013). The Disaster Diaries: How I Learned to Stop Worrying and Love the Apocalypse.

GL19407OE: EARTH SURFACE PROCESSES Credits: 2

Course Outcome:

- To provide an exposure of the surface processes of earth to the students

UNIT I: Surface processes

Introduction to earth surface processes. Mass wasting: Definition, types, and factors affecting mass wasting. Geomorphic landforms created by wind. Topography of sea floor.

UNIT II: Landforms

Geomorphic landforms created by river, glaciers and groundwater

Books Recommended

- Alien, P.A. (1997). Earth Surface Processes, Blackwell publishing.
- Bloom, A.L. (1998). Geomorphology: A Systematic Analysis of Late Cenozoic Landforms, Pearson Education.
- Bridge, J.S. and Demicco, R.V. (2008). Earth Surface Processes, Landforms and Sediment Deposits, Cambridge University Press.
- Esterbrook, D.J. (1992). Surface Processes and Landforms, MacMillan Publ.
- Kale, V.S. and Gupta A. (2001). 1ntoduction to Geomorphology, Orient Longman Ltd.
- Leeder, M. and Perez-Arlucea M. (2005). Physical processes in earth and environmental sciences, Blackwell' publishing.
- Summerfield, M, A. (1991). Globle Geomorphology. Prentice Hall.
- Wllcock, P.R., Iverson, R, M. (2003) Prediction in geomorphology ' AGU Publication.