BIRLA INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM

(Effective from Academic Session: Monsoon 2022)

M.Sc. Geoinformatics

Department of Remote Sensing

INSTITUTE VISION

To become a Globally Recognised Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

INSTITUTE MISSION

- To educate students at Undergraduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

DEPARTMENT VISION:

Be a centre of excellence in the field of Geospatial Technology education and research in the areas of Earth Resources, Environment & Climate to meet the needs of ever increasing requirement of human resources in these fields and to cater to the larger interest of the Society and Nation.

DEPARTMENT MISSION

- Impart quality education and equip the students with strong foundation that could make them capable of handling challenges of the ever advancing geo-spatial technologies.
- Maintain state-of-the-art in research and outreach facilities in phase with the premier institutions for sustained improvement in the quality of education and research.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To prepare the students in identifying, analysing and solving geospatial problems.

2. To train the students in developing practical and executable solutions to the challenges of growing field of Remote Sensing and GIS.

3. To impart the students with strong base of knowledge that makes them suitable both for industries as well as for teaching and research.

4. To inculcate the students with the sensitivity towards ethics, public policies and their responsibilities towards the society.

PROGRAMME OUTCOMES (POs)

PO1: An ability to independently carry out investigation and development work to solve real life geospatial problems.

PO2: An ability to write and present a substantial technical report/document/international level research articles.

PO3: Students should be able to demonstrate a degree of mastery over the areas of Geoinformatics.

PO4: An ability to share theoretical and practical knowledge in both teaching and research as well as in industries.

PO5: An ability to apply professional ethics, accountability and equity.

PROGRAMME COURSE STRUCTURE (ALL SEMESTERS)

SEMESTER - I

	Course Category	Course Code	Subjects	Mode of Delivery L – Lecture; T – Tutorial; P - Practical			Credits
				L	T	P	
SEMESTER- I	PC	GI 501	Principles of Remote Sensing	3	0	0	3
		GI 502	Geographic Information System	3	0	0	3
		GI 503	Digital Cartography and GPS	3	0	0	3
		GI 504R1	Advanced Image Acquisition and Interpretation for Environmental Mapping	3	0	0	3
		GI 505	Remote Sensing Laboratory	0	0	4	2
		GI 506	Geographic Information System Laboratory	0	0	4	2
		GI 507	Digital Cartography and GPS Laboratory	0	0	4	2
		GI 508	Advanced Image Acquisition and Interpretation for Environmental Mapping Laboratory	0	0	4	2
		MT132	Communication Skills-I	0	0	3	1.5
	OE	**OPEN ELECTIVE**		3	0	0	3
	Total Credits (1st Semester) (Theory + Labs)						**24.5**

SEMESTER – II

	Course Category	Course Code	Subjects	L	T	P	Credits
SEMESTER- II	PC	GI 509R1	Digital Satellite Image Processing	3	0	0	3
		GI 510R1	Research Methods and Statistics in Geoinformatics	3	0	0	3
		GI 511	Digital Satellite Image Processing Laboratory	0	0	4	2
		GI 512R1	Programming and Customisation in Geospatial domain Laboratory	0	0	4	2
		GI 513	Field Study Laboratory	0	0	4	2
		GI 518	Spatial data handling through programming	3	0	0	3
		MT133	**Communication Skills-II**	0	0	3	1.5

	PE	GI*	ELECTIVE – I	3	0	0	3
		GI*	ELECTIVE - I Laboratory	0	0	4	2
	OE	**OPEN ELECTIVE**		3	0	0	3
	Total Credits (2nd Semester)						**24.5**

SEMESTER – III

	Course Category	**Course Code**	**Subjects**	**L**	**T**	**P**	**Credits**
SEMESTER- III	**PC**	GI 601	Project (Part - I)				4
		GI 602	Advanced Geospatial Modelling and Decision Support System	3	1	0	4
		GI 603	Aerial, Satellite, UAV based Photogrammetry & Application	3	1	0	4
		GI 604	Advanced Geospatial Modelling & DSS Laboratory	0	0	4	2
		GI 605	Aerial, Satellite, UAV based Photogrammetry &Application Laboratory	0	0	4	2
	PE	GI*	ELECTIVE – II	3	1	0	4
		GI*	ELECTIVE - II Laboratory	0	0	4	2
	OE	**OPEN ELECTIVE**		3	0	0	3
	Total Credits (3rd Semester)						**25**

SEMESTER – IV

	Course Category	**Course Code**	**Subjects**	**L**	**T**	**P**	**Credits**
SEMESTER- IV	**PC**	GI 611	Project (Part – II)				8
	Total Credits (4th Semester)						**8**

Grand TOTAL =82 credits

*ELECTIVES

Course No.	Course Title

ELECTIVE-I (Spring Session)

GI 514 R1	Geoinformatics for Climate Change and Environmental Impact Assessment
GI 515 R1	Geoinformatics for Hydrology & Water Resources
GI 516	Geoinformatics for Climate Change and Environmental Impact Assessment Laboratory
GI 517	Geoinformatics for Hydrology & Water Resources Laboratory

ELECTIVE-II (Monsoon Session)

GI 606	Geoinformatics for Natural Resource Management
GI 607	Geoinformatics for Disaster Management
GI 608	Geoinformatics for Natural Resource Management Laboratory
GI 609	Geoinformatics for Disaster Management Laboratory

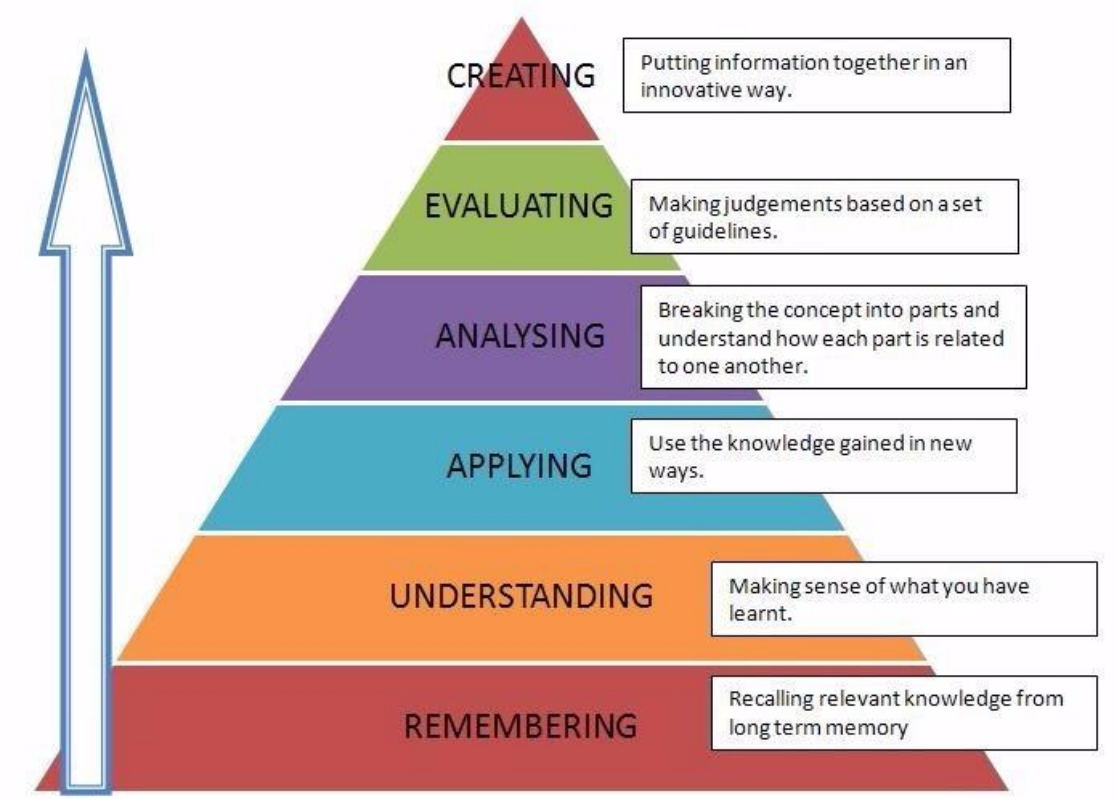
Project (Part – I) – Focus on Problem definition, Literature Review, Data Collection, Objectives and Research Questions Formulation and Detailed Work Plan, and partial fulfillment of initial objectives.

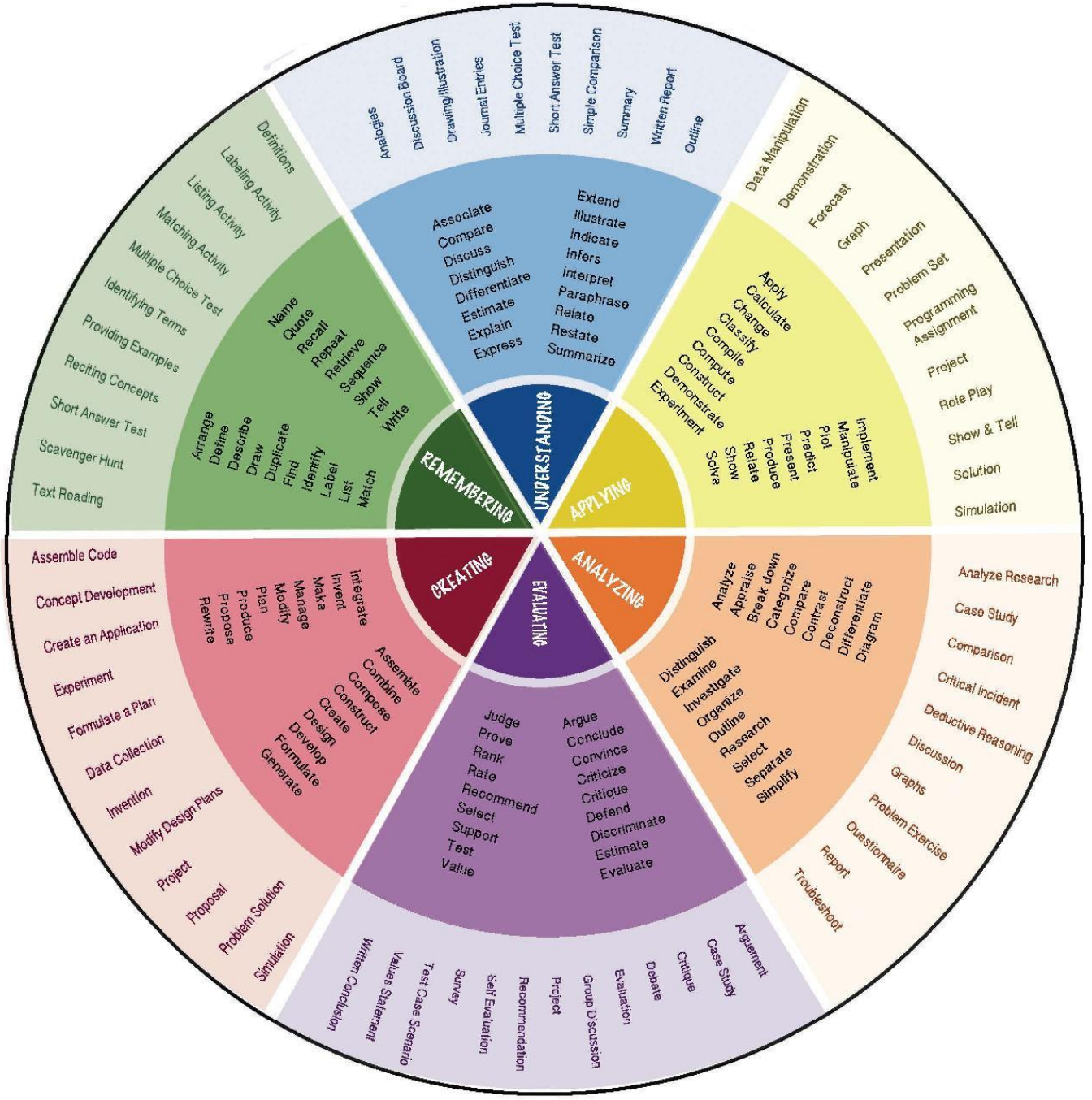
Project (Part – II) – Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication.

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
UNDERSTANDING
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
APPLYING
Apply
Calculate
Change
Classify
Compile
Compute
Construct
Demonstrate
Experiment
Implement
Manipulate
Plot
Predict
Present
Produce
Relate
Show
Solve
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
Simulation
ANALYZING
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
EVALUATING
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
CREATING
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation

COURSE INFORMATION SHEET

SEMESTER – I

Course code: GI 501
Course title: PRINCIPLES OF REMOTE SENSING

Pre-requisite(s): Basic Sciences
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level:01/05 (Monsoon)
Branch: Geoinformatics

Course Objectives

This course aims to:

1.	Disseminate basic concepts and applications of Electromagnetic Spectrum in Remote Sensing, Data acquisition platforms, sensors and their characterstics
2.	Enhance student's knowledge about optical, thermal and microwave based Remote Sensing and its Applications for solving real life problems

Course Outcomes(CO)

On completion of this course, students should be able to:

CO1	Explain basic physical principles of remote sensing
CO2	Understand the basic difference between various kinds of satellites and sensors
CO3	Know the appropriate use of satellite data for different applications
CO4	Explain the principles of thermal and microwave satellites, sensors and their nature of the data
CO5	Apply remote sensing in different thematic studies

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I BASIC CONCEPTS Remote Sensing: History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions, and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Spectral Response and Spectral Signature, Spectral, Spatial, Temporal and Radiometric resolutions	**9**
Module – II REMOTE SENSING SATELLITES AND SENSORS Satellites and their Characteristics: Geo Synchronous and Sun Synchronous, Weather & Communication Satellites: Introduction NOAA, TERRA, MOS, INSAT, GOES etc., Remote sensing systems, Platforms and their characteristics, Balloon, Rocket, Helicopter, Aircraft and Spacecraft, Introduction to commonly used multispectral and hyperspectral satellite system. Sensor classification: Active, Passive, Opto-Mechanical Scanners and push broom scanners. Sensor specification: MSS, TM, LISS (I, II, III, IV). PAN, WiFS, AWiFS, MODIS.	**9**
Module – III DATA RECEPTION AND DATA PRODUCTS Data Formats: BIL, BSQ, BIP,TIFF, Geo-TIFF, HDF, NetCDF, Ground segment organization, Pre-processing, Referencing Scheme, Data product generation, Data product output medium, Open Data Sources	**6**
Module – IV THERMAL AND MICROWAVE REMOTE SENSING Thermal Properties of Terrain: Thermal Capacity, Thermal conductivity, Thermal Inertia, Kinetic heat, Temperature, radiant energy and flux, Thermal IR multispectral spectral scanner, Thermal Infrared remote sensing examples, Microwave Remote sensing concepts: Backscattering, Range Direction, Azimuth Direction, Incident Angle, Depression Angle, Polarization, Dielectric Properties, Surface Roughness and Interpretation, resolutions Speckle and Its Reduction, Passive and active microwave sensors. SLAR and Scatterometer, Applications of thermal and microwave remote sensing images.	**10**

Module – V GROUND TRUTHING AND REMOTE SENSING APPLICATIONS Importance of Ground Truthing in Remote Sensing, Ground Truth Radiometer (GTR), Radiometric Calibration, Digital and Analog Methods, Spectral Response Patterns: Soil, Vegetation, Rocks and Water, RS Applications in Agriculture, Forestry, Land cover/Land use, RS Applications in Water resources and Earth Science.	**6**

TEXT BOOKS:

1. Jensen, J.R., (2006). "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi.

2. Lillesand, Thomas M. and Kiefer, Ralph, W., (2007). "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York

3. George Joseph & C Jeganathan (2017). Fundamentals of Remote Sensing 3rd edition, Universities Press, India

REFERENCE BOOKS:

1. Sabins, F.F. Jr. (2007). 'Remote Sensing – Principles and Interpretation", W.H. Freeman & Co.
2. Reeves, R. G. (1991). "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA
3. Paul, J. C. (2005). Geographical Information Systems and computer Cartography.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	2	
CO2	1	1	3	2	
CO3	2	1	3	2	
CO4	2	1	3	2	
CO5	3	2	3	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD6,CD8
CO5	CD1,CD2,CD3,CD5,CD6,CD8

Course code: GI 502
Course title: GEOGRAPHIC INFORMATION SYSTEM

Pre-requisite(s): Basic physical laws of nature, Geography
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 01/05 (Monsoon)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Introduce the students to the basic concepts of GIS and making the students familiar with the spatial data and spatial data creation and organisation.
2.	Teach various GIS based approaches and techniques to visualise and solve real life natural, environmental and societal problems.

Course Outcomes (CO):

After the completion of this course, students should be able to:

CO1	Differentiate GIS and cartography, normal vs. spatial data
CO2	Georeference the spatial data and handle spatial and non-spatial database
CO3	Describe various GIS tools and techniques within spatial analytical framework
CO4	Visualize GIS outputs in different dimensions
CO5	Apply spatial data analysis to solve natural, environmental and societal problems and challenges

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION Definition, Philosophy & Historical evolution of GIS, Basic concepts about spatial information, Spatial vs. non-spatial data, Spatial data models – Raster and Vector, Components of GIS, Hardware/software requirements for GIS, GIS Vs Cartography, Basics of Cartography: Map Scale, Categories of Maps, Grids and Graticules.	**7**
Module – II DATA STRUCTURE & FORMAT Raster Data & its Representation: Data Structure, Data Compression (block code, chain code, run length code, quadtree, MrSID), Raster file formats, Vector data representation: Data Structure, Non-topological and topological vector data models, Non-topological and topological vector file formats, Comparison between Raster & Vector Data.	**10**
Module – III DATA INPUT AND GEO-CORRECTION Sources of Spatial Data (Raster and Vector), Data Acquisition Through Scanners and Digitizers, Methods of Digitization (Manual vs. Automated), Geometric Transformations of Raster and Vector Data (Affine Transformation and Transformation Coefficients). RMS Error, Sources of Errors in spatial data and, Spatial Data Quality: Accuracy, Precision, Error and Uncertainty	**8**
Module – IV DATABASE MANAGEMENT SYSTEM Advantage of DBMS in context of GIS, RDBMS: Concepts and specific features, Object-Oriented approach to GIS data management, Basic Concepts of Geodatabase, Linkage between spatial and non-spatial data	**5**
Module – V SPATIAL DATA ANALYSIS AND VISUALIZATION Raster Data Analysis Techniques – Local, Focal, Global and Zonal, Vector Data Analysis- Map Manipulation Techniques, Buffering Overlay Analysis, Distance Measurements, Measuring and Mapping Change, Interpolation (DEM Generation).Vector and Raster Data Query: Logical Expressions, Geographic Visualization: Socio-economic thematic maps, The dimensions of spatial data: 2D, 2.5D, 3D and 4D GIS, Current Issues and Trends in GIS.	**10**

TEXT BOOKS:

1. Kang-tsung Chang, (2007).'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.

2. C.P.Lo and Albert K.W.Yeung (2006). "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.

3. Burrough, Peter A. and Rachael McDonnell, (1998).' Principles of Geographical Information Systems' Oxford University Press, New York.

REFERENCE BOOKS:

1. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. (2005).Geographical Information Systems: Principles and Applications, Longman Group, U.K.

2. Terry-Karen Steede (2002). Integrating GIS and the Global Positioning System, ESRI Press

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3	
CO2	2	1	3	2	
CO3	2	1	3	3	
CO4	2		3	3	
CO5	3	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD6,CD8, CD9
CO5	CD1,CD2,CD3,CD5,CD6,CD8

Course code: GI 503
Course title: DIGITAL CARTOGRAPHY AND GLOBAL POSITIONING SYSTEM
Pre-requisite(s): Basic Science & Computer Knowledge
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 01/05 (Monsoon)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Teach the students to the basic concepts of behind conventional cartography and latest digital developments.
2.	Teach various digital techniques to aesthetically visualise qualitative, quantitative data with appropriate spatial resolution, and projections.
3.	Impart fundamental principles behind utilisation and analysis of data acquired using Satellite based Positioning System for surveying and navigation purposes.

Course Outcomes (CO)

After the completion of this course, students should be able to :

CO1	Understand concept behind conventional and modern map making process
CO2	Understand the scale and spatial resolution relationship, and Create digital maps with appropriate projections
CO3	Efficiently present qualitative and quantitative data in the form of maps using digital cartographic principles
CO4	Explain the fundamental principles of GNSS positioning
CO5	Explain various datums, coordinate systems, Differential positioning concepts and associated surveying techniques.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I CONVENTIONAL AND DIGITALCARTOGRAPHY Introduction to cartography-Nature, scope and its role, Basic characteristics of a map, different types of map and scale, Basic Geodesy, Map projections, Digital Cartography: its comparisons with conventional cartography and GIS.	**7**
Module – II DIGITAL MAPPING Sources of data: GNSS, remote sensing, Census etc., Geographic and Cartographic Data bases, Spatial and non-spatial databases, Large data base management, Data measurement and basic statistical processing, Analogue and digital conversion process, DPI, Scale, Pixel size.	**8**
Module – III PERCEPTION AND MAP DESIGN Cartographic design, Color theory and models, Map design, Map lettering and its placement in map compilation, Graphic symbology and visual variables, GIS and Maps, Visualisation process, strategy, Cartographic toolbox, Overall Map Cosmetics, Mapping qualitative and quantitative data, Bertins cartographic variables and its association with data types	**8**
Module – IV SATELLITE POSITIONING SYSTEM - AN OVERVIEW Introduction to Global Navigation Positioning System, Various Global/Regional Satellite constellations, NAVSTAR GNSS signals, Geopositioning - Basic Concepts, Pseudo Range Measurement, Phase Difference Measurement, Sources of GNSS errors, DOP, Geoid, Datum/Ellipsoid - definition and basic concepts, Global Datum vs. Indian Geodetic Datum, Coordinate Systems, Transformation of coordinates, GNSS Remote Sensing.	**10**
Module – V POSITIONING AUGMENTATION AND GNSS APPLICATIONS Differential positioning concept, Various Differential survey Methods, GNSS Survey Planning, Data Processing, Site characteristics of Reference Station, Reference Station Equipment, Augmentation Systems (IRNSS, GAGAN, WAAS, LAAS, etc.) Basic concepts, Applications.	**7**

TEXT BOOKS:

1. Robinson, A.H. and Morrison, J.L.(1995). Elements of Cartography, John Wiley and Sons
2. Gopi, Satish (2005). Global Positioning System: Principles and Applications, Tata Mac-Grow Hill

3. Agrawal, N.K. (2004). Essentials of GPS, Spatial Network Pvt. Ltd

4. Sathish Gopi, (2000). GPS and Surveying using GPS

REFERENCE BOOKS:

1. Anson, R.W. and Ormeling, F.J. (2008). Basic Cartography, Vol. 1, 2nd ed., Elsevier Applied Science Publishers, London.
2. Gunter Seeber (2003). Satellite Geodesy Foundations-Methods and Applications.
   George Joseph & C Jeganathan (2017). Fundamentals of Remote Sensing 3rd edition, Universities Press, India.
   Hofmann W.B &Lichtenegger, H. Collins (2001). Global Positioning System – Theory and Practice, Springer-Verlag Wein, New York.
3. Paul, J. C.(2005). Geographical Information Systems and computer Cartography, Longman.
4. Keates, J.S. (2008). Cartographic Design and production, London, Longman
5. Peterson, M.P. (1995). "Interactive and Animated Cartography" Upper Saddle River, NJ: Prentice Hall
6. Ramesh, P. A. (2000). Fundamentals of Cartography, Concept Publishing Co., New Delhi
7. Rampal, K.K. (2004). Mapping and Compilation, Concept Publishing Co., New Delhi
8. Singh, R.L and Dutt. P.K. (2008). Elements of Practical geography, Students Friends Allahabad

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	2	
CO2	2		3	2	
CO3	2	1	3	3	
CO4	2		3	3	
CO5	3	1	3	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD5, CD8
CO4	CD1,CD2, CD3,CD6,CD8
CO5	CD1,CD2,CD3,CD6,CD8

Course code: GI 504 R1
Course title: ADVANCED IMAGE ACQUISITION AND INTERPRETATION FOR ENVIRONMENTAL MAPPING

Pre-requisite(s): Basic Science & Computer Knowledge
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 01/05 (Monsoon)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Teach the students about the basic characteristics of various terrestrial elements and their interpretation approaches using Remotely Sensed Data .
2.	Introduce students about various advanced sensors, satellite data products, their detail, availability, and their usability for various challenging real-life applications.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Describe various geological and geomorphological characteristics of the surface of the Earth.
CO2	Visually and Digitally differentiate various terrestrial features using different interpretation keys.
CO3	Understand existing data dissemination systems and download appropriate spatial and non-spatial data using web services.
CO4	Understand principles of active sensors and platforms– LIDAR & UAV
CO5	Understand and Apply advanced sensors for various applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I REMOTE SENSING IN ENVIRONMENTAL MAPPING Rocks types, forms, Minerals and their field characteristics, Image interpretation for delineation of lithology (Rocks) and minerals, Geological structures - Folds, Faults and Joints and their field characteristics, Various important land forms, Image characteristics of geological structures and major land forms .	**8**
Module – II IMAGE INTERPRETATION Visual and Digital Satellite Image Interpretation, Elements of image interpretation, development of interpretation keys, Image interpretation for LU/LC and Vegetation mapping, Image interpretation for ocean and coastal monitoring.	**8**
Module – III ONLINE SATELLITE DATA AND THEIR PRODUTS USGS Global Visualization Viewer (GloVis), NASA Earth Observation (NEO), USGS Earth Explorer, ESA's Sentinel data, NOAA, IPPMUS Terra, LANCE, VITO Vision, Bhuvan, MOSDAC, India-WRIS.	**8**
Module – IV LIDAR AND UAV Basics, Discrete and Full waveform LIDAR systems, LIDAR File Formats, Different commercial LIDAR sensors (Airborne and UAV borne), Regulations for UAV in India and world, Payloads and sensor integration, Navigation planning, Fundamental data acquisition modes.	**9**
Module–V ADVANCE SENSORS Earth's Gravity measuring sensor, Rainfall and soil moisture assessment sensor, Sensors for atmospheric studies, Sensors for oceanic studies, High spatial resolution sensors, High temporal resolution sensors.	**7**

TEXT BOOKS:

1.George Joseph & C Jeganathan (2017). Fundamentals of Remote Sensing 3rd edition, Universities Press, India.
2.Kang-tsung Chang (2007). 'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
3.C.P.Lo and Albert K.W.Yeung (2006). "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.
4.Burrough, Peter A. and Rachael McDonnell (1998). 'Principles of Geographical Information Systems' Oxford University Press, New York.
5.Magwire, D. J., Goodchild, M.F. and Rhind, D. M. (2005). 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.
6.Paul Longley, Michael Goodchild, David Maguire and David Rhind (2005). Geographical Information Systems. Principles, Techniques, Applications and Management. John Wiley & Sons.

REFERENCE BOOKS:

1. Laurini, Robert and Derek Thompson (1992). Fundamentals of Spatial Information Systems. Academic Pr., London
2. Kluwer Fotheringham A S, O'Kelly M E. (1998).Spatial Interaction Models: Formulations and Applications.
3. Thanappan Subash (2011). Geographical Information System, Lambert Academic Publishing.
4. John E. Harmon & Steven J. Anderson (2003). The design and implementation of Geographic Information Systems, John Wiley &Sons,.
5. ArcGIS 10.1 Manuals, 2013.
6. Agrawal, N.K. (2004). Essentials of GPS, Spatial Network Pvt. Ltd
7. Sathish Gopi (2000). GPS and Surveying using GPS
8. Leica. A. (2003). GPS Satellite Surveying, John Wiley & Sons, use. New York
9. Terry-Karen Steede (2002). Integrating GIS and the Global Positioning System, ESRPress.
10. Hofmann W.B &Lichtenegger, H. Collins (2001). Global Positioning System – Theory and Practice, Springer-Verlag Wein, New York,.
11. Gunter Seeber (2003). Satellite Geodesy Foundations-Methods and Applications.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	2	
CO2	1		3	3	2
CO3	3	1	3	3	
CO4	1		3	3	
CO5	3	1	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD5, CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD6,CD8
CO5	CD1,CD2,CD3,CD6,CD8

SEMESTER II

Course code: GI 509 R1
Course title: DIGITAL SATELLITE IMAGE PROCESSING
Pre-requisite(s): Basic concept of remote sensing
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 02/05 (Spring)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Teach the students about the Digital processing concepts and techniques for importing, georeferencing and rectifying satellite derived remote sensing images.
2.	Enhance the students knowledge about advanced satellite image processing techniques for deriving diverse proxy indices revealing information about various land cover features, and their usability in real-life natural resource management and monitoring related applications.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Explain the basic characteristics of a digital image and associated issues
CO2	Correct the satellite image radiometrically and geometrically
CO3	Apply various image enhancement techniques on digital satellite image
CO4	Digitally discriminate and classify various land cover features such as agriculture, forests land and other terrestrial features
CO5	Extract information by applying advance image processing techniques to solve complex real world problem using data from diverse sensors

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I BASIC PRINCIPLES AND IMAGE CORRECTION TECHNIQUES Concepts about digital image and its characteristics, Spectral, Spatial, Radiometric and Temporal resolution, Image data storage and retrieval, Sources of image degradation, Radiometric correction techniques, Geometrical errors and its rectification.	**8**
Module – II IMAGE ENHANCEMENT Look-up Tables (LUT) and Types of image displays and FCC, Radiometric enhancement techniques : Contrast stretching: Linear and non-linear methods, Spatial enhancement techniques : Low Pass Filtering, High Pass Filtering, Gradient filters, Directional and non-directional filtering,	**8**
Module – III MULTI-BAND ENHANCEMENT TECHNIQUES Band ratio, Types of Vegetation indices, Principal Component Analysis, Multi dated data analysis and Change detection, Image fusion techniques.	**6**
Module – IV PATTERN RECOGNITION AND CLASSIFICATION Concept of Pattern Recognition, Multi-spectral pattern recognition, Spectral discrimination, Signature bank, Unsupervised classification methods. Supervised classification techniques, Parametric and Non-Parametric classifiers, Limitations of standard classifiers, Accuracy assessment of Classified output: confusion matrix, error analysis.	**10**
Module–V MICROWAVE AND HYPERSPECTRAL IMAGE PROCESSING Microwave: SAR Image Processing software - Measurement and discrimination, Backscatter Extraction - Preprocessing and speckle filtering, Hyperspectral: data reduction - MNF transformation, spectral library, Spectral Angle mapper, End-member Extraction.	**8**

TEXT BOOKS

1. Thomas M. Lillesand & Kiefer, Ralph W. (2007). Remote Sensing and Image Interpretation, John Wiley & Sons, New York.
2. Jensen, JR. (2006). Remote Sensing of the Environment – An Earth Resources Perspective, Prentice Hall Inc.
3. Curran, P., (1985). Principles of Remote Sensing, Longman, London.
4. Campbell, James B., (2006). Introductory Remote Sensing: Principles and Concepts, Routledge.
5. Gibson, P.J., (2000). Introduction to Remote Sensing, 2nd ed., Taylor & Francis, London.
6. Cracknell, A.P. & Hayes, L.W B., (2007). Introduction to Remote Sensing, Taylor & Francis, London

REFERENCE BOOKS

1. Sabins, Floyd F. (2007). Remote Sensing: Principles and Interpretation, H. Freeman and C., New York.
2. Rencz, Andrew N. (1999). Remote Sensing for the Earth Sciences: Manual of Remote Sensing, 3rd ed., John Wiley & Sons, Inc., New York.
3. Chein I Chang (2003). "Hyperspectral Imaging: Techniques for Spectral Detection and Classification", Kluwer Academic/Plenum Publishers, New York, N.Y., (ISBN: 0-306-47483-2).
4. Marcus Borengasser and William C., Hungate and Russel Watkins (2008). Hyper spectral Remote sensing: principles and application" CRC, ISBN 13: 9781566706544
5. Floyd, M.Handerson and Anthony, J.Lewis (1998). Principles and applications of Imaging RADAR", Manual of Remote sensing, Third edition, vol.2, ASPRS, Jhumurley and sons, Inc.
6. Philippe Lacomme,JeanclandeMarchais,Jean-Philippe Hardarge and Eric Normant (2001). Air and spaceborne radar systems - An introduction, Elsevier publications.
7. Anonymous (1975). Manual of remote sensing, Vol 1,American Society of Photogrammetry.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	2	
CO2	2		3	3	
CO3	3		3	3	
CO4	2	1	3	3	
CO5	3	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD5, CD8
CO4	CD1,CD2, CD3,CD5, CD6,CD8
CO5	CD1,CD2,CD3,CD5,CD6,CD8

Course code: GI 510R1
Course title: RESEARCH METHODS AND STATISTICS IN GEOINFORMATICS
Pre-requisite(s): Knowledge of statistics
Co- requisite(s): Knowledge of RS & GIS

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 02/05 (Monsoon)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Teach students about fundamentals of research process and diverse research possibilities in Geoinformatics domain.
2.	Enhance the students' knowledge about various steps involved in carrying out proper research, its administration, effective communication and quality standards.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Understand the formulation of various schemes in Geoinformatics domain
CO2	Explain concepts behind Project management, field report preparation, and research proposals
CO3	Apply sampling techniques, tools and associated Geoinformatics research methods to extract quantitative and qualitative information about the real-life geoinformatics problem.
CO4	Use the National / Global quality standards, ethics of research.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I RESEARCH IN GEOINFORMATICS Research Problems in Geoinformatics domain. Identification of problems at regional and Local level, National and International Geoinformatics projects: Past and Recent, Geographic data sources and different types of data requirement, Formulation of research schemes.	**7**
Module – II FIELD AND PROJECT REQUIREMENTS Need for Field Visit and Preparation of field reports, Research proposal, Literature review, Project/Report Writing, Components of Research Thesis/Project Report, Project Administrator and project management, Classification of Projects/thesis, Problems and opportunities in Projects.	**8**
Module – III SAMPLING AND STATISTICS Statistical Concepts: Population, Sample, Random, Bias, Percentile, Standard Score, Distribution, Correlation, Regression (logistic, linear). Analysis of variance, Need for sampling, types of sampling, sample size estimation and accuracy evaluation. Hypotheses and its testing, chi-square test, t-test, Calculation and Evaluation of Confidence Intervals.	**8**
Module – IV METHODS IN GEOINFORMATICS Types of Research Methods: Quantitative and Qualitative, Research Techniques and Tools: Questionnaire, Interview, Observation, etc., Analytical methods in Geoinformatics, Different models in various Natural Resources Monitoring.	**10**
Module–V TOOLS, QUALITY AND ETHICS Tools & Methods: Project Communications and Presentation, Intellectual property Right, Plagiarism and associated softwares, Evaluating Quality of Research paper/journal: Citation Index, Impact Factor, National/Global standards, SCI, SCOPUS, etc., Referencing/Citation methods, Reference management software.	**7**

TEXT BOOKS:

1. Deborah Rumsey (2003). Statistics for Dummies, Wiley Publishing, Inc.,New Jersey.
2. Huxold, W.E. and Levinsohn A.G. (1995). Managing Geographic Information Projects. Oxford University Press, New York.
3. Earickson, R. and Harlin, J. (1994). Geographic Measurement & Quantitative Analysis, Macmillan, New York.

REFERENCE BOOKS:

1. Bennet P. Lientz&Kathryn P. (2001). Project Management for the 21st Century Academic Press, California.
2. Miguel Roig (2015). Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. (https://ori.hhs.gov/sites/default/files/plagiarism.pdf)

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2		3	2	
CO2	2	3	3	2	2
CO3	2	2	3	3	2
CO4	2	1	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD5, CD8
CO4	CD1,CD2, CD3,CD6,CD8

Course code: GI 518
Course title: SPATIAL DATA HANDLING THROUGH PROGRAMMING
Pre-requisite(s): (i) Knowledge of Basic Sciences
(ii) Student must have undergone GI 501, GI 502
Co- requisite(s): Knowledge of RS & GIS

Credits:	**L:**	**T:**	**P:**	**C:**
	3	**0**	**0**	**3**

Class schedule per week: 3
Class: M. Sc
Semester / Level: 02/05 (Spring)
Branch: Geoinformatics

Course Objectives:

This course aims to:

1.	Enhance the student's understanding of logic development and its transformation into programs
2.	Make the student learn to solving complex problems through R and Python
3.	Utilize programming to solve problems of various application areas of Earth Science.

Course Outcomes:

On completion of this course, students should be able to:

CO1	To Develop algorithms for arithmetic and logical problems in R
CO2	Handle Spatial data in **R**
CO3	Make use of Python for deployment of programs to process spatial data
CO4	Utilise Python tools for digital image processing
CO5	Make computations using Images & Image Collections in Google Earth Engine

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I BASICS OF *R* Introduction and Overview of R, Data Types - R Objects and Attributes, Vectors and Lists, Matrices, Factors, Missing Values, Data Frames, Names Attribute, Reading Tabular Data, Reading Large Tables, Textual Data Formats, Connections: Interfaces to the Outside World, Subletting - Basics, Lists, Matrices, Partial Matching, Removing Missing Values	**9**
Module – II ADVANCE CAPABILITIES OF R AND SPATIAL DATA HANDLING Vectorized Operations, Control Structures, Functions, Scoping Rules, Coding Standards, Loop Functions, Debugging Tools, and Simulation, statistical analysis, Time-series analysis, Problem solving with spatial data	**7**
Module – III BASICS OF PYTHON Introduction to Python, Basics of Python Syntax, Data Types of Pythons, Basic Operations of Python, Functions, Modules, and Packages of Python, Extension: Building a Python Environment, conditions, range, Loops, break, continue, and else in Loops	**9**
Module – IV ADVANCE FUNCTIONS AND SPATIAL DATA HANDLING WITH PYTHON Self-defined Functions, Recursion, Scope of Variable, Standard Library Functions, Exceptions, Handling raster data with Python, handling vector data with Python. Python tools for digital Image Processing	**7**
Module–V GOOGLE EARTH ENGINE FOR GEOSPATIAL APPLICATIONS Introduction to JavaScript for Earth Engine, Basic JavaScript data types, Earth Engine Objects and Methods, Functional Programming Concepts, Introduction to the Earth Engine JavaScript API, Visualizing Images and Image Bands, Computations using Images, Image Collections, Compositing, Masking, and Mosaicking, NDVI, mapping a Function over a Collection.	**9**

TEXT BOOKS:

1. Mark Lutz: Learning Python
2. Hadley Wickham, Garrett Grolemund: R for Data Science
3. Mikhailov, Eugeniy E: Programming with MATLAB for Scientists: A Beginner's Introduction
4. Lalit Kumar, Onisimo Mutanga: Google Earth Engine Applications

REFERENCE BOOKS:

1. Wes McKinney: Python for Data Analysis
2. Colin Gillespie, Robin Lovelace: Efficient R Programming
3. Stormy Attaway: Matlab A Practical Introduction to Programming and Problem Solving

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Evaluation:

Individual assignment, Quizes, Mid and End semester examinations

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	1	1	1	3	-
CO2	2	2	3	3	2
CO3	3		2	3	3
CO4	3	1	2	3	3
CO5	2	2	3	3	1

Low = 1, Medium = 2, High= 3

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/institutional visits/field visit
CD6	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD6
CO2	CD1, CD2, CD3, CD4, CD6
CO3	CD1, CD2, CD3, CD4, CD6
CO4	CD1, CD2, CD3, CD4, CD6
CO5	CD1, CD2, CD3, CD6

SEMESTER III

Course code: GI 602
Course title: ADVANCED GEOSPATIAL MODELLING AND DECISION SUPPORT SYSTEM
Pre-requisite(s): Basic concept of GIS
Co- requisite(s): Knowledge of programming

Credits:	L:	T:	P:	C:
	3	1	0	4

Class schedule per week: 4
Class: M.Sc.
Semester / Level: 03/06 (Monsoon)
Branch: Geoinformatics

Course Objectives

This course aims to:

1.	Introduce students towards vector and raster based geo-spatial and geo-statistical analytical techniques.
2.	Impart knowledge about Spatial and Non-spatial Decision Making Process, techniques and Decision Support Systems.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Differentiate two types of spatial analysis techniques: Vector & Raster
CO2	Make use of GIS tools and geostatistical analysis techniques to solve real world spatial problems
CO3	Understand the basic architecture of DSS and SDSS
CO4	Understand and make use of spatial and non-spatial MCDM techniques

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION TO SPATIAL ANALYSIS AND MODELING Spatial Analysis: Definition, Processes & Steps, Classification of Spatial analysis techniques, Raster–Based Techniques: Overlay Analysis, Slope and Aspects, Cost-Distance Calculation, Vector-Based Techniques: Overlay Analysis, Network Analysis : Linear referencing, Optimal Routes, Location and Service Area Problems, Digital Terrain Analyses and Modeling: TIN and DEM, Surface Representation & Analysis, Architecture of Geodatabase Model, Advantages of using Geodatabase over shapefile and coverage.	**10**
Module – II GEOSTATISTICAL ANALYSIS TECHNIQUES Spatial Interpolation: Introduction, Control Points, Global Methods: Trend Surface Analysis, Regression Models, Local Methods: Thiessen Polygons, Density Estimation, Inverse Distance Weighted Interpolation, Kriging: Ordinary Kriging, Universal Kriging.	**8**
Module – III INTRODUCTION TO DSS Introduction to decision making process and decision support systems, Introduction of a frame work for planning and decision making, Different types of DSS, Components of DSS, GIS and Spatial Decision Making, Difference between DSS & SDSS.	**8**
Module – IV MULTICRITERIA ANALYSIS AND DECISION MAKING Principles and elements of multiple-criteria decision making, Classification of Multiple-criteria Decision Problem: Multi-objective Vs Multi-attribute, Decision Alternatives and constraints, Criterion weighting, Decision rules, Multiple-criteria decision making in spatial data analysis.	**8**
Module–V ANALYTICAL HIERARCHY PROCESS(AHP) Introduction to AHP, Basic Principles of AHP, Effect Table, Pair Wise comparison, Consistency, Weightage, performance score, Case studies involving AHP.	**6**

TEXT BOOKS

1.Bonczek, R.H., C.W. Holsapple, and A.B. Whinston, (1981). Foundations of Decision Support Systems, Academic Press, New York. Basic text on DSS
2.Geoffrion, A.M., (1983). "Can OR/MS evolve fast enough? Interfaces 13:10. Source for six essential characteristics of DSS.
3.House, W.C. (1983). Decision Support Systems, Petrocelli, New York. Basic DSS text
4.Sprague, R.H., (1997). A framework for the development of decision support systems, Management Information Sciences Quarterly 4:1-26. Source for DSS development model.
5.Sprague, R.H., and Carlson, E.D., (1982). Building Effective Decision Support Systems, Prentice-Hall, Englewood Cliffs NJ. Basic DSS text
6.Burrough, Peter A. and Rachael McDonnell (1998). Principles of Geographical Information Systems. Oxford University Press, New York.
7.Laurini, Robert and Derek Thompson (1992). Fundamentals of Spatial Information Systems. Academic Pr., London.

REFERENCE BOOKS

1.Kluwer Fotheringham A S, O'Kelly M E. (1998).Spatial Interaction Models: Formulations and Applications.
2.Paul Longley, Michael Goodchild, David Maguire and David Rhind (2005). Geographical Information Systems. Principles, Techniques, Applications and Management. John Wiley & Sons.
Burt James E., Barber Gerald M., Rigby David L. (2009). **Elementary statistics for Geographers**.3rd ed., New York: Guilford Press.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1		2	1	1
CO2	2	1	1	2	2
CO3	2		3	3	
CO4	2	1	3	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD5,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD5, CD6,CD8

Course code: GI 603
Course title: AERIAL, SATELLITE, UAV BASED PHOTOGRAMMETRY & APPLICATIONS

Pre-requisite(s): Basic concept of remote sensing, GNSS
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	1	0	4

Class schedule per week: 4
Class: M.Sc.
Semester / Level: 03/06 (Spring)
Branch: Geoinformatics

Course Objectives
This course aims to make the students:

1.	Learn fundamental aspects of Aerial Photogrammetry, and its applications in various thematic domains.
2.	Learn analogue and digital based approaches in photogrammetry.
3.	Understand the recent developments and role of satellite and UAV in terrain modelling and mapping.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Understand the historic developments in the field of Photogrammetry
CO2	Make planimetric measurements (both manually and digitally) from a given Aerial, Satellite and UAV derived High Resolution Images
CO3	Handle Stereoscopes, anaglyph glasses and digital workstations for Photogrammetric purposes.
CO4	Discuss flight planning requirements, Advantages and limitations so as to get desired scale and accuracy for a given situation where natural resources or thematic mapping requirement to be fulfilled

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION Need for Photogrammetry, Historical developments in Photogrammetry, Fundamental concepts and Importance of flight planning, End Lap, Side Lap, Scale, Ground Coverage, Weather Conditions, Purpose, Flying Height, Fundamentals and elements of visual photo interpretation, Mapping terrain elements: land use land cover, drainage and physiographical features.	**7**
Module – II GEOMETRY OF AERIAL PHOTOGRAPHS Projection, Tilt, Swing, Scale, Image Displacement due to relief, due to lens distortion, due to tilt, Parallax, stereoscopic depth perception, overlaps in stereo pairs, principles of floating marks, Parallax bar and types, measurement of absolute and differential parallax, Parallax height measurement, correction to measure parallaxes – contouring from stereometric heights. Types of photographs, Vertical and Tilted photographs.	**8**
Module – III ANALYTICAL PHOTOGRAMMETRY Co-ordinate system, air base components, degree of freedom, Elements of interior and exterior orientation of an aerial photographs, Numerical Derivations for Height based on relief displacement, coordinates, parallax, Orientation Procedures, Coordinate Transformation concepts, Epi-polar Geometry, Photo-triangularion: Pass-points for Aerotriangulation, semi-analytical aero-triangulation, analyticalaerotriangulation, bundle adjustment with GNSS, Aero-triangulation with Satellite images, strategies for aero-triangulation.	**10**
Module – IV DIGITAL PHOTOGRAMMETRY Analogue to Digital conversion, Image measurements, colour balancing, Image matching, Feature extraction- points, lines and regions, Planimetric Measurements, GCPs and Ortho-Rectification, Ortho-photographs, Digital Terrain Model derivation from Satellite images, Limitations, quality checks and interactive control.	**8**
Module–V TERRAIN MODELING WITH UAV Digital Photogrammetric Images from UAV and associated concepts, UAV flight planning, coverage types, processing methods. Recent trends in its application, automated aerial triangulation: concepts, solutions, analysis, Photogrammetry work-stations, review of available software.	**7**

TEXT BOOKS

1. Wolf, P.R. (2000). Elements of Photogrammetry with Applications in GIS, McGraw Hill Ins, Singapore.
2. Rampal, K.K. (2004). Textbook of Photogrammetry, John-Wiley & Sons.
3. Moffit, F.M. (1980). Photogrammetry, International Text Book Co.
4. McGlone J.C. (editor) (2013). Manual of Photogrammetry. 6th edition. American Society for Photogrammetry and Remote Sensing.
5. Drury, S.A. (2004). "Image Interpretation in Geology, Publisher: - Chapman and Hall, London, UK.

REFERENCE BOOKS

1.Panday, S. N. (1987). Principles and Application of Photogeology, Parentice Hall Inc.
2.Ray, R. (2012). An Introduction to photogrammetry, MITRAM publications, Kolkata.ISBN:978-93-80036-41-0.
3.Beginners Guide to UAV: https://www.digitaltrends.com/opinion/start-serious-drone-habit/

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1	2	3	2	
CO2	2		3	3	
CO3	2	2	3	3	
CO4	2	2	3	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD5, CD8
CO4	CD1,CD2, CD3,CD6,CD8

ELECTIVES

Course code: GI 514 R1
Course title: GEOINFORMATICS FOR CLIMATE CHANGE AND ENVIRONMENTAL IMPACT ASSESSMENT
Pre-requisite(s): GI 501, GI 502
Co- requisite(s):

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 3
Class: M.Sc.
Semester / Level: 02/05 (Spring)
Branch: Geoinformatics
Course Objectives

This course aims to:

1.	Enhance student's understanding about climatic system of earth and its changes over time.
2.	Teach the fundamental concepts about global warming, climatic dependence of various ecosystems (agriculture, forest and glaciers) and associated mapping methods using remote sensing.
3.	Disseminate information about various global initiatives, environmental impact assessment methods and modelling using remote sensing and GIS.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Explain weather and climate, local to global climatic variations, and El Nino vs La Nino.
CO2	Analyse relationship between different ecosystems (forest, agriculture and glacier) and climatic parameters such as rainfall, temperature, etc. to assess the impact of global warming on these systems using RS and GIS technology
CO3	Map and monitor surface water bodies, glaciers, and drought using different satellite data
CO4	Describe global policies and EIA methods, and link them with local, regional and national developmental initiatives

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION TO WEATHER AND CLIMATE Fundamentals of Weather and Climate; Local, Regional, Continental and global weather Pattern, Global bio-geo-Climatic conditions; Weather variations and associated effects – El Nino, La Nino, and associated Southern Oscillation, Drought and Flood Scenario; Mapping weather parameters with a focus on rainfall, temperature and wind.	**8**
Module – II FOREST, AGRICULTURE AND CLIMATE Vegetation growth rhythm and climatic interaction; Carbon accounting with climate change scenario; Time-Series Satellite data; space-time dynamics; Phenology of Vegetation; Global changes in phenology; Droughts in Amazon and monitoring mechanism; Forest Fire and climate change with Indian examples. Food security, Drought monitoring and forecast; Weather dependence of Agriculture; Climate change impact on agriculture economy.	**8**
Module – III SNOW, GLACIER WATER AND CLIMATE Surface water mapping and monitoring; snow cover mapping; snowmelt runoff forecasting; Glaciers Inventory; Glacial Mass Balance and Glacial retreat with changing climate using remote sensing with a focus on Himalaya.	**8**
Module – IV ATMOSPHERE AND GLOBAL WARMING Atmospheric structure and composition; Greenhouse effect and Global Warming; Role of aerosols, Aerosol retrieval from space; Climate forcing; Remote Sensing missions for weather monitoring.	**7**
Module–V GLOBAL POLICIES AND ENVIRONMENTAL IMPACT ASSESSMENT United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Intergovernmental Panel on Climate Change (IPCC); Reducing Emissions from Deforestation and forest Degradation (REDD); Convention of Biological Diversity (CBDScope of EIA); EIA Methods and Mitigation; Criteria and Indicators; Certification;Ecological, Economical and Demographic impact assessment. Indian National Policies on Natural resources monitoring and climate change.	**9**

TEXT BOOKS

1.ECA (Economics of Climate Adaptation),(2009). Shaping climate resilient development: a framework for decision making. ClimateWorks Foundation, Global Environment Facility, European Commission, McKinsey & Company, The Rockefeller Foundation, Standard Chartered Bank and Swiss Re. 164pp.

2.Morris, P. and Therivel, R.(2008). Methods of Environmental Impact Assessment, 2nd edition, Spon Press, London (2001 reprint).

3.Roy, P.S., Dwivedi, R.S., and Vijayan, D. (2010). Book on Remote Sensing Applications. National Remote Sensing Centre, ISRO, Hyderabad. ISBN: 9788190946001.

4.Milly, P.C.D., R.T. Wetherald, K.A. Dunne and T.L. Delworth(2002). Increasing risk of great floods in a changing climate. Nature Vol 415: 514–517.

REFERENCE BOOKS:

1. FAO (2011). Climate Change, Water and Food Security. Compiled by Hugh Turral, Jacob Burke and Jean-Marc Faures, Rome. ISBN: 9789251067956
2. FAO(2016). Planning, implementing and evaluating Climate-Smart Agriculture in Smallholder Farming Systems. Job Number 15805. Report under Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO. ISBN: 978925109305.
3. IPCC (2014). IPCC Assessment Report. UNFCCC.
4. Kulkarni, A., I.M. Bahuguna, B.P. Rathore, S.K. Singh, S.S. Randhawa, R.K. Sood and S. Dhar (2007). Glacial retreat in Himalaya using Indian Remote Sensing satellite data. Current Science, Vol. 92, No. 1.
5. Lal, M., T. Nozawa, S. Emori, H. Harasawa, K. Taka, A. Abe-Ouchi, T. Nakajima, T. Takemura and A. Numaguti(2001). Future climate change: Implications for Indian summer monsoon and its variability. Current Science, Vol. 81, No. 9, 10.
6. Rees, H.G. and D.N. Collins(2006). Regional differences in response of flow in glacier-fed Himalayan rivers to climatic warming. Hydrological Processes, 20 (10). 2157–2169. 10.1002/hyp.6209.
7. Schmidhuber, J. and F. Tubiello(2007). Global food security under climate change. PNAS 104 (50) 19703–19708.
8. Thenkabail, P.S., J.G. Lyon, H. Turral and C. Biradar(2009). Remote Sensing of Croplands for Food Security. 476p. CRC Press. Taylor and Francis, New York. ISBN 978-1-4200-9009-3.
9. Tubiello, F. and G. Fischer(2007). Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000–2080 Technological Forecasting & Social Change 74 1030–1056.
10. Walsh, M. (2008). The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. U.S. Climate Change Science Program Synthesis and Assessment Product 4.3.
11. WWF (2005). An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China. Kathmandu. Nepal.

12. World Bank(2010). Economics of Adaptation to Climate Change: Synthesis Report. Washington DC. 100pp.
13. World Bank. (2009). Water and Climate Change: Impacts on groundwater resources and adaptation options. Water Unit Energy, Transport, and Water Department. Washington DC. 98pp.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	2	
CO2	2		3	3	
CO3	2		3	3	
CO4	2	3	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD5, CD8
CO3	CD1, CD2, CD3, CD5, CD8
CO4	CD1,CD2, CD3,CD6,CD8

Course code: GI 515 R1
Course title: GEOINFORMATICS FOR HYDROLOGY & WATER RESOURCES

Pre-requisite(s): Basic concept of remote sensing, GIS
Co- requisite(s): Knowledge of natural resources

Credits:	L:	T:	P:	C:
	3	0	0	3

Class schedule per week: 4
Class: M.Sc.
Semester / Level: 02/05 (Spring)
Branch: Geoinformatics

Course Objectives

This course aims to:

1.	Introduce students about hydrologic cycle, Precipitation, Aquifer & Aquifer coefficients, ground water movement and understand the data required for various hydrological studies.
2.	Make them understand river basin and watershed concepts, parameters and management strategies.
3.	Disseminate knowledge about water resource estimation, evaluation, and modelling.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Describe hydrologic cycle, data requirement for hydrological studies and characterise aquifers and ground water movement.
CO2	Evaluate basins and drainages to infer surface and near surface characteristics of the area.
CO3	Describe ground water regimes of India and determine water quality and ground water prospects zones with the use of satellite data.
CO4	Design suitable watershed management strategy by characterising watersheds for sustainable development of water resources including site suitability analysis for water recharge structures and reservoir sediment estimation.
CO5	Estimate and model surface runoff, flood, drought, snowmelt runoff and soil erosion.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I BASIC CONCEPTS Hydrologic cycle, Forms of precipitation, Precipitation measurement - conventional vs satellite data based, Data for hydrological studies. Aquifers, Geological materials as aquifers and Aquifer parameters - Porosity, Specific yield, Storage coefficient. Ground water movement - Darcy's Law, Permeability, Hydraulic Conductivity, Transmissivity	**8**
Module – II GROUND-WATER EXPLORATION AND EVALUATION Ground water regimes in India, Geophysical techniques for groundwater prospecting. Remote sensing in hydro-geomorphology and ground water prospect mapping, Remote sensing in water quality mapping and monitoring.	**8**
Module – III RIVER BASINS Classification of streams and rivers, Drainage pattern, Delineation of Drainage basin and catchment, Interlinking of river basins. Remote sensing based site selection for river valley projects.	**8**
Module – IV WATERSHED MANAGEMENT Watershed characterization using remote sensing, Morphometric parameters and analysis, Watershed problems and management strategy, mobile applications. Ground water recharge structures and their site suitability analysis.	**8**
Module–V OPERATIONAL APPLICATIONS IN WATER RESOURCES Satellite image based surface runoff modeling, Flood and drought- mapping and modeling, Reservoir sediment estimation, Snow and Glacier Hydrology, Snowmelt runoff modeling, Soil erosion modeling.	**8**

TEXT BOOKS

1.Schultz, G. A. and Engman, E. T. (2000).Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
2.Murthy, J. V. S. (1994). Watershed Management in India. Wiley Eastern Ltd., New Delhi.
3.Todd David Keith (2005). Groundwater Hydrology, John Wiley & Sons, New York, Second Edition.

REFERENCE BOOKS

1.H. M. Raghunath, (2000). Hydrology- principles, Analysis, Design, New Age International, New Delhi.
2.P. Singh, Vijay P. Singh, (2000). "Snow and Glacier Hydrology".
3.P. Singh, (2001). "Snow and Glacier Hydrology", Springer.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	2	
CO2	2		3	3	
CO3	2		3	3	
CO4	2	1	3	2	
CO5	3	2	3	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD5,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD6,CD8
CO5	CD1,CD2,CD3,CD5,CD6,CD8

Course code: GI 606
Course title: GEOINFORMATICSFOR NATURAL RESOURCE MANAGEMENT

Pre-requisite(s): Knowledge of natural resources
Co- requisite(s): Knowledge of RS & GIS

Credits:	L:	T:	P:	C:
	3	1	0	4

Class schedule per week: 4
Class: M.Sc.
Semester / Level: 03/06 (Monsoon)
Branch: GEOINFORMATICS

Course Objectives

This course aims to:

1.	Introduce students about ecological, economical and social dimension of natural resource and importance of its sustainable management.
2.	Make them understand about various policies, ethics and geo-spatial techniques involved in natural resources management.

Course Outcomes (COs)

On completion of this course, students should be able to:

CO1	Explain concepts related to different types of natural resources
CO2	Understand the policies, and ethics regarding conservation practices
CO3	Make use of the scientific method of sustainable resources management
CO4	Apply Geospatial Techniques for better management of natural resources

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION Fundamentals of Natural resources, Classification of Natural resources: Abiotic and biotic resources, Ecological, social and economic dimension of resource management, Sustainable utilization of the natural resources	**6**
Module – II NATURAL RESOURCES PLANNING & MANAGEMENT Approaches in Resource Management**:** Ecological approach; economic approach; ethnological approach; Geoinformatics approach, Ecological principles, policies, and ethics regarding conservation practices, The Scientific Method and Adaptive Management, Management of Common International Resources	**8**
Module – III LAND AND WETLAND MANAGEMENT Land use: Classification, planning and desertification, Wetland: A brief Introduction, Classification of Wetland, Over-utilization of surface and ground water, drought, conflicts over water, dams-benefits and problems. Water ecology and management, Impact of climate change on land and wetland, Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, Solid waste Management, Waste water management.	**10**
Module – IV FOREST MANAGEMENT AND WILDLIFE CONSERVATION Forest: Present status, distribution and its contribution as natural resource, Over-exploitation: deforestation and its societal impact, Forest products. Developing and developed world strategies for forestry, Environmental Impact Assessment.	**8**
Module–V MANAGEMENT OF OIL & MINERAL RESOURCES Petroleum Product and minerals: A brief introduction, Renewable Energy Sources, Use and exploitation, Environmental effects of extracting and using mineral resources, Case studies.	**8**

TEXT BOOKS:

1.Michael J. Conroy, James T. Peterson,(2013).Decision Making in Natural Resource Management**:** A Structured, Adaptive Approach. John Wiley & Sons.
2.Moulton, M.P. and J. Sanderson(1999). Wildlife issues in a changing world. Lewis Publishers, Boca Raton, Florida, 500 pp.
3.Francois Ramade (1984)**.** Ecology of Natural Resources. John Wiley & Sons Ltd.

REFERENCE BOOKS:

1.P. K. Joshi(2009).Geoinformatics for Natural Resource Management .Nova Science Publishers
2.Mann, K.H. (2000). Coastal Ecology & Management, Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
3.Harikesh N. Mishra(2014). Managing Natural Resources- Focus on Land and Water. PHI Lerning Publication.
4.Vitousek, P.M.(1994). Global Change and Natural Resource Management, Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2		3	2	
CO2	2	2	1	1	3
CO3	2		3	3	1
CO4	2	1	3	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD5,CD6,CD8

Course code: GI 607
Course title: GEOINFORMATICS IN DISASTER MANAGEMENT
Pre-requisite(s): Knowledge of natural disasters
Co- requisite(s): Knowledge of RS & GIS

Credits:	L:	T:	P:	C:
	3	1	0	4

Class schedule per week: 4
Class: M.Sc.
Semester / Level: 03/06 (Monsoon)
Branch: Geoinformatics

Course Objectives

This course aims to:

1.	Impart basic concepts of disaster, its causes and its historial background
2.	Enhance student's knowledge about disaster management planning
3.	Make the students learn Geoinformatics approaches to deal with disaster risk reduction and management.

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Explain various types of disasters and responsible factors.
CO2	Interpret and discriminate different stages of disaster management planning and utility of geoinformaticstools in every stage.
CO3	Understand administrative structure of disaster management in India.
CO4	Understand the ethical values and humanitarian values.
CO5	Apply integrated geospatial techniques in disaster management and disaster risk reduction.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I INTRODUCTION Fundamental concepts of hazards and disasters, their types, and characterization, Zonation of hazards, natural and human induced disasters, Disaster and National losses, historical perspective of disasters in India.	**8**
Module – II DISASTER MANAGEMENT Fundamental concept of Disaster Management, Government, NGOs and peoples participation disaster management, Existing organizational structure for managing disasters in India, Geoinformatics in disaster mitigation.	**8**
Module – III GEOLOGICAL HAZARDS: Landslide, Earthquake, Mining hazards (Land subsidence, Mine flooding etc.), Volcanic hazards, Groundwater hazards, Glacial hazards, Geoinformatics in Geological Hazards.	**8**
Module – IV HYDRO METEOROLOGICAL AND ENVIRONMENTAL HAZARDS Flash floods, River floods, Dam burst, Cloud burst, Cyclones, Coastal hazards and Drought, Forest hazards (Deforestation, Degradation and Forest fire), Land & soil degradation, Desertification, Pollution (Water, air and soil), Geoinformatics in Hydro Meteorological and Environmental Hazards	**10**
Module–V CASE STUDIES Earthquakes in India, Floods in Indo Gangetic plains, Landslides in Himalayan region, Drought in Indian plateau regions	**6**

TEXT BOOKS

1. Roy, P.S. (2000). Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS).
2. Skidmore A. (2002) Environmental Modeling with GIS & Remote Sensing, Taylor & Francis.

REFERENCE BOOKS

1. Anji Reddy, M. (2004). Geoinformatics for environmental Management. B. S. Publication.
2. Parag Diwan(2010). A MANUAL ON DISASTER MANAGEMENT. Pentagon Press ISBN: 10: 8182744385 / 13: 978-8182744387
3. Joshi, P. K.(2009). Geoinformatics for Natural Resource Management Nova Science Publishers

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 % (3 × 10%)
Assignment (s)	10
Seminar before a committee	10

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	2	
CO2	2	1	3	2	
CO3	2	2	3	2	1
CO4	1	1	1	1	3
CO5	3	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods
CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

Course Outcome	Course Delivery Method Used
CO1	CD1,CD2,CD3,CD8
CO2	CD1,CD2,CD3,CD5,CD8
CO3	CD1, CD2, CD3, CD8
CO4	CD1,CD2, CD3,CD6,CD8
CO5	CD1,CD2,CD3,CD5,CD6,CD8

Laboratory related subjects

Course code: GI 505

Course title: PRINCIPLES OF REMOTE SENSING LABORATORY

Pre-requisite(s): Basic theoretical knowledge of Remote Sensing
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 01/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Interpret hard copy satellite FCC images
CO2	Understand the effect of different resolutions of satellite image on identifying different terrestrial features.
CO3	Generate field spectra for various land cover features and draw inferences.
CO4	Extract different features from satellite image

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Familiarization with the various remote sensing softwares and Hard copy images
Lab 2	Downloading satellite data from various sources in the world wide web
Lab 3	Displaying satellite image in different colour composites
Lab 4	Familiarisation with Ground truth radiometer/ Spectro Radiometer
Lab 5& 6	Field Spectra Collection: vegetation, bare soil, and concrete using Spectro Radiometer and analyse it with satellite data.
Lab 7	Compare reflectance values from MODIS satellite image and field collected spectra for same land feature
Lab 8 &9	Thermal data exploration
Lab 10& 11	Microwave Data exploration
Lab 12	Extraction of Water bodies and Agricultural land use from a given satellite image
Lab 13	Discriminate Land surface features using spectral, thermal and microwave satellite images.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	2	
CO2	2		3	3	
CO3	3	2	3	3	1
CO4	3	1	3	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 506

Course title: GEOGRAPHIC INFORMATION SYSTEM LABORATORY

Pre-requisite(s): Basic theoretical knowledge of GIS
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 01/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Georeference the spatial data and handle huge spatial and non-spatial database
CO2	Concept of errors in spatial data and their removal
CO3	Apply spatial data analysis to solve natural,environmental and societal problems and challenges
CO4	Design and produce thematic maps

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Familiarization with the GIS software
Lab 2	Georeferencing of spatial data in GIS software
Lab 3	Geodatabase creation and Digitization of point line and polygon features
Lab 4	Creation of Spatial data from Non-spatial data
Lab 5	Topology creation of spatial data
Lab 6	Removing topological error
Lab 7	Attribute data Integration with spatial data
Lab 8	Map Designing(layout creation)
Lab 9	Thematic Map creation
Lab 10,11	Performing vector analysis; Attribute query, buffering, overlay
Lab 12	Generation of Digital Elevation Model from spot height
Lab 13	Performing raster analysis

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	2	
CO2	1		3	3	1
CO3	3	2	3	3	3
CO4	2	1	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 507

Course title: DIGITAL CARTOGRAPHY AND GNSS LABORATORY LABORATORY

Pre-requisite(s): Basic theoretical knowledge of GIS and GPS
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 01/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO 1	Understand Indian and international numbering systems of Maps
CO 2	Convert analog map in digital form
CO 3	Collect GNSS data in different survey modes and post process them to generate output to be integrated in GIS environment.
CO 4	Handle integrated geospatial techniques and apply them in solving real world problems.

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Familiarization with SOI topographical sheets and UTM Grids
Lab 2	Familiarization with different types of scale (Simple, comparative, Diagonal)
Lab 3	Familiarization with Projections(Conical, Polyconic, Cylinderical with 1 or 2 standard parallels).
Lab 4	Conversion of data from Analog to Digital form
Lab 5	Visualization of Distortions due to change in projections
Lab 6	Study of Bertin variables
Lab 7	Digital Cartography, Output Generation and Thematic map composition: eg Tourism/Geologic/Geomorphologic
Lab 8	Introduction to GNSS receivers and initial settings
Lab 9	Creating codes and attribute table in GNSS receiver
Lab 10	Data collection in Point and Line mode using GNSS with different datum
Lab 11	Data collection in Area mode using GNSS with different datum
Lab 12	GNSS Data collection in differential positioning mode
Lab13	Post processing of the GNSS data

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	2	
CO2	1		3	3	
CO3	3	2	3	3	1
CO4	3	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 508

Course title: ADVANCED IMAGE ACQUISITION AND INTERPRETATION FOR ENVIRONMENTAL MAPPING LABORATORY
Pre-requisite(s): Basic theoretical knowledge of RS, GIS and GPS
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 01/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Download images and other spatial data from online resources
CO2	Carry out spatial data analysis to solve natural, environmental and societal problems and challenges.
CO3	Elucidate integrated geospatial techniques and apply them in solving real world problems.

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Elements of Image interpretation
Lab 2	Visual interpretation of Satellite images and composition of interpretation keys
Lab 3	Acquisition of Satellite Images: Exploration of various sites on www
Lab5	Familiarisation with Hardware and software of UAV
Lab 4	Acquisition of Satellite Images: Through UAV mode
Lab 5	Processing of UAV images
Lab 6	Understanding formats of satellite images and how to practically exchange them
Lab 7	On screen image interpretation: Comparision of images displayed on RGB and IHS display system
Lab 8	for LU/LC and Vegetation mapping Interpretation of Images with typical natural features
Lab 9	Interpretation of Images for ocean and coastal monitoring
Lab 10	Image characteristics of geological structures and major land forms
Lab 11	Exploring sample LIDAR data
Lab 12	Exploring Advance sensors
Lab 13	Thematic layer extraction from multidimensional remote sensing data from online resources

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	2	
CO2	3	2	3	3	2
CO3	3	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 511

Course title: DIGITAL SATELLITE IMAGE PROCESSING LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS and GPS
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 02/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Download and Georeference satellite data from various sources.
CO2	Apply different image enhancement techniques.
CO3	Classify satellite images for generating land use land cover

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Importing raw satellite data into DIP software
Lab 2	Geo-reference of imageries with the help of already georeferenced topographic sheet
Lab 3	Sub-setting of area of interest from the satellite image ; display and interpretation of black & white images and FCC
Lab 4	Radiometric Correction of satellite images
Lab 5	Study of the various contrast enhancement techniques :Digital data stretching and Concept of Look Up Tables
Lab 6	Applications of Low Pass and High Pass Filters to the satellite data
Lab 7	Signal Discrimination between features based on spectral profile
Lab 8	Unsupervised and Supervised classification
Lab 9	Accuracy assessment of Supervised Classification
Lab 10	Performing PCA and generating different indices
Lab11	Study of combinations of PCA layers to identify Hydroxyl minerals
Lab 12	Verifying classification algorithms using statistics
Lab13	Comparisons of results from Lab 12 with the classifications digitally

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	2		3	3	
CO2	2	1	3	3	1
CO3	2	1	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code: GI 512 R1
Course title: PROGRAMMING AND CUSTOMISATION IN GEOSPATIAL DOMAIN LABORATORY

Pre-requisite(s): Basic computer skills
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 02/05 (Spring)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Understand and Use Compiler programming Environment
CO2	Understand and use various libraries, Function and Syntaxes.
CO3	Write a simple to complicated Programming Codes in R, Python and Google Earth Engine.

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1.	Introduction to computers & programming concept
Lab 2.	Programming Environment and Libraries in R
Lab 3.	Basic Programming using R
Lab 4.	Programming for Reading, Writing from/to file, and Plotting
Lab 5	Programming for Handling & Processing Images in R
Lab 6	Programming Environment and Libraries in Python
Lab 7, 8	Using Python to deal with Functions and Objects
Lab 9 & 10	Handling Arrays and Satellite Images with Python
Lab 11	Introduction to Google Earth Engine environment
Lab 12,13	Programming in Google Earth Engine

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1		2	3	
CO2			1	2	1
CO3	1		2	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code: GI 513
Course title: FIELD STUDY LABORATORY

Pre-requisite(s): Basics theoretical knowledge of RS, GIS, GPS and field equipments
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4
Class: M. Sc.
Semester / Level: 02/05 (Spring)
Branch: GEOINFORMATICS

Course Outcomes (CO):
On completion of this course, students should be able to:

CO1	Prepare Field Visit related Plan
CO2	Develop Keen Field Observations Skill
CO3	Appreciate different environmental conditions and learn to Live together in community and in hard terrain conditions
CO4	Prepare detailed field report and develop effective communication skills

List of Laboratories

Sl.No.	**Name of the Laboratories**
FIELD	Equivalent to 10 Laboratory turns
FIELD	
FIELD	
FIELD	
Lab 11	Report Writing
Lab12	Learning to make effective presentations
Lab13	Explanation of Field phenomenon as they differ from a controlled environment of the lab

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1	2			2
CO2			2	3	1
CO3			2	1	3
CO4		3			2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code: GI 516

Course title: GEOINFORMATICS FOR CLIMATE CHANGE AND ENVIRONMENTAL IMPACT LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS, GPS and associated software
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 02/05 (Spring)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Visually and digitally differentiate various environmental conditions including vegetated features and glaciers from satellite data.
CO2	Use time-series remote sensing data and GIS tools to quantify drought condition, vegetation growth rhythm, glacier dynamics and their environmental impact.
CO3	Design appropriate tools, models and strategy for local to regional problems based on various published reports and policies .

List of Laboratories

Sl.No.	**Name of the Laboratories**

Lab 1 Visual Interpretation of different types of forests and crops
Lab 2. Shoreline change mapping of Waterbodies
Lab 3 Biomass and Carbon Accounting using RS & GIS
Lab 4 To identify El-Nino and La-Nina years using ONI and SST/Temperature anamoly
Lab 5& 6 Drought Condition Assessment using RS based indices and meteorological data
Lab 7 & 8 Exploring Climatic Research Unit **(** CRU) data set and its utilization of climate change related studies
Lab 9 Evaluation of atmospheric dynamics using virtual ballooning
Lab 10 TRMM based Rainfall Mapping and relating with Ground Meteorological Data
Lab 11 Glacier Condition and Change Assessment using Temporal RS data
Lab 12 Vegetation Phenology using Time-Series RS data
Lab 13 Explore scenarios for future climate using the simple online climate model

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3	
CO2	2	1	2	2	1
CO3	1	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 517

Course title: GEOINFORMATICS IN HYDROLOGY AND WATER RESOURCES LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS, GPS and associated sotware
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 02/05 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Create rainfall maps using different data sources and analyse it
CO2	Delineate watersheds by using different approaches and characterize by computing morphometric parameters.
CO3	Create groundwater potential and water quality maps by interpreting satellite data.
CO4	Model snow melt run off, flood and soil erosion.

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab 1	Downloading of Satellite Rainfall data (TRMM) and Generating Spatial Rainfall Map.
Lab 2	Downloading of Rainfall point data and generating spatial rainfall map using interpolation techniques.
Lab 3	Delineation of watershed map using DEM and topographic maps.
Lab 4	Calculation of various morphometric parameters and characterise watershed.
Lab 5	Mapping of various land forms with the help of satellite data.
Lab 6	Interpretation of Lineaments and analysis.
Lab 7 &8	Mapping of Hydro-geomorphology and Ground water prospects.
Lab 9	Estimation of Water quality and Reservoir sedimentation.
Lab 10	Estimation of USLE parameters for soil erosion modelling.
Lab 11	Conducting Geo-electric Resistivity for ground water exploration.
Lab 12	Mapping of Snow and Glaciers using digital techniques.
Lab 13	Interpreting flood plains and mapping flood hazard zones using RS & GIS.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3	1
CO2	2		3	3	
CO3	1	1	3	3	1
CO4		1	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 604

Course title: ADVANCED GEOSPATIAL MODELLING AND DECISION SUPPORT SYSTEM LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS, GPS and associated sotware
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 03/06 (Monsoon)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Perform spatial analysis using vector and raster analysis techniques
CO2	Make use of GIS tools and geostatistical analysis techniques to solve real world spatial problems
CO3	Solve multi-criteria using spatial and non-spatial MCDM techniques

List of Laboratories

Sl.No.	**Name of the Laboratories**
Lab1	Creating a Geodatabase and importing feature datasets to it
Lab2	Topology creation of feature dataset of Geodatabase
Lab3	Editing of feature dataset and error correction
Lab4	Overview of vector analysis tools and solving a spatial problem using vector analysis functions
Lab5	Making a model involving vector analysis functions for solving a spatial problem using Model Builder
Lab6	Overview of raster analysis tools and solving a spatial problem using raster analysis functions.
Lab7	Making a model for involving raster analysis functions for solving a spatial problem using Model Builder
Lab8	Surface generation using different interpolation techniques
Lab9	Surface generation using Geostatistical techniques
Lab10	Customization of ArcGIS
Lab11	Mapping accident locations using Linear Referencing technique
Lab12	Preparation of raster layers for Multicriteria Analysis
Lab13	Solving a spatial problem using Multicriteria Analysis(Spatial AHP)

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1	2	3	3	1
CO2	2	2	3	3	1
CO3	3	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 605

Course title: AERIAL, SATELLITE, UAV BASED PHOTOGRAMMETRY & APPLICATION LABORATORIES

Pre-requisite(s): Basic theoretical knowledge of RS, GPS and associated sotware
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M.Sc.

Semester / Level: 03/06 (Spring)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Use Pocket Stereoscope and make planimetric measurements from Aerial Photos.
CO2	Interpret Aerial photos with stereoscopic vision for delineating various landforms and landcover features.
CO3	Use photogrammetric techniques and tools under Digital Environment so as to create digital surface models, and extract point, line and polygon features and their position, height, area and volume.

List of Laboratories

Sl.No.	**Name of the Laboratory**
Lab 1	Depth perception (3D view) using pocket stereoscope
Lab 2	Depth perception (3D view) using mirror stereoscope
Lab 3	Use of parallax bar and measurement of distance and height
Lab 4	Stereoscopic vision and photo interpretation of B/W aerial photograph
Lab 5	Stereoscopic vision and photo interpretation of colour aerial photograph
Lab 6	Differential parallax measurement and contouring by parallax bar method
Lab 7	Digital Stereoscopic Model - Non-Oriented Approach
Lab 8	Digital Stereoscopic Model - Interior & Exterior Orientation
Lab 9	Digital Stereoscopic Model - 3D based Planimetric Measurements
Lab 10	Digital Ortho-Rectification - Relief Displacement Correction
Lab 11	Point, Line & Polygon Feature Extraction using Stereopair from HighSpatial Resolution Aerial & satellite images
Lab 12	Understanding and Experimenting with UAV based image acquisition
Lab 13	Creation of Point, Line, Polygon and Land Cover Features from Images acquired from satellite and UAV.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1			3	3	
CO2	1	1	3	3	1
CO3		2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code: GI 608
Course title: GEOINFORMATICS FOR NATURAL RESOURCE MANAGEMENT LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS, GPS and associated sotware
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 03/06 (Spring)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Visually and Digitally differentiate various agriculture and forestry features from satellite data.
CO2	Use various remote sensing and GIS tools for extracting land cover, land capability, degradation, waterlogging, and model acreage, lifezones and fire risk.
CO3	Execute spatial models related to landscape metrics, biodiversity, wild life habitat suitability, and environmental problems.

List of Laboratories

Sl.No.	**Name of the Laboratory**
Lab 1	Image Interpretation of Standard FCC on screen and on photograph
Lab 2	Classification of Satellite Images- Revision
Lab 3	Use of INDICES
Lab 4	Extraction of Land Surface Temperature from satellite data
Lab 5	Site Suitability for Forest Fire Zones
Lab 6	Extraction of Water Bodies
Lab 7	Extraction of Forested area
Lab 8	Site suitable for Fishing Zones
Lab 9	Site Suitability for Solid waste and Waste water for an upcoming urbanization
Lab 10	Identification of forest cover types in a satellite image
Lab11	Creation of Solar atlas for a given area
Lab 12	Removal of Haze from industrial townships in satellite imagery
Lab13	Site suitability analysis of wind mills

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	1		3	3	
CO2	2	1	3	3	1
CO3		2	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code: GI 609
Course title: GEOINFORMATICS FOR DISASTER MANAGEMENT LABORATORY

Pre-requisite(s): Basic theoretical knowledge of RS, GIS, GPS and associated sotware
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**	**4**	**2**

Class schedule per week: 4

Class: M. Sc.

Semester / Level: 03/06 (Spring)

Branch: GEOINFORMATICS

Course Outcomes (CO):

On completion of this course, students should be able to:

CO1	Take help from Bhuvan Disaster services and other online web portal for data collection related to disasters and environmental/man-made factors associated with disaster.
CO2	Prepare map of different natural and man-made disaster-prone areas.
CO3	Apply integrated geospatial techniques in disaster management and disaster risk reduction.

List of Sessionals

Sl.No.	**Name of the Laboratory**
Lab 1	Overview of "Bhuvan" Geoportal of ISRO for disaster services
Lab 2	Estimation of flood inundated area using pre and post flood satellite image and its comparison with dataset provided by "Bhuvan"
Lab 3	Identification of coal-mine fire with the help of LST derived from satellite image
Lab 4	Identification of disaster prone areas in a satellite image w.r.t.Earthquake
Lab 5& 6	Identification of regions prone to meteorological drought by downloading and analyzing rainfall data and generating drought indices
Lab 7	Identification of disaster prone areas in a satellite image w.r.t. Forest fires and its comparison with dataset provided by "Bhuvan"
Lab 8	Mapping of areas prone to road accidents
Lab 9	Performing water quality analysis for different parameters to test its suitability for drinking purposes
Lab10,11	Performing air quality analysis by calculating AQI using CPCB dataset
Lab 12	Analysing lightning disaster by using satellite data and meteorological data
Lab 13	Prepare list of Do's and Dont's for at least three natural disaster and prepare the administrative hierarchy of disaster management of home district

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
2 Quizzes	20 % (2 × 10%)
Day to Day Performance & Lab File	30%
Viva	20%
Final Exam	30%

Indirect Assessment –

1. Student Feedback on Faculty

Course Delivery Methods

CD1	Laboratory experiments

Mapping Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CO1	2		3	3	
CO2	2	3		3	2
CO3	1	2	3	3	

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course code: GI 601 & GI 611
Course title: Project (Part - I) & Project (Part -II)

Pre-requisite(s): Completion of all Labs of 1st and 2nd semester
Co- requisite(s):

Credits:	**L:**	**T:**	**P:**	**C:**
	0	**0**		**4+8**

Class schedule per week: 4
Class: M. Sc.
Semester / Level: 03&04/06
Branch: Geoinformatics

Course Objectives: This course aims to make the student with following abilities:

A.	Carry out independent research project addressing real life Geospatial problems with sound scientific framework.
B.	Prepare spatial maps from satellite data and other sources utilising various Geoinformatics techniques and produce research report with acceptable quality and ethics, and communicate results to stakeholders.

Course Outcomes (CO): On completion of this course, students should be able to:

CO1	Collect and summarise relevant existing literatures related to the problem in hand.
CO2	Identify Research Gaps, Develop appropriate research questions and Objectives in relation to their domain of research.
CO3	Design Research Methodology and Create coherent geospatial database and other relevant data for each objective.
CO4	Apply Geoinformatics tools and techniques to evaluate the appropriateness of results in relation to objectives and research questions.
CO5	Integrate and synthesis all results and write a scientifically sound academic report with appropriate referencing, and communicate research findings to stakeholders.

Mapping Course Outcome with Programme Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	1	2	2	3	3
CO2	2	3	2	2	3
CO3	3	2	2	3	3
CO4	3	3	3	2	1
CO5	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)