Course Structure
&
Syllabus

M.Tech. Remote Sensing

Department of Remote Sensing

Birla Institute of Technology

Mesra, Ranchi- 835215

Jharkhand, INDIA

Restructured and applicable from
Session 2021-22 onwards

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 Geo-spatial Technology education and research 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	2 Programme Core (PC)	8	19
		1 Progammet Elective (PE)	3	
		4 LABS (2 PC + 2 PE)	8	
2	SECOND	3 Programme Core (PC)	10	19
		1 Progamme Elective (PE)	3	
		3 LABS (2 PC + 1 PE)	6	
3	THIRD	Research Project	8	14
		Open Elective (OE-I)/MOOC	3	
		Open Elective (OE-II)/MOOC	3	
4	FOURTH	Research Project	16	16
TOTAL				**68**

MASTER OF TECHNOLOGY (*Remote Sensing*)

PROGRAMME CORE (PC) (*offered in MO session only)*

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
1	RS 501R1	Principles of Remote Sensing and Digital Satellite Image Processing	Basic Physics/Science Computer Knowledge	4
2	RS 502R1	Geographic Information System and Satellite Navigation System	Basic Sciences/ Basic Computing	4
3	RS 503	Remote Sensing and Digital Satellite Image Processing Laboratory	RS 501	2
4	RS 504	GIS &Satellite Navigation System Laboratory	RS 502	2
5	RS 515	Programming and Customisation in geospatial domain Laboratory	RS 501, RS 502	2

PROGRAMME CORE (PC) (*offered in SP session only)*

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
1	RS 511	Aerial and Satellite Photogrammetry & Image Interpretation	RS 501	3
2	RS 512	Advanced Remote Sensing and Geospatial Modelling	RS 501, RS 502	4
3	RS 513	Aerial and Satellite Photogrammetry & Image Interpretation Laboratory	RS 511	2
4	RS 514	Advance Remote Sensing and Geospatial Modelling Laboratory	RS 512	2
5	RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	RS 501, RS502	3

ELECTIVES

Students pursuing M. Tech in Remote Sensing Technology should complete at least three (*09 credits*) courses each from the Programme Electives and atleast 2 Open electives (*06 credits*) listed below.

PROGRAMME ELECTIVE (PE) (Theory & Laboratory)

S. No	Course Code	Course Title	Pre requisites / Co requisites	Credits
GROUP-A (MO session only)				
1	RS 505	Remote Sensing in Agriculture & Forestry	RS 501 & RS 502.	3
2	RS 506	Remote Sensing in Disaster Management		3
3	RS 507	Remote Sensing in Hydrology & Water Resources		3

4	RS 508	Remote Sensing in Agriculture & Forestry Laboratory	RS 503, RS 504 & RS 505	2
5	RS 509	Remote Sensing in Disaster Management Laboratory	RS 503, RS 504 & RS 506	2
6	RS 510	Remote Sensing in Hydrology & Water Resources Laboratory	RS 503, RS 504 & RS 507	2
GROUP-B (SP session only)				
7	RS 516	Remote Sensing in Snow and Glacier Hydrology	RS 501, RS 502	3
8	RS 517	Remote Sensing in Climate Change and Environmental Impact Assessment	RS 501 & RS 502	3
9	RS 518	Remote Sensing in Snow and Glacier Hydrology Laboratory	RS 503, RS 504 & RS 516	2
10	RS 519	Remote Sensing in Climate Change and Environmental Impact Assessment Laboratory	RS 503, RS 504 & RS 517	2

OPEN ELECTIVE (OE)

These open elective courses are available only to candidates from other departments. However, all the courses (listed below) may not be announced in a semester. Students are requested to contact the department Head or Coordinator to know the availability on semester basis.

Choice A: Open Electives (beginner level)

GI 501 Principles of Remote Sensing (Theory = 3 Credits) – Monsoon Semester
GI 505 Principles of Remote Sensing (Laboratory = 2 Credits) – Monsoon Semester
RS 502 Geographic Information System and Satellite Navigation System (Theory = 3 Credits) – Monsoon Semester
RS 504 Geographic Information System and Satellite Navigation System Lab (Laboratory = 2 Credits) – Monsoon Semester
GI 509 Digital Satellite Image Processing (Theory = 4 Credits) – Spring Semester
GI 511 Digital Satellite Image Processing (Laboratory = 2 Credits) – Spring Semester
RS 520 Real World Operationalisation of GIS and GNSS (3 Credits) – Spring Semester

Choice B: Open Electives (Advanced level)

RS 511 Aerial and Satellite Photogrammetry & Image interpretation (Theory = 3 Credits) – Spring Semester
RS 513 Aerial and Satellite Photogrammetry & Image interpretation (Laboratory = 2 Credits) – Spring Semester
GI 602 Advanced Geo-Spatial Modelling and Decision Support System (Theory = 4 Credits) – Spring Semester
GI 604 Advanced Geo-Spatial Modelling and Decision Support System (Laboratory = 2 Credits) – Spring Semester
RS 507 Remote Sensing in Hydrology & Water Resources (Theory = 3 Credits) – Monsoon Semester
RS 510 Remote Sensing in Hydrology & Water Resources (Laboratory = 2 Credits) – Monsoon Semester

MINOR PRGRAMME

Minor in Remote Sensing: (minimum required credits = 12) (Only for Students from OTHER DEPARTMENTS). Subjects can be chosen from the list of Open Electives.

Beginner Level Credit Requirement = 6 Credits
Advanced Level Credit Requirement = 6 Credits

COURSE STRUCTURE

SEMESTER - I

	Course Category	Course Code	Subjects	L	T	P	Credit
SEMESTER-I	PC	RS 501R1	Principles of Remote Sensing and Digital Satellite Image Processing	3	1	0	4
		RS 502R1	Geographic Information System and Satellite Navigation System	3	1	0	4
		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 515	Programming and Customisation in geospatial domain Laboratory	0	0	4	2
	PE	RS *	ELECTIVE – I	3	0	0	3
		RS *	ELECTIVE – I Laboratory	0	0	4	2
	Total Credits (1st Semester)						**19**

SEMESTER – II

	Course Category	Course Code	Subjects	L	T	P	Credit
SEMESTER-II	PC	RS 511	Aerial and Satellite Photogrammetry & Image Interpretation	3	0	0	3
		RS 512	Advanced Remote Sensing and Geospatial Modelling	3	1	0	4
		RS 513	Aerial and Satellite Photogrammetry & Image Interpretation Laboratory	0	0	4	2
		RS 514	Advanced Remote Sensing and Geospatial Modelling Laboratory	0	0	4	2
		RS 521	Data Sources, Statistics and Research Methods in Geospatial Domain	3	0	0	3
	PE	RS *	ELECTIVE – II	3	0	0	3
		RS *	ELECTIVE – II Laboratory	0	0	4	2
	Total Credits (2ndSemester)						**19**

SEMESTER – III

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

SEMESTER – IV

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

TOTAL = 68 credits

PROGRAMME ELECTIVES

Course No.	Course Title

PE-I (Semester-I)

RS 505	Remote Sensing in Agriculture & Forestry
RS 506	Remote Sensing in Disaster Management
RS 507	Remote Sensing in Hydrology & Water Resources
RS 508	Remote Sensing in Agriculture & Forestry Laboratory
RS 509	Remote Sensing in Disaster Management Laboratory
RS 510	Remote Sensing in Hydrology & Water Resources Laboratory

PE-II (Semester- II)

RS 516	Remote Sensing in Snow and Glacier Hydrology
RS 517	Remote Sensing in Climate Change and Environmental Impact Assessment
RS 518	Remote Sensing in Snow and Glacier Hydrology Laboratory
RS 519	Remote Sensing in Climate Change and Environmental Impact Assessment Laboratory

THESIS (Programme Core)

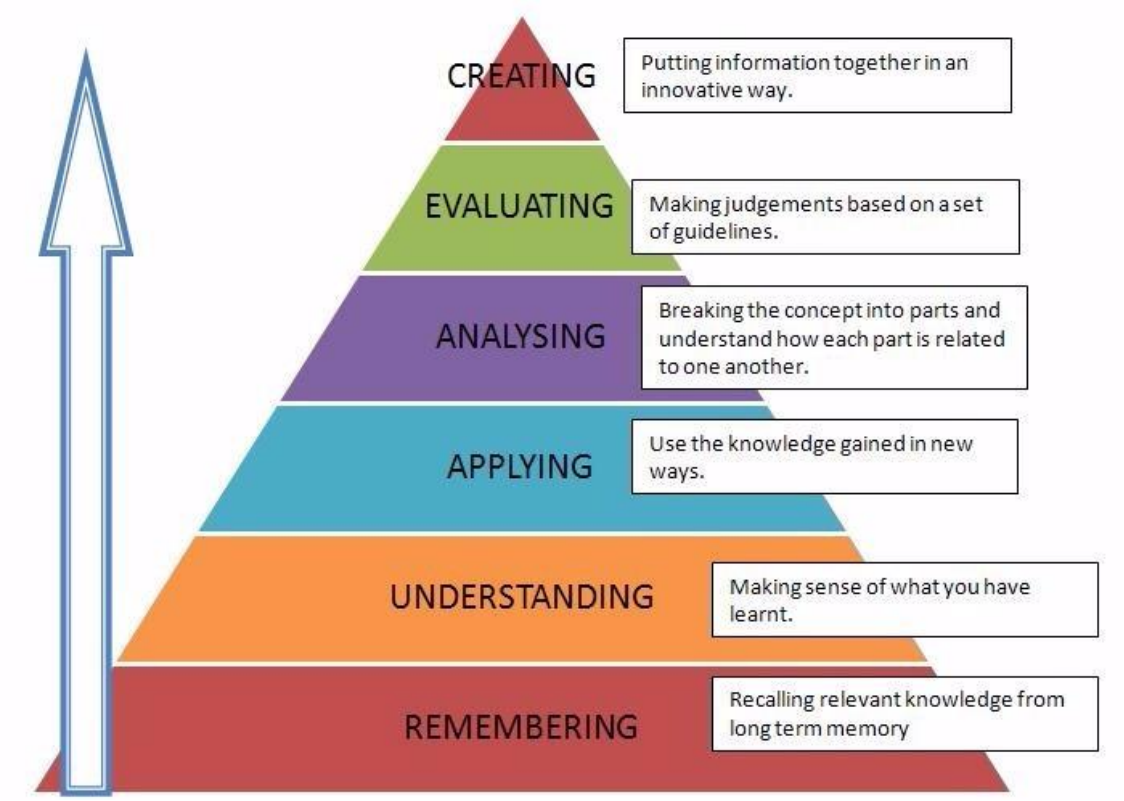
RS 601 - Thesis (Part – I) – Focus on Problem definition, Literature Review, Data Collection, Objectives and Research Qeustions Formulation and Detailed Work Plan, and partial fulfillment of initial objectives.

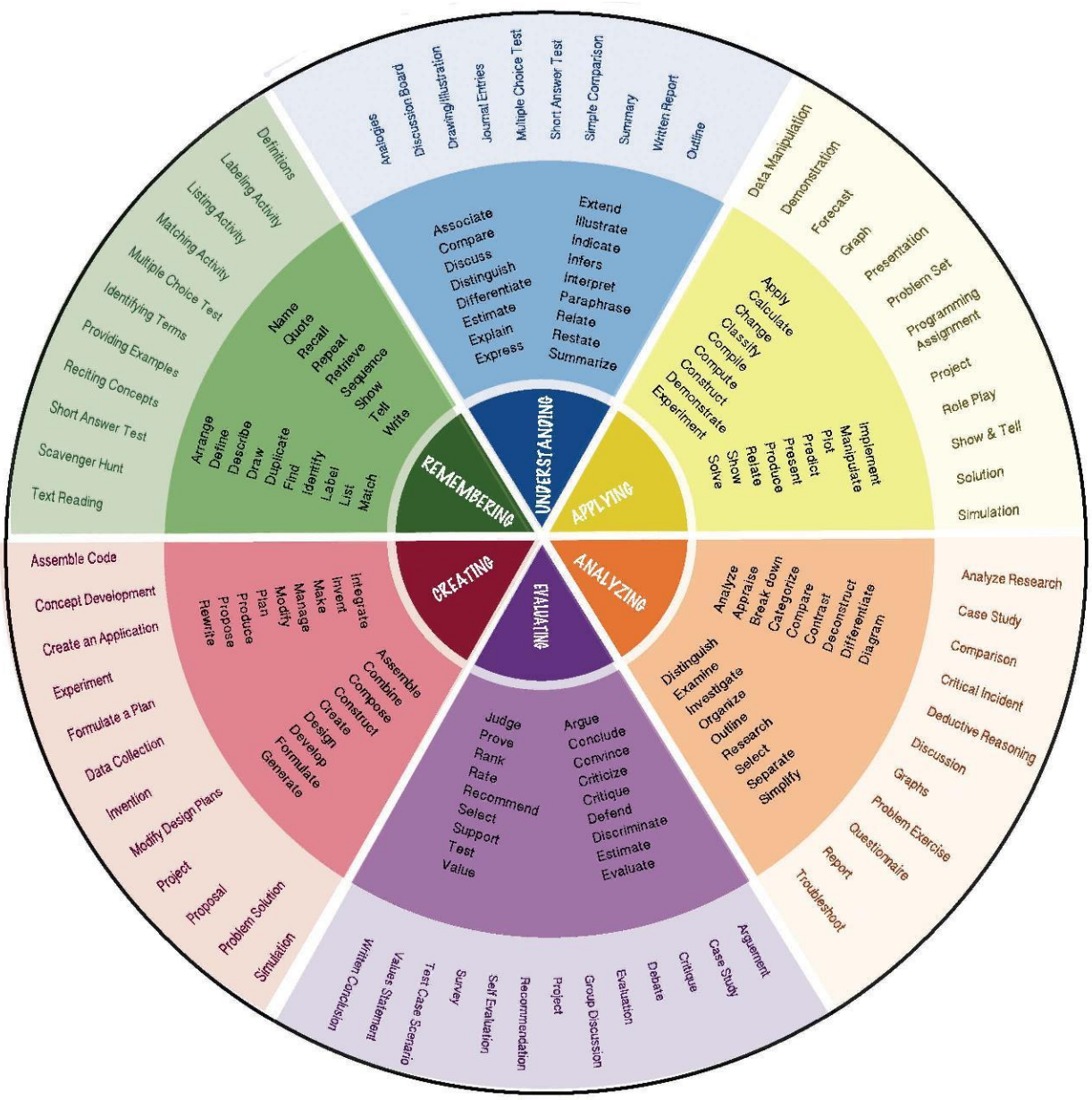
RS 604 - Thesis (Part – II) – Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication in peer reviewed journals.

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
Plot
Predict
Present
Produce
Relate
Show
Solve
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

M. Tech. (REMOTE SENSING)

SEMESTER I

Course code: RS 501R1
Course title: PRINCIPLES OF REMOTE SENSING & DIGITAL SATELLITE IMAGE PROCESSING

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

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to:

1.	Disseminate basic concepts and applications of Electromagnetic Spectrum in Remote Sensing, Energy Balance and Data acquisition platforms, sensors and their characterstics
2.	Enhance student's knowledge about optical, thermal and microwaves based Remote Sensing and Applications for solving real life problems
3.	Introduce students to digital image processing tools and techniques.

Course Outcomes (CO):

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

CO1	Explain physical principles and sensing process in remote sensing.
CO2	Explain different type of sensors (optical, microwave, thermal and LIDAR) and their characteristics.
CO3	Describe preprocessing requirements and discuss various Digital Image Processing techniques.
CO4	Rationalise statistical outlook of satellite images and different classification approaches with respect to diverse applications.
CO5	Apply the knowledge of remote sensing in various thematic studies

MODULE 1: BASIC CONCEPTS

Remote Sensing: History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Energy Balance Equation, Spectral Response and Spectral Signature, Spectral, Spatial, Temporal and Radiometric resolutions.

MODULE 2: DATA ACQUISITION

Platform: Balloon, Rocket, Helicopter, Aircraft and Spacecraft, Aerial vs. Satellite Remote Sensing, Satellites and their Specifications: LANDSAT, SPOT, ENVISAT, RADARSAT, IRS, IKONOS, Sensors and their Specifications: MSS, TM, LISS(I,II,III,IV), PAN, WiFS, AWiFS, MODIS, Weather & Communication Satellites.

MODULE 3: OPTICAL, THERMAL AND MICROWAVE REMOTE SENSING

Imaging and Non-Imaging, Active and Passive, Multispectral, Superspectral and Hyperspectral Sensors, Electro-Optical Systems, Opto-Mechanical Scanners, Infrared Scanners, Scatterometer, Thermal Properties of Terrain, Thermal IR Environmental Considerations, Thermal Infrared and Thermal Scanners, Microwave Remote sensing concepts: Backscattering, Range Direction, Azimuth Direction, Incident Angle, Depression Angle, Polarization, Dielectric Properties, Surface Roughness and Interpretation, Speckle and Its Reduction, Applications of optical, thermal and microwave remote sensing.

MODULE 4: IMAGE ENHANCEMENT AND FILTERING TECHNIQUES

Concepts about digital image and its characteristics, Sources of image degradation - Image restoration and Noise Abatement , Radiometric and Geometric correction technique, linear and non linear transformation for geometric corrections, Look-up Tables (LUT) and Types of image displays and FCC, Radiometric enhancement techniques, Spatial enhancement techniques, Contrast stretching: Linear and non-linear methods, Low Pass Filtering: Image smoothing, High Pass Filtering: Edge enhancement and Edge detection, Gradient filters, Directional and non-directional filtering.

MODULE 5: PATTERN RECOGNITION

Concept of Pattern Recognition, Multi-spectral pattern recognition, Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers, Unsupervised classification methods. Supervised classification techniques, Limitations of standard classifiers.

TEXT BOOKS:

1. Joseph,George and Jeganathan, C. (2017). "Fundamentals of Remote Sensing", 3rd Edition, Universities press (India) Pvt. Ltd., Hyderabad.
2. Jensen, J.R. (2006). "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi.
3. Jensen, J.R. (1996). Introductory Digital Image Processing A remote sensing perspective. Prentice Hall Seies in GIS , USA
4. Lillesand, Thomas M. and Kiefer, Ralph, W. (2007). "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York.

REFERENCE BOOKS:

1. Sabins, F.F. Jr. (2007). 'Remote Sensing – Principles and Interpretation", W.H. Freeman & Co.
2. Reeves, Robert G. (1991), "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA

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 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	3	3	
CO2	2	1	3	3	
CO3	2	1	3	3	1
CO4	3	1	3	3	1
CO5	3	3	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, CD6
CO2	CD1, CD6
CO3	CD1, CD2, CD3, CD6
CO4	CD1, CD2, CD3, CD6
CO5	CD1,CD2,CD3,CD4,CD5, CD6

Course code: RS 502R1
Course title: GEOGRAPHIC INFORMATION SYSTEM AND SATELLITE NAVIGATION SYSTEMS

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

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to:

1.	Introduce the students to the basic concepts of GIS and making the students familiar with the spatial data and spatial analysis techniques
2.	Introduce the satellite based positioning system, concept of geodesy and augmentation systems
3.	Impart concepts about reference surfaces (Datum), coordinate transformation models and surveying methods.

Course Outcomes (CO):

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

CO1	Describe various GIS and Navigation tools and techniques within spatial analytical framework and handle spatial and non-spatial database.
CO2	Carry out spatial data analysis to solve natural, environmental and societal problems and challenges.
CO3	Explain various datums, coordinate systems, Differential positioning concepts and associated surveying techniques.
CO4	Elucidate integrated geospatial techniques and apply them in solving real world problems.

SYLLABUS:

MODULE 1: BASIC CONCEPTS OF GIS

Definition, Philosophy & Historical evolution of GIS, Spatial vs. non-spatial data, Components of GIS, Spatial data models – Raster and Vector; advantages & disadvantages, Raster Data & its Representation: Data Structure& File format, Data Compression (block code, chain code, run length code, quadtree, MrSID), Vector data representation: Data Structure& File format,Topology, Advantage of DBMS in Context of GIS, Relational and Object Oriented DBMS.

MODULE 2: DATA INPUTANDGEO-CORRECTION

Sources of Spatial Data (Raster and Vector), Data Acquisition Through Scanners and on-screen Digitisation, Projections, Geometric Transformations of Raster and Vector Data (Affine

Transformation and Transformation Coefficients), RMS Error, Types of Co-ordinate Systems, Spheroid and Datums, Sources of Errors, Spatial Data Quality: Accuracy, Precision, Error and uncertainty.

MODULE 3: SPATIAL ANALYSIS AND VISUALIZATION

Spatial Analysis: Definition, Steps and classification, Raster Data Analysis Tools – Local, Focal, Zonal and Global, Vector Data Analysis – Buffering, Distance Measurements, Analyzing Geographic Relationship, Overlay Analysis, Quantifying Change, Spatial Interpolation: Introduction, DEM Generation Surface Representation & Analysis, Network Analysis, Linkage Between Spatial and Non-Spatial Data, Basics of Geodatabase Model, Difference between 2D,2.5D, 3D and 4D GIS, Current issues and trends in GIS.

MODULE 4: SATELLITE POSITIONING SYSTEM - AN OVERVIEW

Introduction to Global Navigation Positioning System, Various Global/Regional Satellite constellations, NAVSTAR GPS signals, Geopositioning - Basic Concepts, Pseudo Range Measurement, Phase Difference Measurement, Sources of GNSS errors, DOP, Geoid, Datum/Ellipsoid - definition and basic concepts, Global Datum vs. Indian Geodetic Datum, Coordinate Systems, Transformation of coordinates, GNSS Remote Sensing.

MODULE 5: POSITIONING AUGMENTATION AND GNSS APPLICATIONS

Differential positioning concept, Various Differential survey Methods, GNSS Survey Planning, Data Processing, Site characteristics of Reference Station, Reference Station Equipment, Augmentation Systems (IRNSS, GAGAN, WAAS, LAAS, etc.) Basic concepts, Applications.

TEXT BOOKS:

1. Burrough, Peter A. and Rachael McDonnell (1998). 'Principles of Geographical Information Systems' Oxford University Press, New York.
2. George Joseph & C. Jeganathan (2018). Fundamentals of Remote Sensing 3rd edition, Universities Press, India.
3. C.P.Lo and Albert K.W.Yeung (2006). Concepts and Techniques of Geographic Information Systems. Prentice Hall of India,New Delhi.
4. Kang-tsung Chang (2007). Introduction to Geographic Information Systems, Tata McGraw Hill, New Delhi.
5. Satheesh Gopi (2005). Global Positioning System: Principles and Applications. McGraw Hill Publishers.
6. N. Madhu, R. Sathikumar, Satheesh Gopi (2006). Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India Publisher.

REFERENCE BOOKS:

1. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. (2005). Geographical Information Systems: Principles and Applications', Longman Group, U.K.
2. Paul Longley, Michael Goodchild, David Maguire and David Rhind (2005). Geographical Information Systems. Principles, Techniques, Applications and Management. John Wiley & Sons.
3. Laurini, Robert and Derek Thompson (1992). Fundamentals of Spatial Information Systems. Academic Pr., London
4. Kluwer Fotheringham A S, O'Kelly M E. (1998). Spatial Interaction Models: Formulations and Applications.

5. Thanappan Subash (2011). Geographical Information System,Lambert Academic Publishing.
6. John E. Harmon & Steven J. Anderson (2003). The design and implementation of Geographic Information Systems, John Wiley &Sons,.
7. ArcGIS 10.1 Manuals, 2016.
8. N.K.Agrawal (2004). Essentials of GPS, Spatial Network Pvt. Ltd
9. Leica. A. (2003). GPS Satellite Surveying, John Wiley & Sons. New York
10. Terry-Karen Steede (2002). Integrating GIS and the Global Positioning System, ESRI Press
11. Hofmann W.B &Lichtenegger, H. Collins (2001). Global Positioning System – Theoryand Practice, Springer-Verlag Wein, New York,.
12. Gunter Seeber (2003). Satellite Geodesy Foundations-Methods and Applications,Gruyter, Walter de GmbH.

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 Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
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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	3	3	2
CO2	3	2	1	2	2
CO3	2		3	3	2
CO4	3	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, CD4, CD6
CO2	CD1, CD2, CD3, CD6
CO3	CD1, CD2, CD3, CD6
CO4	CD1, CD2, CD3, CD4, CD6

ELECTIVES

Course code: RS 505
Course title: REMOTE SENSING IN AGRICULTURE AND FORESTRY

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.	Enhance the student's understanding about role of remote sensing for agriculture and forestry applications.
2.	Make the student assess various situations of agriculture damages and land degradation, and to detect and quantify those problems using remote sensing.
3.	Learn various forestry, ecological and wildlife related concepts, and to use remote sensing in those fields.

Course Outcomes (CO):

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

CO1	Map and quantify various agricultural features, yield, and identify the difference between healthy crop and affected crop using remote sensing data.
CO2	Identify and visually interpret various land features and its degradation on the satellite imagery and importance of secondary data in the field of agriculture.
CO3	Able to identify different types of forests features and associated problems (such as forest fire, degradation, deforestation etc) with the help of satellite data.
CO4	Able to model landscape ecological metrics, anthropogenic disturbances and wildlife site suitability using RS&GIS.

MODULE 1: INTRODUCTION

Spectral Properties of Vegetation: Natural and Man-made, Crop Yield and Acreage Estimation, Discriminate Analysis, Agricultural Applications: Sensor Requirements.

MODULE 2: DAMAGE ASSESSMENT

Plant Stress, Disease and Change Detection, Various Vegetation and Climatic Indices for Drought Damage assessment and Monitoring, Pest Control and Monitoring, Salt Affected land Mapping and Monitoring. Land degradation (water logging, salinization, erosion) assessment using RS & GIS.

MODULE 3: LAND USE/LAND COVER

Basic Concept and Criteria of Land Use / Land Cover Classification, Methodology, Classification System, Level of Classification, Land Capability Assessment.

MODULE 4: FORESTRY CONCEPTS

Conventional/Recent Remote Sensing Classification and Forest Inventory, Climatic, Altitudinal and Topographical Zones and Vegetation Relation, Forest Types Classification and Retrieval of Biophysical Parameters, Sensor Requirements, Landscape Ecology Concepts.

MODULE 5: VISUAL AND DIGITAL ANALYSIS:

Forest Cover, Canopy Density, Biomass Assessment, Forest Fire and Burnt Area Identification, Indian Forest Fire Alarm, Geospatial Modelling of Forest Fire Risk Zones, Sustainable Management, Criteria & Indicators based Decision Framework. Wildlife and Landscape Relationship, Habitat Assessment and Suitability Modelling, Disturbance Index and Analysis.

TEXT BOOKS:

1. Nicolas Baghdadi and Meherez Zribi (2016). Land Surface Remote Sensing in Agriculture and Forest, ISTE Press and Elsevier, UK.ISBN:978-1-78548-103-1
2. Roy, P.S., Dwivedi, and Vijayan, D. (2010). Remote Sensing Applications. NRSC, ISRO, Hyderabad. ISBN 978-81-909460-0-1.
3. NDMA (2010). National Disaster Management Guidelines: Management of Drought. A publication of National Disaster Management Authority Government of India, New Delhi. ISBN: 978-93-80440-08-8
4. Fortin, M.S. and Dale, M. (2005). Spatial Analysis for Ecologist, Cambridge University Press, Cambridge. ISBN- 9780521804345.

REFERENCE MATERIALS:

1. Boyd, D.S. and Danson, F.M. (2005). Satellite remote sensing of forest resources: Three decades of research development. Prog. Phys.Geogr., 29, 1-26.
2. Kogan, F.N. (2001). Operational Space Technology for Global Vegetation Assessment. Bulletin of the American Meteorological Society, 82:1949-1964.
3. Thornthwaite, C.W. (1948). An Approach toward a rational classification of climate, Geographical Review, 21: 633-655.
4. Sinha, A.K. (1986). Spectral Reflectance characteristics of Soils and its correlation with soils properties and surface conditions, Journal of Indian Soceity of Remote Sensing, 14(1), 1-9.
5. Nagendra, H. and Gadgil, M. (1999). Satellite imagery as a tool for monitoring species diversity: An assessment, Journal of Applied Ecology, 36: 388-397.
6. Muller, D. and Ellenberg, D.H. (1974). Aims and Methods of Vegetation Ecology, John Wiley and Sons,New York.
7. Franklin, S.E. (2001). Remote Sensing for Sustainable Forest Management, Lewis Publishers, Washington, D.C.
8. Behera, M.D. and Roy, P.S. (2002). Lidar Remote Sensing for Forestry Applications: The Indian Context, Current Science, 83(11):1320-1327.

9. Delcourt H.R. and Delcourt, P.A. (1988), Quaternary Landscape Ecology: Relevant Scales in Spce and Time, Landscape Ecology, 2: 23-44.
10. Farina, A. (2008). Principles and Methods in Landscape Ecology, Chapman & Hall Publication, London. ISBN – 9780412730405.
11. Digby, P.G.N. and Kempton, R.A. (1996). Multivariate Analysis of Ecological Communities. Chapman & Hall Publication. London. ISBN – 0412246406.
12. Environmental Education Media Films: http://www.eempc.org/
13. Environmental Development related: www.kosmosjournal.org

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	2	2	3	3
CO2	2	2	2	3	2
CO3	2	2	2	3	3
CO4	3	2	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, CD3, CD6
CO2	CD1, CD2, CD3, CD4, CD6
CO3	CD1, CD2, CD3, CD4, CD6
CO4	CD1, CD2, CD3, CD4, CD5, CD6

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 507
Course title: REMOTE SENSING IN HYDROLOGY & WATER RESOURCES
Pre-requisite(s): (i) Knowledge of Basic Sciences
(ii) Student must have 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:

A.	Introduce students about hydrologic cycle, Precipitation, Aquifer & Aquifer coefficients, ground water movement and understand the data required for various hydrological studies.
B.	Make them understand river basin and watershed concepts, parameters and management strategies.
C.	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 .

MODULE 1: 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.

MODULE 2: 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.

MODULE 3: 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.

MODULE 4: Watershed management

Watershed characterization using remote sensing, Morphometric parameters and analysis, Watershed problems and management strategy. Ground water recharge structures and their site suitability analysis.

MODULE 5: 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.

TEXT BOOKS:

1. Murthy, J. V. S. (1994). Watershed Management in India. Wiley Eastern Ltd., New Delhi.
2. David Keith Todd (2005). Groundwater Hydrology, John Wiley & Sons, New York, Second Edition.
3. H. M. Raghunath (2000). Hydrology- principles, Analysis, Design, New Age International, New Delhi.
4. P. Singh, Vijay P. Singh (2000). "Snow and Glacier Hydrology".

REFERENCE BOOKS:

1. P. Singh (2001). "Snow and Glacier Hydrology", Springer.
2. Schultz, G. A. and Engman, E. T. (2000). Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.

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	3	3	2
CO2	3	1	2	3	2
CO3	3		3	3	3
CO4	3	1	3	3	3
CO5	3	2	3	3	2

Low = 1, Medium = 2, High= 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

LABORATORIES

Course code: RS 503
Course title: REMOTE SENSING & DIGITAL SATELLITE IMAGE PROCESSING LAB

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

Class schedule per week: 4
Class: M. TECH
Semester / Level: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the student learn practical aspects related to:

A.	Usage of diverse remote sensing data for extracting needed geo-spatial information.
B.	Executioin of various analogue and digital information extraction techniques, both manuallay and using computers..

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

CO1	Interpret Satellite Hard copy FCC images and Survey of India Toposheets.
CO2	Collect Field Spectra for various land cover featuers.
CO3	Execute various radiometric and spatial enhancement techniques and create land cover map using different clustering techniques using DIP methods.

Lab 1 Understanding Remote Sensing Data and Visual Interpretation

Lab 2 Import / Export of Satellite Data, Display, Analysis, and Digital interpretation of earth surface featuresin Standard FCC

Lab 3 Radiometric and atmospheric corrections

Lab 4 Geo-referencingand Geocoding

Lab 5 Field Spectra Collection: vegetation, bare soil, and concreteusing Spectro Radiometer

Lab 6 Analysis of satellite derived spectral response and field spectra

Lab 7 Study of the various contrast enhancement techniques

Lab 8 Spectral Enhancement (Ratio images and PCA)Techniques

Lab 9 Spatial Enhancement: Low Pass Filtering & High Pass Filtering Techniques

Lab 10 Multi-Resolution (Fusion) Analysis

Lab 11 Unsupervised Classification

Lab 12 Supervised Classification & Accuracy Evaluation

Lab 13 Advance Classification

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
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3

Course code: RS 504
Course title: GEOGRAPHIC INFORMATION SYSTEMS & NAVIGATION SYSTEMS LABORATORIES
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: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to impart practical knowledge related to :

A.	Creation of spatially coherent Geo-database containing vector and raster.
B.	Solving real life spatial problems involving various analytical techniques for both vector and raster data.
C.	Collection of GPS data, execution of processing techniques and integrate with other spatial layers.

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

CO1	Describe various GIS techniques within spatial analytical framework and handle huge spatial and non-spatial database.
CO2	Apply spatial analysis techniques of ArcGIS software to solve environmental and societal problems and challenges.
CO3	Collect GNSS data in different survey modes and post process them to generate output to be integrated in GIS environment.
CO4	Handle integrated geospatial techniques and apply them in solving real world problems.

Lab 1 Basics of Geodatabase, Vector, Raster, Catalogue and Georeferencing

Lab 2 Topology creation and correcting topological errors & Non-topological editing.

Lab 3 Linking spatial with non-spatial data.

Lab 4 Layout generation (designing a map, cartographic elements, thematic mapping).

Lab 5 Vector analysis I (Query, Overlay, Clip, Dissolve and Merge Functions).

Lab 6 Raster analysis I (Arithmatic, Logical and Global functions)

Lab 7 Raster Analysis II (Local, Focal and Zonal functions)

Lab 8 Introduction to GNSS receivers ,initial settings and creating codes and attribute table in GNSS receiver

Lab 9 Understanding different projection, coordinate system and Datums &Standardisation

Lab 10 Point, Line and Polygon Data collection using GNSS for Planimetric Measurements

Lab 11 GNSS Data collection in differential mode positioning

Lab 12 Post processing of the GNSS data and Export functions

Lab 13 GNSS and GIS integrations output preparation

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
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3

Course code: RS 515
Course title: PROGRAMMING AND CUSTOMISATION IN GEOSPATIAL DOMAIN 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: 01/05 (Monsoon)
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 (CO):
On completion of this course, students should be able to:

CO1	Understand and Use Compiler programming Environment
CO2	Understand and appropriately Utilise various libraries, Fuction and Syntaxes.
CO3	Write a simple to complicated Programming Codes in C, R and Python.

Lab 1. Introduction to computers & programming concept

Lab 2. Programming using concepts of Variables, Operators

Lab 3. Programming using Control Structures

Lab 4. Programming using Decision Making

Lab 5 Programming using Functions

Lab 6 Programming using Arrays& Strings

Lab 7, 8,9 &10 Basic and Advanced Geospatial Programming using R

Lab 11 Programming using concepts Python

Lab 12 Using Python to deal with Functions and Objects

Lab 13. Using Python to deal with Arrays and Satellite Images

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

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

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

Indirect Assessment –

1. Student Feedback on Faculty
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 508
Course title: REMOTE SENSING IN AGRICULTURE AND FORESTRY 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: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the student:

A.	Utilise diverse remote sensind data for extracting vegetation related spatial information.
B.	Execute appropriate digital image processing and modelling techniques for diverse agriculture and forestry applications.

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

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

Lab 1 Visual Interpretation of different types of forests and crops.

Lab 2 On-Screen Land Degradation Mapping

Lab 3 Digital classification of Agriculture and Foresty Types

Lab 4 Detection of Plant Stress, Change Detection and Salt Affected Areas.

Lab 5 Desertification, Waterlooging and Flood Damage Assessment using RS & GIS.

Lab 6 Land Cover Mapping using multi-temporal RS data.

Lab 7 Acreage and Land Capability Modelling using RS & GIS.

Lab 8 Climatic, Altitudinal and Topographic relation with Life Zones and its Modelling.

Lab 9 Landscape Metrics Modelling.

Lab 10 Anthropogenic Disturbance Modelling using RS & GIS

Lab 11 Biodiversity Modelling using RS & GIS

Lab 12 Wildlife Habitat Modelling using RS& GIS

Lab 13 Forest Fire Risk Modelling 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
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

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

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: 01/05 (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 disasterprone 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	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
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 510
Course title: REMOTE SENSING IN HYDROLOGY AND WATER RESOURCES 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: 01/05 (Monsoon)
Branch: REMOTE SENSING
Name of Teacher:

Course Objectives

This course aims to make the student:

A.	Map Hydrology related information using ground observation as well as satellite data.
B.	Model rainfall, ground water and snow related parameters.

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

CO1	Map Rainfall from various data sources.
CO2	Delineate and characterise watershed by computing morphometric parameters.
CO3	Assess groundwater potential and water quality.
CO4	Model Snow melt run off, flood and soil erosion.

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 Hydrogeomorphology 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
2. Student Feedback on Course Outcome

Mapping Course Outcome with Programme Outcome

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

Low = 1, Medium = 2, High= 3