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

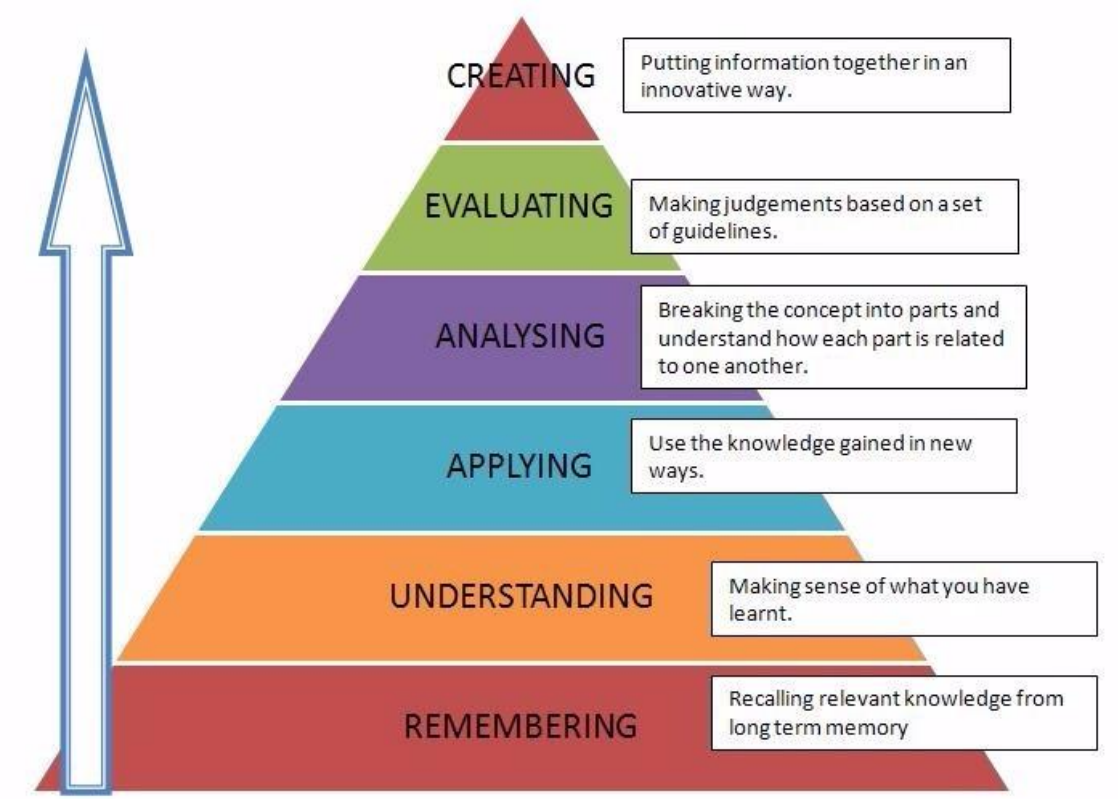
Project (Part – I) – Focus on Problem definition, Literature Review, Data Collection, Objectives and Research Questions Formulation and Detailed Work Plan, and partial fulfillment of initial objectives.

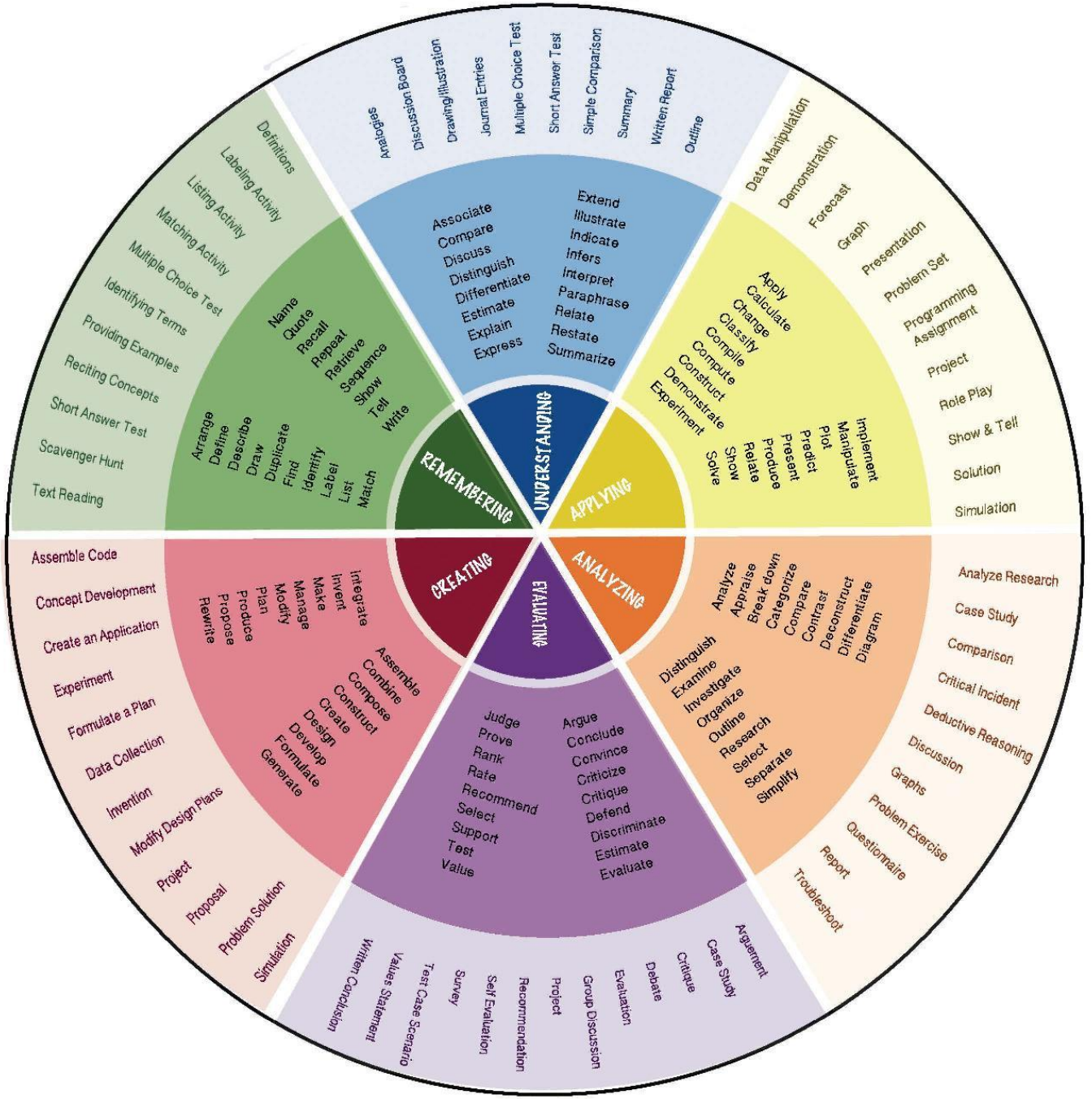
Project (Part – II) – Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication.

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
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
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
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
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
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
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
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 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

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.

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12. World Bank(2010). Economics of Adaptation to Climate Change: Synthesis Report. Washington DC. 100pp.
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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

Laboratory related subjects

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)