Course Structure & Syllabus

(w.e.f. Session 2022-23)

Master of Technology (Remote Sensing)

SPECIALISATIONS OFFERED:

I. Earth Resources II. Environment & Climate

DEPARTMENT OF REMOTE SENSING

BIRLA INSTITUTE OF TECHNOLOGY

Mesra, Ranchi- 835215

Jharkhand, INDIA

2022

Institute Vision

To become a Globally Recognized 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 and 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)	**Programme Outcomes (POs)**
1. To prepare the students in identifying, analysing and solving geospatial problems.	1. An ability to independently carry out research/ investigation and development work to solve real life geospatial problems.
2. To train the students in developing practical and executable solutions to the challenges of growing field of Remote Sensing and GIS.	2. An ability to write and present a substantial technical report/document and publish international level research articles.
3. To impart the students with strong base of knowledge that makes them suitable both for industries as well as for teaching and research.	3. Students should be able to demonstrate a degree of mastery over the areas of Remote Sensing and GIS technology. The mastery should be at a level higher than the requirements in the appropriate bachelor program. .
4. To inculcate the students with the sensitivity towards ethics, public policies and their responsibilities towards the society.	4. An ability to share theoretical and practical knowledge in both teaching and research as well as in industries.
	5. An ability to apply professional ethics, accountability and equity.

M.Tech. (Remote Sensing)

PROGRAMME SCHEME - SEMESTER WISE DISTRIBUTION

S. No	Semester	Course Category	Credits	Total
1	FIRST	3 Programme Core (PC)	9	21.5
		1 Progammet Elective (PE)	3	
		5 LABS (4 PC + 1 PE)	9.5	
2	SECOND	3 Programme Core (PC)	9	19.5
		1 Progamme Elective (PE)	3	
		4 LABS (3 PC + 1 PE)	7.5	
3	THIRD	Research Project - Thesis (Part – I)	8	14
		1 Open Elective (OE-I)/ MOOC	3	
		1 Open Elective (OE-II)/ MOOC	3	
4	FOURTH	Research Project - Thesis (Part – II)	16	16
TOTAL				**71**

PROGRAMME CORE (PC) for both i. EARTH RESOURCES ii. ENVIRONMENT & CLIMATE (*offered in* MO session *only*)

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
1	RS 501	Principles of Remote Sensing and Digital Satellite Image Processing	Basic Physics/Science Computer Knowledge	3
2	RS 502R2	Geographic Information System and Satellite Navigation System	Basic Sciences/ Basic Computing	3
3	RS 511	Aerial and Satellite Photogrammetry & Image Interpretation	RS 501	3
4	RS 503	Remote Sensing and Digital Satellite Image Processing Laboratory	RS 501	2
5	RS 504	GIS &Satellite Navigation System Laboratory	RS 502R2	2
6	RS 513	Aerial and Satellite Photogrammetry & Image Interpretation Laboratory	RS 511	2
7	MT 132	Communication Skills I		1.5

PROGRAMME CORE (PC) FOR EARTH RESOURCES (*offered in* SP session *only*)

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
1	RS 512R1	Advanced Remote Sensing and Geospatial Modelling	RS 501, RS 502R2	3
2	RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	RS 501, RS 502R2	3
3	RS 522	Programming concepts for spatial data handling	RS 501, RS 502R2	3
4	RS 514	Advance Remote Sensing and Geospatial Modelling Laboratory	RS 512	2
5	RS 515R1	Programming and Customisation in geospatial domain Laboratory	RS 501, RS 502R2	2
6	MT 133	Communication Skills II		1.5

PROGRAMME CORE (PC) FOR ENVIRONMENT & CLIMATE (*offered in* SP session *only*)

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
1	RS 523	Physical Meteorology	RS 501, RS 502R2	3
2	RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	RS 501, RS 502R2	3
3	RS 522	Programming concepts for spatial data handling	RS 501, RS 502R2	3
4	RS 525	Meteorological Laboratory	RS 512	2
5	RS 515R1	Programming and Customisation in geospatial domain Laboratory	RS 501, RS 502R2	2
6	MT 133	Communication Skills II		1.5

PROGRAMME ELECTIVE (PE) (Theory & Laboratory)

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
EARTH RESOURCES: MO SESSION 'GROUP-A'				
1	RS 505	Remote Sensing in Agriculture & Forestry	RS 501 & RS 502R2.	3
2	RS 507	Remote Sensing in Hydrology & Water Resources		3
3	RS 508	Remote Sensing in Agriculture & Forestry Laboratory	RS 503, RS 504 & RS 505	2
4	RS 510	Remote Sensing in Hydrology & Water Resources Laboratory	RS 503, RS 504 & RS 507	2
ENVIRONMENT & CLIMATE: MO SESSION 'GROUP-A'				
1	RS 517	Remote Sensing in Climate Change and Environmental Impact Assessment	RS 501 & RS 502R2.	**3**
2	RS 519	Remote Sensing in Climate Change and Environmental Impact Assessment Laboratory	RS 503, RS 504 & RS 506	2
EARTH RESOURCES: SP SESSION 'GROUP-B'				
1	RS 516	Remote Sensing in Snow and Glacier Hydrology	RS 501, RS 502R2	3
2	RS 506	Remote Sensing in Disaster Management	RS 501 & RS 502R2	3
3	RS 518	Remote Sensing in Snow and Glacier Hydrology Laboratory	RS 503, RS 504 & RS 516	2
4	RS 509	Remote Sensing in Disaster Management Laboratory	RS 503, RS 504 & RS 517	2
ENVIRONMENT & CLIMATE: SP SESSION 'GROUP-B'				
1	RS 524	Dynamic Meteorology	RS 501, RS 502R2	3
2	RS 526	Numerical Modelling Laboratory	RS 501 & RS 502R2	2
3	RS 527	Remote Sensing of Environment	RS 503, RS 504 & RS 516	3
4	RS 528	Remote Sensing of Environment Laboratory	RS 503, RS 504 & RS 517	2

Students should complete *Programme Electives* and *Open electives* as per the semester-wise **course structure** below:

COURSE STRUCTURE

SEMESTER – I (BOTH FOR I. EARTH RESOURCES & II. ENVIRONMENT & CLIMATE)

	Course Category	Course Code	Subjects	L	T	P	Credit
SEMESTER-I	PC	RS 501	Principles of Remote Sensing and Digital Satellite Image Processing	3	0	0	3
		RS 502R2	Geographic Information System and Satellite Navigation System	3	0	0	3
		RS 511	Aerial and Satellite Photogrammetry & Image Interpretation	3	0	0	3
		RS 503	Remote Sensing and Digital Satellite Image Processing Laboratory	0	0	4	2
		RS 504	Geographic Information System&Satellite Navigation SystemLaboratory	0	0	4	2
		RS 513	Aerial and Satellite Photogrammetry & Image Interpretation Laboratory	0	0	4	2
		MT 132	Communication Skills I	0	0	3	1.5
	PE	RS *	ELECTIVE – I	3	0	0	3
		RS *	ELECTIVE – I Laboratory	0	0	4	2
	Total Credits (1st Semester)						**21.5**

SEMESTER – II EARTH RESOURCES

	Course Category	Course Code	Subjects	L	T	P	Credit
SEMESTER-II	PC	RS 512	Advanced Remote Sensing and Geospatial Modelling	3	0	0	3
		RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	3	0	0	3
		RS 522	Programming concepts for spatial data handling	3	0	0	3
		RS 514	Advanced Remote Sensing and Geospatial Modelling Laboratory	0	0	4	2
		RS 515R1	Programming and Customisation in geospatial domain Laboratory	0	0	4	2
		MT 133	Communication Skills II	0	0	3	1.5
	PE	RS *	ELECTIVE – II	3	0	0	3
		RS *	ELECTIVE – II Laboratory	0	0	4	2
	Total Credits (2ndSemester)						**19.5**

SEMESTER – II ENVIRONMENT & CLIMATE

	Course Category	Course Code	Subjects	L	T	P	Credit
SEMESTER-II	PC	RS 523	Physical Meteorology	3	0	0	3
		RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	3	0	0	3
		RS 522	Programming concepts for spatial data handling	3	0	0	3
		RS 525	Meteorological Laboratory	0	0	4	2
		RS 515R1	Programming and Customisation in geospatial domain Laboratory	0	0	4	2
		MT 133	Communication Skills II	0	0	3	1.5

	PE	RS *	ELECTIVE – II	3	0	0	3
		RS *	ELECTIVE – II Laboratory	0	0	4	2
	Total Credits (2nd Semester)						**19.5**

SEMESTER – III

	Course Category	**Course Code**	**Subjects**	**L**	**T**	**P**	**Credit**
SEMESTER-III	**PC**	RS 601	Thesis (Part – I)				8
	OE+	**OPEN ELECTIVE / MOOC**		3	0	0	3
	OE+	**OPEN ELECTIVE / MOOC**		3	0	0	3
	Total Credits (3rd Semester)						**14**

SEMESTER – IV

	Course Category	**Course Code**	**Subjects**	**L**	**T**	**P**	**Credit**
SEMESTER-IV	**PC**	RS 604	Thesis (Part – II)				16
	Total Credits (4th Semester)						**16**

TOTAL (41+30) = 71 credits

***PROGRAM ELECTIVES:**

'GROUP - A' MO SESSION

Semester-I EARTH RESOURCE

Course No. **Course Title**

RS 505 Remote Sensing in Agriculture & Forestry
RS 507 Remote Sensing in Hydrology & Water Resources
RS 508 Remote Sensing in Agriculture & Forestry Laboratory
RS 510 Remote Sensing in Hydrology & Water Resources Laboratory

Semester-I ENVIRONMENT & CLIMATE

RS 517 Remote Sensing in Climate Change and Environmental Impact Assessment
RS 519 Remote Sensing in Climate Change and Environmental Impact Assessment Laboratory

'GROUP - B' SP SESSION

Semester- II EARTH RESOURCES

RS 516 Remote Sensing in Snow and Glacier Hydrology
RS 506 Remote Sensing in Disaster Management
RS 518 Remote Sensing in Snow and Glacier Hydrology Laboratory
RS 509 Remote Sensing in Disaster Management Laboratory

Semester- II ENVIRONMENT & CLIMATE

RS 524 Dynamic Meteorology
RS 526 Numerical Modelling Laboratory
RS 527 Remote Sensing of Environment
RS 528 Remote Sensing of Environment Laboratory

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

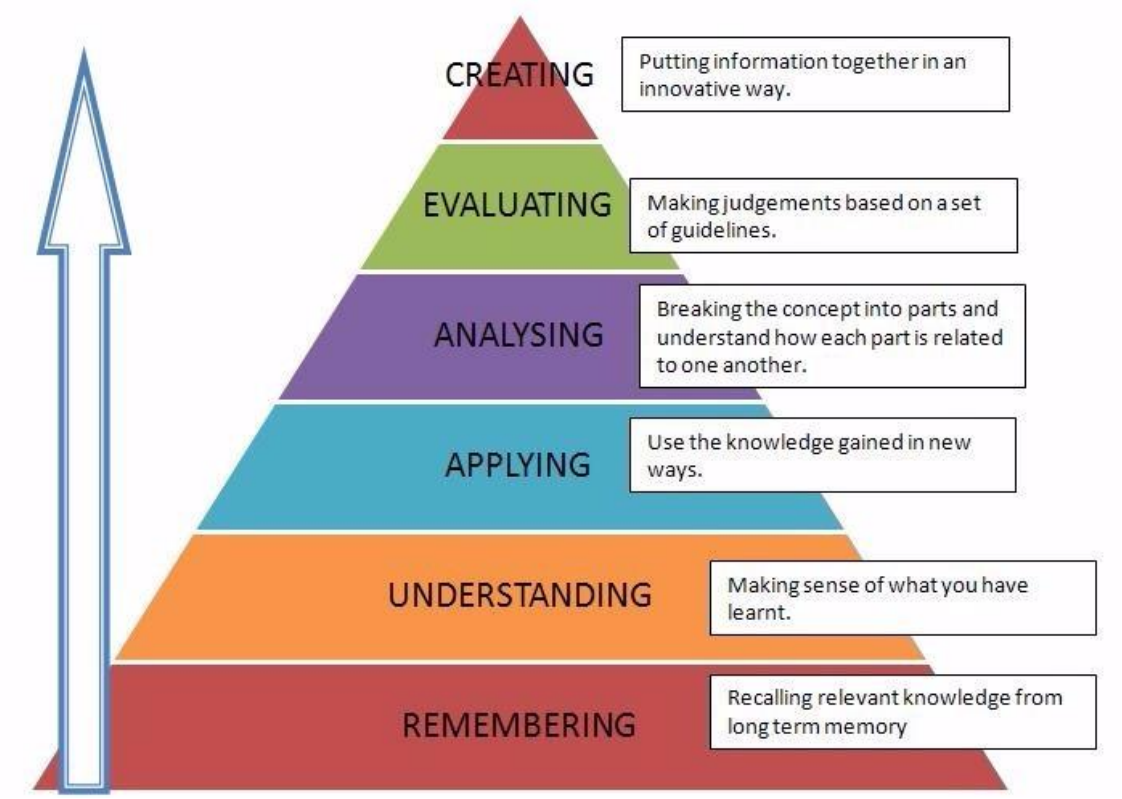
Thesis (Part – II) Semester IV – Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication in peer reviewed journals.

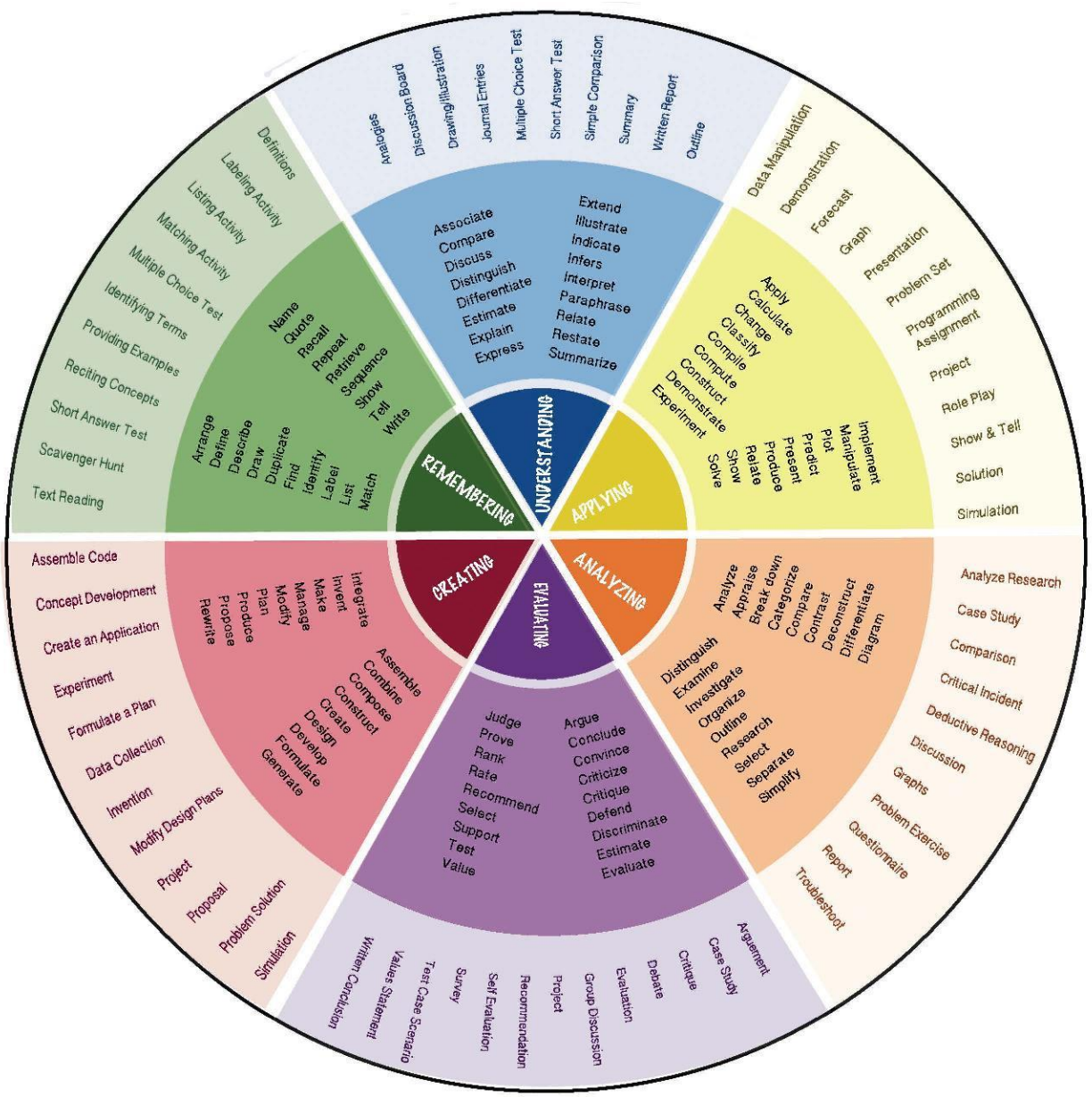
OE+ - OPEN ELECTIVE /MOOC – To be opted as offered by other Departments/ SWAYAM or NPTEL

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

SEMESTER II: PROGRAMME CORE
EARTH RESOURCES

Course code: RS 512R1
Course title: ADVANCED REMOTE SENSING AND GEOSPATIAL MODELLING
Pre-requisite(s): (i) Basic knowledge of Remote Sesning, GIS, and GNSS
(ii) Student must have undergone RS 501 and RS 502
Co- requisite(s):

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

Class schedule per week: 3
Class: M. TECH
Semester / Level: 02/05 (Spring)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the students:

1.	Understand Thermal, Microwave and Hyperspectral Remote Sensing techniques and its application areas.
2.	Learn advanced pattern and process modelling techniques associated with spatial problems.
3.	Realize the importance of uncertainty and errors associated with various spatial processes, and to quantify those errors.
4.	Learn techniques of Time Series Analysis and Web GIS.

Course Outcomes (COs):

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

CO1	Describe various advanced RS & GIS tools and techniques within spatial analytical framework to solve natural, environmental and societal problems and challenges.
CO2	Relate backscattering signals from different surfaces to physical processes, and understand SAR processing techniques.
CO3	Make use of thermal and hyperspectral data for real world applications (analysing Urban Heat Island problem, estimation of surface composition, forest species identification etc.).
CO4	Utilise sampling concepts, point pattern analysis, time-series analysis for various real life problems and associated uncertainty and errors.
CO5	Explain WebGIS concepts and able to use various scripting languages, web tools in implementing GIS functions on web.

MODULE 1: ADVANCES IN THERMAL AND MICROWAVE REMOTE SENSING

Determination of Emissivity and Land surface Temperature (LST) using thermal band, Microwave sensor technology, platforms and data types, Basic and advanced processing techniques such as InSAR, differential InSAR or polarimetric InSAR, Applications of active and passive microwave remote sensing data in areas of geology, hydrology, agriculture and

environmental sciences, etc., Application of LST in analysing Urban Heat Island effect, coalfire extent, energy balance, etc.

MODULE 2: HYPERSPECTRAL AND LASER REMOTE SENSING

Basic principle of hyperspectral image creation and spectral radiometry concepts, Processing and information extraction techniques in hyperspectral images, Spectral mixture analysis, feature extraction, classification and spectral library creation, Applications of hyperspectral remote sensing, Physics of Lidar and its application.

MODULE 3: SPATIAL PATTERNS, PROCESSES AND UNCERTAINTY MODELLING

Kriging and Spatial Autocorrelation, Points and Pattern Analysis: Nearest Neighbour Analysis, Quadrat Analysis, Poisson Processes, Uncertainty, Spatial resolution induced error, Positional Uncertainty, Attributed Uncertainty, Error Propagation Analysis, Taylor Series Approximation.

MODULE 4: GEO-SPATIAL MODELLING AND TIMESERIES ANALYSIS

SDSS, General Suitability & Multicriteria Modelling, AHP, Logistic modelling, Geographically Weighted Regression, Land Cover Change Modelling, Markov Chain Modelling, Advantages and difficulties in Time-series satellite data, Time-Composite Techniques, Temporal Smoothing Techniques - Fourier, Double Logistic, Gaussian, Seasonal Trend, Information Extraction Algorithms, Applications from Time-series.

MODULE 5: WEB GIS

Roles of Clients & Servers, Basics of web GIS, Architecture, Datawarehouse and geospatial web services, OGC, Open source and proprietary web-based scripting and mapping environments, KML, GeoJSON, and other formats for drawing vector data in the browser, Application Programming Interfaces (APIs),GeoServer, NSDI, Census GIS, BHUVAN, Crowd Sourcing.

TEXT BOOKS:

1. Floyd M. Henderson et.al.(1998). Imaging Radar (Manual of Remote Sensing, Volume 2) 3rd Edition , Wiley.
2. Dale A. Quattrochi et.al. (2004). Thermal Remote Sensing in Land Surface Processing.CRC Press.
3. Marcus Borengasser et.al. (2007). Hyperspectral Remote Sensing: Principles and Applications ,*CRC Press.*
4. Mitchell, Andy (2012). The Esri Guide to GIS Analysis, Volume 3: Modeling Suitability, Movement, and Interaction. Redlands, CA, Esri Press.
5. Yue-hong Chou (1997). Exploring Spatial Analysis in Geographical Information System. Onword Press. Thomson Learning.
6. Devillers, R. and Jeansoulin, R. (2006). Fundamentals of Spatial Data Quality. ISTE Ltd., USA.

REFERENCE MATERIALS:

1. ArcGIS Resource Center Web APIs, http://resources.arcgis.com/content/web/web-apis
2. ArcGIS JavaScript APIs, http://help.arcgis.com/en/webapi/javascript/arcgis/
3. ArcGIS JavaScript API Samples, https://developers.arcgis.com/en/javascript/jssamples/
4. Parker, D.C., Manson, S.M., Janssen, A., Hoffmann, M. and Deadman, P. (2003). Multi-agent systems for the simulation of land use and land cover change. A Review. Annals of the Association of American Geographer, 93(2).

5. Parker, D.C. (2005). Integration of GIS and Agent-based Models of Land use: Challenges and Prospects in D.J. Maguire, M.F. Goodchild, and M. Batty, eds. GIS, Spatial Analysis and Modelling. ESRI Press, Redlands, CA
6. Goodchild et. al. (1996). GIS and Environmental Modeling: Progress and Research Issues. GIS world, Inc.
7. Berners-Lee, T. (1996). The world wide web: past, present and future. Cambridge, MA: Massachusetts Institute of Technology, Laboratory for Computer Science. http://www.w3.org/People/Berners-Lee/1996/ppf.html.
8. Jones, C. B., and R.S. Purves (2008). Web-based GIS. In The Handbook of Geographical Information Science, eds. J. P. Wilson and A. S. Fotheringham, 559-580. Oxford: WileyBlackwell.
9. Sheather, S. (2009). Spatial Modelling Principles in Earth Sciences. Springer.
10. Maguire, Batty, & Goodchild (2005). GIS, Spatial Analysis, and Modeling. ESRI Press.
11. ArcGIS Resource Center Web APIs, http://resources.arcgis.com/content/web/web-apis
12. ArcGIS JavaScript APIs, http://help.arcgis.com/en/webapi/javascript/arcgis/
13. ArcGIS JavaScript API Samples, https://developers.arcgis.com/en/javascript/jssamples/

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

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 PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	3	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

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

Course code: RS 521
Course title: DATA SOURCES, STATISTICS AND RESEARCH METHODS IN GEOSPATIAL DOMAIN
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.Tech
Semester / Level: 02/05 (Spring)
Branch: Remote Sensing
Name of Teacher:

Course Objectives

This course aims to make the students:

1.	Learn about various geo-spatial data providers at global and national level.
2.	Understand various steps and important components involved in project management, field report preparation, and sampling statistics.
3.	Gain knowledge about importance of quality, ethics, and different research methods being used in the geo-spatial domain.

Course Outcomes (CO):

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

CO1.	Explain the formulation of various schemes in Geoinformatics domain
CO2.	Write Project reports and project proposals
CO3.	Apply research methods quantitatively and qualitatively
CO4.	Use the National/Global standards of research

MODULE 1: GEO-SPATIAL RESEARCH & DATA SOURCES

Geo-spatial Research Problems. National and International Projects: Past and Recent, Different types of Geo-spatial data requirement, USGS Global Visualization Viewer (GloVis), NASA Earth Observation (NEO), USGS Earth Explorer, ESA's Sentinel data, NOAA, IPMUS Terra, LANCE, VITO Vision, Bhuvan, MOSDAC, India-WRIS, Identification of problems at regional and Local level.

MODULE 2: 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.

MODULE 3: 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.

MODULE 4: 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.

MODULE 5: 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.

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
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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

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

Low = 1, Medium = 2, High= 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

Course code: RS 522
Course title: PROGRAMMING CONCEPTS FOR SPATIAL DATA HANDLING
Pre-requisite(s): (i) Knowledge of Basic Sciences
(ii) Student must have undergone RS 501, RS 502
Co- requisite(s):

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

Class schedule per week: 3
Class: M. TECH
Semester / Level: 02/05 (Spring)
Branch: REMOTE SENSING

Course Objectives:

This course aims to:

1.	Enhance the student's understanding about the basic programming languages C
2.	Make the student learn concepts of R and Python
3.	Make the student learn the spatial data handing through R, Python, MATLAB and Google Earth Engine

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 C
CO2	Handle Spatial data in **R**
CO3	Make use of Python for deployment of programs to process spatial data
CO4	Utilise MATLAB tools for digital image processing
CO5	Make computations using Images & Image Collections in Google Earth Engine

MODULE 1: - BASICS OF C PROGRAMMING
Syntax, and constructs of C; variables, assignment, declarations, expressions, statements, input/output, conditionals, branching, iteration. Arrays, pointers, static and dynamic structures, dynamic allocation, file structures. Functions and recursion: Parameter passing in a function, procedure call, call by value and reference, function prototypes; recursion; library functions, static functions.

MODULE 2: - CONCEPTS 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, Vectorized Operations, Control Structures, Functions, Scoping Rules, Coding Standards, Loop Functions, Debugging Tools, and Simulation,Problem solving with spatial data

MODULE 3: - CONCEPTS 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, Self-defined Functions, Recursion, Scope of Variable, Standard Library Functions, Exceptions,Handling spatial data with Python

MODULE 4: - MATLAB

Introduction to MATLAB, MATLAB Functions, Graphics with MATLAB, Programming with MATLAB, Mathematical Computing with MATLAB, Elements of Digital Image Processing, Digital Image Basics, Image Enhancement Techniques, Multiband Image Processing and Feature Detection and Extraction, Image Classification Techniques and Visual interpretation of Multispectral Data.

MODULE 5: - 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, Quality Mosaicking, Exporting Charts and Images, Case Studies using Global Forest Change and Global Surface Water (GSW) datasets.

TEXT BOOKS:

1. B. W. Kernighan and D. M. Ritchie: The ‘C’ Programming Language.
2. Mark Lutz: Learning Python
3. Hadley Wickham, Garrett Grolemund: R for Data Science
4. Mikhailov, Eugeniy E: Programming with MATLAB for Scientists: A Beginner’s Introduction
5. Lalit Kumar, Onisimo Mutanga: Google Earth Engine Applications

REFERENCE BOOKS:

1. B. Gottfried: Programming in C.
2. Wes McKinney: Python for Data Analysis
3. Colin Gillespie, Robin Lovelace: Efficient R Programming
4. 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

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 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

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 II: PROGRAMME ELECTIVES
EARTH RESOURCES

Course code: RS 506
Course title: REMOTE SENSING IN DISASTER MANAGEMENT
Pre-requisite(s): (i) Knowledge of Basic Sciences
(ii) Computer Knowledge

Co- requisite(s):

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

Class schedule per week: 3
Class: M. TECH
Semester / Level: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

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 geomatics tools in every stage.
CO3	Understand administrative structure of disaster management in India.
CO4	Understand the ethical and humanitarian values.
CO5	Apply integrated geospatial techniques in disaster management and disaster risk reduction.

MODULE 1: INTRODUCTION

Natural and human induced disasters, Fundamental concept of Disaster Management, Various natural disasters and their characterization: Cyclones, Floods, Earth quakes, land subsidence and Landslides, Forest fires, Droughts. Disasters and National losses, Historical perspective of disasters in India. Existing organizational structure for managing disasters in India, NGOs and people participation in disaster management.

MODULE 2: RS & GIS FOR HAZARD, RISK AND DAMAGE ASSESSMENT

Hazard evaluation – Zonation – Risk assessment and vulnerability, Damage assessment – Land use planning and regulation for sustainable development, Potential of GIS application in disaster mapping – Disaster management plan.

MODULE 3: LONG TERM MITIGATION MEASURES

Needs and approach towards prevention, principles and components of mitigation, Disaster legislation and policy – Insurance – Cost effective analysis – Utilisation of resource, Training – Education – Public awareness –Role of media.

MODULE 4: DISASTER MANAGEMENT PLANNING

Spatial and non-spatial data bank creation, Natural disaster management plans, Shelterbelts, Special structures, Disaster preparedness and Mitigation. Information needs of Disaster management, Operational emergency management – Vulnerability analysis of infrastructures, Settlements and population, Pre-disaster and post disaster planning for relief operations, Satellite communications during disasters: networks, use of Internets, Warning system - rehabilitation - Post disaster review, Global Disaster Alert and Coordination System.

MODULE 5: DISASTER MODELING AND CASE STUDIES

Known/Generic Models in managing various disasters, Earthquakes in India, Tsunami Impact Assessment, Floods in Indo Gangetic plains, Landslides in Himalayan region, Drought in Indian plateau regions, Glacial lake outburst floods.

TEXT BOOKS:

1. Roy, P.S. (2000). Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS).
2. Sdidmore, A. (2002). Environmental Modeling with GIS and Remote Sensing, Taylor & Francis.
3. Anji Reddy, M. (2004) Geoinformatics for environmental Management. B. S. Publication.
4. Murthy, D.B.N. (2008) - Disaster Management - Deep & Deep Publication.

REFERENCE BOOKS:

1. Bhattacharya, Tushar (2012). Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd. ISBN-10: 1259061302; ISBN-13: 978-1259061301
2. UN (2015). Disasters without boarders United Nations Publications Sales No: E15.II.F.13, ISBN: 978-92-1-120699-9
3. Gupta, H. K. (2012). Disaster Management, Universities press India , e-ISBN 9788173718663
4. Hyndman, Donald and Hyndman, David (2018). Natural Hazards and Disasters, ISBN - 13:0538737524
5. Pandey, Mrinalini (2014). Disaster Management, Willey India Pvt.Ltd ISBN 10: 8126549246 / ISBN 13: 9788126549245
6. Shukla, Shailesh,and Hussain, Shamna (2013) Biodiversity, Environment and Disaster Management Unique Publications, ISBN: 9788183577670, 8183577679
7. Babar, Md. (2007). Environmental Changes and Natural Disasters, New India Publishing Agency.
8. A. Orhan, R. Backhaus, P. Boccardo, S. Zlatanova (2010). Geoinformation for Disaster and Risk Management Examples and Best Practices, Joint Board of Geospatial Information Societies and United Nations Office for Outer Space Affairs, Denmark.
9. Liu Y. & Baas S. (2001). Strengthening pastoral institutions in North-West China pastoral area to access improved extension services for risk management and poverty alleviation. (www.fao.org/sd/2001/IN0601_en.htm).
10. Swift, J. & Baas, S. (2003). Managing Pastoral Risk in Mongolia - A Plan of Action. ProjectTCP/FAO/MON0066.FAO.Rome. (available at www.fao.org/docrep/009/ ah828e/ ah828e00.htm).
11. Tearfund (2005). Mainstreaming disaster risk reduction: a tool for development organisations by S. La Trobe and I. Davis. Teddington, Middlesex. UN/ISDR. 2004.
12. UN/ISDR. (2004). Living with Risk: A global review of disaster reduction initiatives. 2004 Version, Volume II Annexes. Geneva.
13. ESRI (2006). GIS and Emergency Management in Indian Ocean Earthquake/Tsunami

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

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 PROGRAMME OUTCOMES

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

Low = 1, Medium = 2, High= 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD3, CD6
CO3	CD1, CD6
CO4	CD1, CD5, CD6
CO5	CD1, CD2, CD3, CD4, CD5, CD6

Course code: RS 516
Course title: REMOTE SENSING IN SNOW AND GLACIER HYDROLOGY
Pre-requisite(s): (i) Knowledge of Basic Sciences
(ii) Student must have undergone RS 501, RS 502

Co- requisite(s):

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

Class schedule per week: 3
Class: M. TECH
Semester / Level: 02/05 (Spring)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to:

1.	Teach the concepts and role of Snow and Glacier components of the Cryosphere.
2.	Make the student understand periglacial and hydrological implications of glaciers using remote sensing.
3.	Make students learn various global initiatives and techniques of snowmelt-runoff modelling using remote geospatial techniques.

Course Outcomes (Cos)

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

CO1	Explain differnces between snow and glaciers, types of galciers and glacial landforms and its formation.
CO2	Identify and visually interpret snow and glacier extent on the satellite images and analyse in terms of changes, and quantify relationship between glacial geomorphology and glacier hydrology.
CO3	Able to measure depth of snow cover, snow water equivalent and snow response to microwave.
CO4	Describe implications of snowmelt models including inferences on their efficacy to describe global climate change phenomena and able to generate report.

MODULE 1: GLACIAL GEOMORPHOLOGY
Ice and related phenomenon, Types of glaciers, Movement of glaciers, Erosional work of glaciers , Transportation and depositional work of glaciers, Glacier depositional landforms, Glacio-fluvial deposits and landforms, Glacial geomorphic cycle. Meaning and concept of Periglacial climate, Periglacial areas, Permafrost, Mechanism of Periglacial processes, Genetic classification of Periglacial landforms, Periglacial cycle of erosion

MODULE 2: HYDROLOGICAL ASPECTS OF GLACIERS
Classification of glaciers and its mapping using Satellite Data, Inventory of glaciers, Spatial characteristics of a glacier, Mass balance of a glacier and its measurement, Depth of a glacier and its measurement.

MODULE 3: SPATIAL SNOW, ICE AND GLACIERS
Scope and importance of snow and glaciers, Properties of snow and ice - Thermal and Optical, Water Inventory, snow and ice on the earth - snow covered areas on the Globe, the records of glacier retreat and advancement in centuries with spatial distribution

MODULE 4: MEASUREMENT OF DEPTH, WATER EQUIVALENT AND AREA OF SNOW COVER

Depth of snow cover, Snow cover water equivalent, Areal extent of snow cover, satellite sensors for snow related studies, Microwave response of snow, Metamorphism of snow

MODULE 5: REMOTE SENSING BASED SNOWMELT ESTIMATION, SNOWMELT RUNOFF MODELING AND FORCASTING

Remote Sensing in estimating Snowmelt indices, Comparison of energy balance and index approach, Observed maximum snowmelt rates, Modeling of snowmelt runoff, Storage potential, Time delay in runoff generation, Forecasting of snowmelt runoff, Simulation accuracy.Snowmelt Runoff Model SRM, Precipitation Runoff Modeling System PRMS, HBV MODEL University of British Columbia Watershed Model UBC

TEXT BOOKS:

1. Tedesco, M. (2015). Remote SEsning of the Cryosphere, Wiley Blackwell Publisher, ISBN: 978-1-118-36885-5.
2. Arthur Homes (1993). Principles of Physical Geology, Thomas Nelson & Sons Ltd. Edinburgh.
3. P. Singh, Vijay P. Singh (2000). Snow and Glacier Hydrology. Water Science and Technology, Springer.

REFERENCE BOOKS:

1. Douglas I Benn, David, J. A. Evans (2010). Glaciers and Glaciation, Hodder Education.
2. Kurt M. Cuffey and W. S. B. Paterson (2010). The Physics of Glaciers, Fourth Edition.
3. P. McL. D. Duff and Arthur Holmes (1999). Himalayan Glaciers.
4. 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 Faculty
2. Student Feedback on Course Outcome

Course Evaluation:

Individual assignment, Quizes, Mid and End semester examinations

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 PROGRAMME OUTCOMES

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

Low = 1, Medium = 2, High= 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD6
CO2	CD1, CD2, CD3, CD6
CO3	CD1, CD2, CD3, CD6
CO4	CD1, CD2, CD3, CD4, CD5, CD6

SEMESTER II: LABORATORIES

EARTH RESOURCES

Course code: RS 514
Course title: ADVANCED REMOTE SENSING AND GEOSPATIAL MODELLING LABORATORY
Pre-requisite(s): Basic physics
Co- requisite(s):

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 02/05 (Spring)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the student with the ability to :

A.	Handle advanced sensor data and extract information using diverse software environment.
B.	Execute various spatial techniques and models to quantify and solve real-life spatial patterns and problems.

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

CO1	Dowload, Import, use and understand diverse spatial and satellite data.
CO2	Understand and use various remote sensing and GIS softwares, tools and models for information extraction in Stand-alone and Web environment.
CO3	Create a workflow and practically execute models for understanding spatial patterns, processes and solve real-life spatial problems.

Lab 1 Handling Thermal and Microwave Data

Lab 2 Modelling Urban Heat Island using Thermal data

Lab 3 SAR data processing and applications

Lab 4 Hyperspectral data processing

Lab 5 Spectral Mixture Analysis, Feature Extraction and Classification using Hyperspectral data

Lab 6 LIDAR data Processing

Lab 7 Surface Interpolation using Krigingtechnique

Lab 8 Spatial Pattern Analysis using GIS

Lab 9 Understanding Two-point and Multi-point Statistics

Lab 10 Modelling Resolution Uncertainty and Error in the Spatial Data

Lab 11 Spatial Regression and Geographically Weighted Regression

Lab 12 Smoothingand information extraction using Time Series Data

Lab 13 WebGIS relatedservices, programmingand Scripting

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

Indirect Assessment –

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

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3

Course code: RS 515R1
Course title: PROGRAMMING AND CUSTOMISATION IN GEOSPATIAL DOMAIN LABORATORY
Pre-requisite(s): Computer skills
Co- requisite(s):

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 02/05(Spring)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives:

This course aims to impart following practical knowledge to students:

A.	Practically carry out programming concepts learned in theory class.
B.	Write simple to advanced programming in different languages.

Course Outcomes:

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

CO1	Understand and Use C Compiler programming Environment
CO2	Understand and appropriately Utilise various libraries, Fuction and Syntaxes in R and Pyhton
CO3	Write a simple to complicated Programming Codes in MATLAB & Google Earth Engine.

Lab 1. Programming in C: environment, variables, operators &controls

Lab 2. Programming using Functions, Decision making & Arrays in C

Lab 3. Programming Environment and Libraries in R

Lab 4. Programming for Reading, Writing from/to file, and Plotting

Lab 5. Programming for Handling & Processing Images in R

Lab 6, 7, 8 Programming in Python

Lab 9, 10 Programming in MATLAB

Lab 11,12, 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	50
Semester End Examination	50

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
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3

Course code: RS 509
Course title: REMOTE SENSING IN DISASTER MANAGEMENT LABORATORY
Pre-requisite(s): Basic physics
Co- requisite(s):

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 02/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the student:

A.	Utilise diverse remote sensind data for extracting spatial information associated with Disasters.
B.	Execute various information extraction and modelling techniques to assess vulnerability and risk associated with different disasters.

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 causing factors of 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.

Lab 1-2	Explore Bhuvan& Google Earth etc. in general, and specifically for Disaster services and analyse the situation in your state
Lab 3	Mapping flood inundated area using satellite data
Lab 4	Download MODIS Fire data and TRMM rainfall data, and analyse.
Lab 5	Download MODIS Snow related data and analyse.
Lab 6	Identify the drought prone region using vegetation indices derived from satellite data
Lab 7	Identify and map landslides from satellite images and compare the same with high resolution Google-earth image
Lab 8	Delineate forest fire regions in the given study area with the help of MODIS LST product for a particular date and compare your result with Bhuvan site
Lab 9	Mapping lightning incidence location
Lab 10	Water sample collection from different location and its analysis for assessing different water quality parameters and comparison with the BIS standards
Lab 11	Download Air quality data from CPCB website for your city and find out the trend of different air quality parameters for last few years
Lab 12	Compare the Air quality parameters for metro cities (Before Diwali and after Diwali)
Lab 13	Modelling Hazard Zonation (flood/earthquake/landslide).

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

Indirect Assessment –

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

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3

Course code: RS 518
Course title: REMOTE SENSING IN SNOW AND GLACIER HYDROLOGY LABORATORY
Pre-requisite(s): Basic physics
Co- requisite(s):

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 02 /05 (Spring)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to impart practical knowledge about:

A.	Mapping of Snow and associated parameters using satellite data
B.	Execution skills for various analogue and digital image processing techniques to map and model various processes associated with snow and glaciers.

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

CO1	Visually and Digitally differentiate various snow covered areas and Glacier landforms from satellite data.
CO2	Use optical remote sensing data and GIS tools to quantify glacial mass balance, snow water equivalent and snow indices.
CO3	Use Radar remote sensing data to quantify snow and glacier conditions.

Lab 1 Visual Interpretation of snow and glacier on optical satellite data.

Lab 2-3 On-Screen glacial landform mapping

Lab 4-5 Glacier area extraction and cumputation -Accumulation and Ablation using RS data

Lab 6-7 Computing glacier mass balance using Area Accumulation Ratio method.

Lab 8 Snow cover area and glacier mapping using SAR data.

Lab 9 Snow water equivalent estimation using delta - K technique.

Lab 10 Generation of Snow Indices for delineating snow cover.

Lab 11-12 SAR data processing and generation of snow backscater image

Lab 13 Wet SCA estimation using SAR data.

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

Indirect Assessment –

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

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3