# 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.

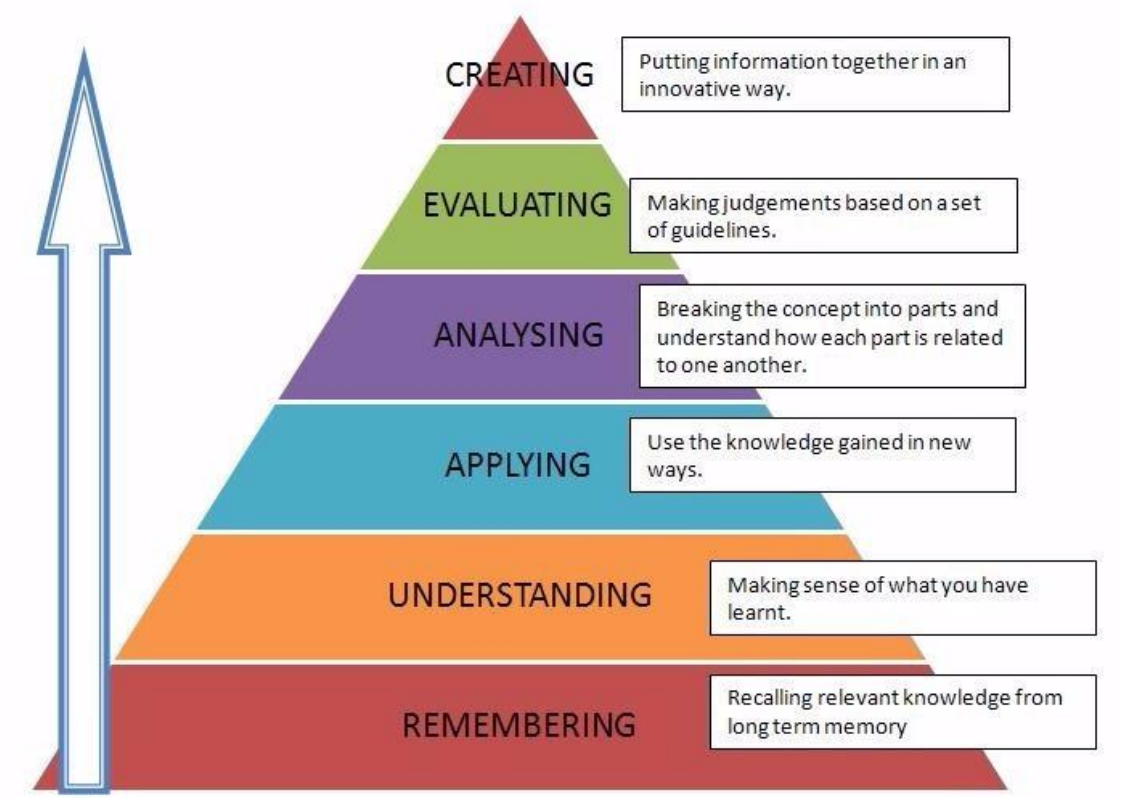
**Thesis (Part – II) Semester IV –** Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication in peer reviewed journals.

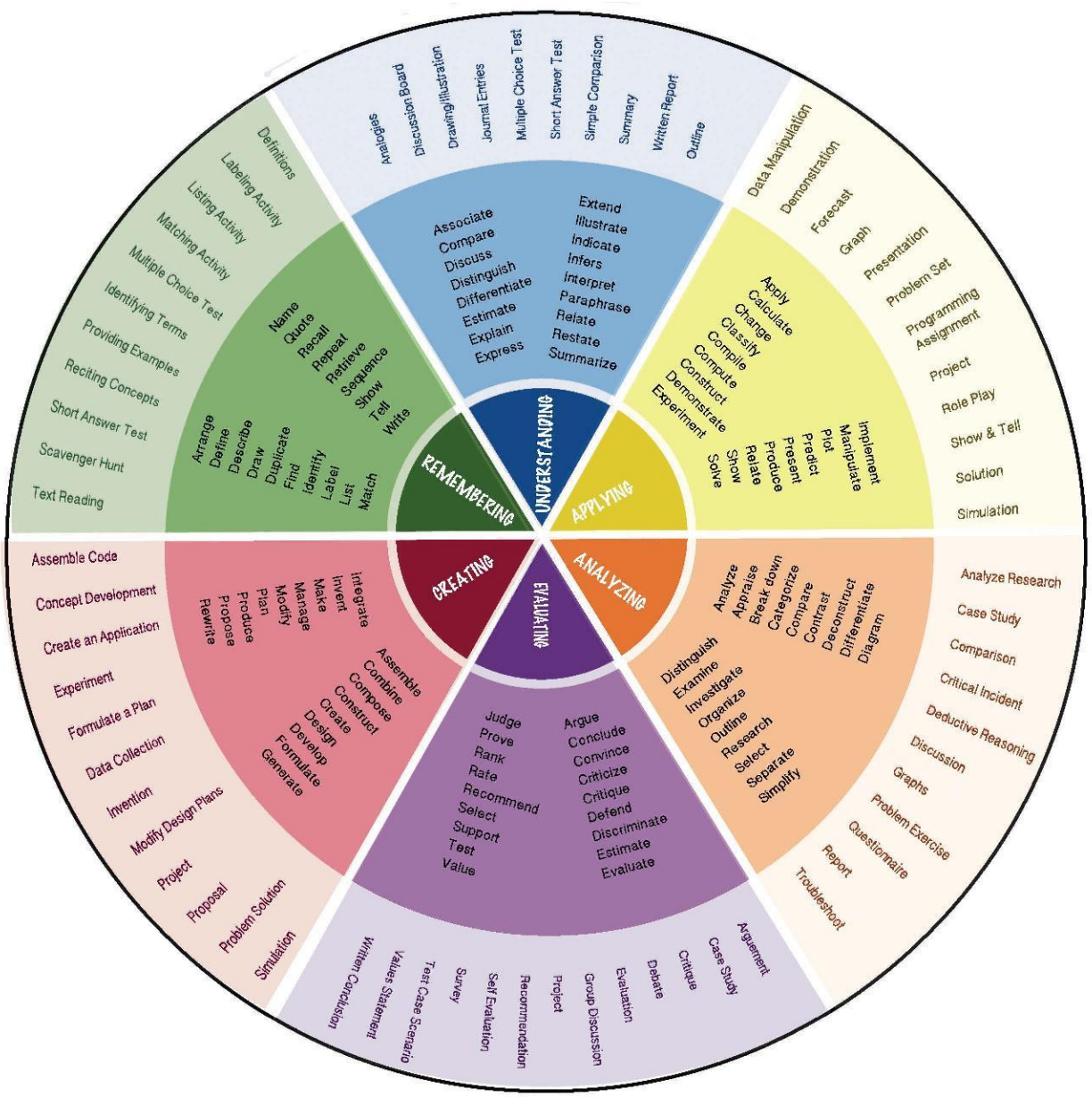
**OE+ - OPEN ELECTIVE /MOOC – To be opted as offered by other Departments/ SWAYAM or NPTEL**

**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
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
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
Written Conclusion
Values Statement
Test Case Scenario
Survey
Self Evaluation
Recommendation
Project
Group Discussion
Evaluation
Debate
Critique
Case Study
Argument
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate

## SEMESTER I : PROGRAMME CORE
## EARTH RESOURCES / ENVIRONMENT & CLIMATE

**Course code: RS 501**
**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** | **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. | 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 502R2**
**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** | **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. | 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 |
| **CO4** | Explain various surveying concepts and techniques |
| **CO5** | Elucidate integrated geospatial techniques and apply them in solving real world problems |

**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, Data Processing, Augmentation Systems (GAGAN, WAAS, LAAS, etc.). Various levels, Levelling methods, Compass, Theodolite and Total Station and their uses, Tachometer, Trignometric levelling, Travesing, Triangulation and Triletration

**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 |
| 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 | 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 |

**Course code: RS 511**
**Course title: AERIAL AND SATELLITE PHOTOGRAMMETRY & IMAGE INTERPRETATION**
**Pre-requisite(s): Student must have the knowledge of Remote Sensing, GIS & GNSS**
**Co- requisite(s): Basic understanding of various satellite data**

| **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 make the students:

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

**Course Outcomes (COs):**

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

| | |
|---|---|
| **CO1** | Explain the historic developments in the field of Photogrammetry, and image interpretation concepts. |
| **CO2** | Carry out plannimetric measurements and principles with reference to Aerial and Satellite High Resolution Images. |
| **CO3** | Explain the Analytical aspects of Photogrammetric technique. |
| **CO4** | Justify the need for orthophotos and satellite based photogrammetry and explain the modern digital photogrammetric approaches using satellite, GPS. |
| **CO5** | Explain the role of UAV in terrain mapping and apply photogrammetric principles. |

**MODULE 1: ENVIRONMENTAL MAPPING & INTERPRETATION**

Importance of Image Interpretation, Image interpretation for delineation of lithology (Rocks), minerals and their characteristics, Geological structures - Folds, Faults and Joints and their field characteristics, Various important land forms, Image characteristics of geological structures and major land forms, Visual and Digital Satellite Image Interpretation, Elements of image interpretation, development of interpretation keys, Image interpretation for LU/LC and Vegetation mapping, Image interpretation for ocean and coastal monitoring.

**MODULE 2: GEOMETRY OF AERIAL PHOTOGRAPHS**

Need for Photogrammetry, Historical developments in Photogrammetry, Fundamental concepts and Importance of flight planning, End Lap, Side Lap, Scale, Ground Coverage, Weather Conditions, Purpose, Flying Height, Projection, Tilt, Swing, Scale, Image Displacement due to relief, due to lens distortion, due to tilt, Parallax, stereoscopic depth perception, overlaps in stereo pairs, principles of floating marks, Parallax bar and types, measurement of absolute and

differential parallax, Parallax height measurement, correction to measure parallaxes – contouring from stereometric heights. Types of photographs, Vertical and Tilted photographs.

**MODULE 3: ANALYTICALPHOTOGRAMMETRY**

Co-ordinate system, air base components, degree of freedom, Elements of interior and exterior orientation of an aerial photographs, Numerical Derivations for Height based on relief displacement, coordinates, parallax, Orientation Procedures, Coordinate Transformation concepts, Epi-polar Geometry, Photo-triangularion: Pass-points for Aerotriangulation, semi-analytical aero-triangulation, analytical aero-triangulation, bundle adjustment with GNSS, Aero-triangulation with Satellite images, strategies for aero-triangulation.

**MODULE 4: DIGITAL PHOTOGRAMMETRY**

Analogue to Digital conversion, Image measurements, colour balancing, Image matching, Feature extraction- points, lines and regions, Planimetric Measurements, GCPs and Ortho-Rectification, Ortho-photographs, Digital Terrain Model derivationfrom Satellite images, Limitations, quality checks and interactive control.

**MODULE 5: TERRAIN MODELING WITH UAV**

Digital Photogrammetric Images from UAV and associated concepts, UAV flight planning, coverage types, processing methods. Recent trends in its application, automated aerial triangulation: concepts, solutions, analysis, Photogrammetry work-stations, review of available software.

**TEXT BOOKS:**

1. Wolf, P.R. (2000). Elements of Photogrammetry with Applications in GIS, McGraw Hill Ins, Singapore.
2. Rampal, K.K. (2004). Textbook of Photogrammetry, John-Wiley & Sons.
3. Moffit, F.M. (1980). Photogrammetry, International Text Book Co.

**REFERENCE BOOKS:**

1. McGlone J.C. (2013). Manual of Photogrammetry. 6th edition. American Society for Photogrammetry and Remote Sensing.
2. Drury, S.A. (2004). “Image Interpretation in Geology, Publisher: - Chapman and Hall, London, UK.
3. Panday, S.N. (1987). Principles and Application of Photogeology, Parentice Hall Inc.
4. Ray, R. (2012). An Introduction to photogrammetry, MITRAM publications, Kolkata.ISBN:978-93-80036-41-0.
5. Beginners Guide to UAV: https://www.digitaltrends.com/opinion/start-serious-drone-habit/

## COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

**Direct Assessment**

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

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

**Indirect Assessment –**

1. Student Feedback on 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 | 3 | 1 |
| **CO2** | 3 | 1 | 3 | 3 | 2 |
| **CO3** | | | 3 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 3 | 1 |
| **CO5** | 3 | 1 | 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, CD2, CD3, CD6 |
| CO3 | CD1, CD3, CD6 |
| CO4 | CD1, CD2, CD3, CD6 |
| CO5 | CD1, CD2, CD3, CD4, CD6 |

## SEMESTER I: PROGRAMME ELECTIVES

## EARTH RESOURCES

**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 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 |

# SEMESTER I: PROGRAMME ELECTIVES
# ENVIRONMENT & CLIMATE

**Course code: RS 517**
**Course title: REMOTE SENSING IN CLIMATE CHANGE AND ENVIRONMENTAL IMPACT ASSESSMENT**
**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. | Enhance student's understanding about climatic system of earth and its changes over time. |
| 2. | Teach the fundamental concepts about global warming, climatic dependence of various ecosystems (agriculture, forest and glaciers) and associated mapping methods using remote sensing. |
| 3. | Disseminate information about various global initiatives, environmental impact assessment methods and modelling using remote sensing and GIS. |

**Course Outcomes (Cos):**

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

| | |
|---|---|
| **CO1** | Understand and explain the differences between weather and climate, local to global climatic variations, and Elnino vs Lanino. |
| **CO2** | Quantify relationship between ecosystmes (forest, agriculture and glacier) and rainfall, temperature, and map/model the impact of global warming on these systems using RS & GIS. |
| **CO3** | Able to identify/map different types of surface waterbodies, glaciers, and drought impact from satellite imageries. |
| **CO4** | Describe global policies and EIA methods, and link them with local, regional and national developmental initiatives and generate report. |

## MODULE 1: INTRODUCTION TO WEATHER AND CLIMATE

Fundamentals of Weather and Climate; Greenhouse effect and Global Warming; Local, Regional, Continental and global weather Pattern; Global bio-geo-Climatic conditions; Weather variations and associated effects - Elnino, LaNino, Southern Oscillation, Drought and Flood Scenario; Mapping weather parameters with a focus on rainfall, temperature and wind. Remote Sensing missions for weather monitoring.

**MODULE 2: AGRICULTURE, FOREST AND CLIMATE**

Vegetation growth rhythm and climatic interaction; Food security, Drought monitoring and forecast; Weather dependence of Agriculture; Climate change impact on agriculture economy. Carbon accounting with climate change scenario; Time-Series Satellite data; space-time dynamics; Phenology of Vegetation; Global changes in phenology; Droughts in Amazon and monitoring mechanism; Forest Fire and climate change.

**MODULE 3: SNOW, GLACIER WATER AND CLIMATE**

Surface water mapping and monitoring; snow cover mapping; snowmelt runoff forecasting; Glaciers Inventory; Glacial Mass Balance and Glacial retreat with changing climate.

**MODULE 4: ENVIRONMENTAL IMPACT ASSESSMENT**

Scope of EIA; EIA Methods and Mitigation; Criteria and Indicators; Certification; Ecological, Economical and Demographic impact assessment.

**MODULE 5: GLOBAL POLICIES**

United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Intergovernmental Panel on Climate Change (IPCC); Reducing Emissions from Deforestation and forest Degradation (REDD); Convention of Biological Diversity (CBD); Committee on World Food Security.

**TEXT BOOKS:**

1. Roy, P.S., Dwivedi, R.S., and Vijayan, D. (2010). Book on Remote Sensing Applications. National Remote Sensing Centre, ISRO, Hyderabad. ISBN: 9788190946001.
2. FAO (2011). Climate Change, Water and Food Security. Compiled by Hugh Turral, Jacob Burke and Jean-Marc Faures, Rome. ISBN: 9789251067956
3. Morris, P. and Therivel, R. (2001). Methods of Environmental Impact Assessment, 2nd edition, Spon Press, London (2008 reprint).
4. Thenkabail, P.S., J.G. Lyon, H. Turral and C. Biradar (2009). Remote Sensing of Croplands for Food Security. 476p. CRC Press. Taylor and Francis, New York. ISBN 978-1-4200-9009-3.

**REFERENCE MATERIALS:**

1. ECA (Economics of Climate Adaptation) (2009). Shaping climate resilient development: a framework for decision making. ClimateWorks Foundation, Global Environment Facility, European Commission, McKinsey & Company, The Rockefeller Foundation, Standard Chartered Bank and Swiss Re. 164pp.
2. FAO (2015). Booklet on FAO's work on Climate Change. Job Number 15165.
3. FAO (2016). Planning, implementing and evaluating Climate-Smart Agriculture in Smallholder Farming Systems. Job Number 15805. Report under Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO. ISBN: 978925109305.
4. IPCC (2014). IPCC Assessment Report. UNFCCC.
5. Kulkarni, A., I.M. Bahuguna, B.P. Rathore, S.K. Singh, S.S. Randhawa, R.K. Sood and S. Dhar (2007). Glacial retreat in Himalaya using Indian Remote Sensing satellite data. Current Science, Vol. 92, No. 1.
6. Lal, M., T. Nozawa, S. Emori, H. Harasawa, K. Taka, A. Abe-Ouchi, T. Nakajima, T. Takemura and A. Numaguti (2001). Future climate change: Implications for Indian summer monsoon and its variability. Current Science, Vol. 81, No. 9, 10.
7. Milly, P.C.D., R.T. Wetherald, K.A. Dunne and T.L. Delworth (2002). Increasing risk of great floods in a changing climate. Nature Vol 415: 514–517.

8. Rees, H.G. and D.N. Collins (2006). Regional differences in response of flow in glacier-fed Himalayan rivers to climatic warming. Hydrological Processes, 20 (10). 2157–2169. 10.5002/hyp.6209.
9. Schmidhuber, J. and F. Tubiello (2007). Global food security under climate change. PNAS 104 (50) 19703–19708.
10. Tubiello, F. and G. Fischer (2007). Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000–2080 Technological Forecasting & Social Change 74 1030–1056.
11. USDA (ed Walsh, M) (2008). The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. U.S. Climate Change Science Program Synthesis and Assessment Product 4.3.
12. WWF (2005). An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China. Kathmandu. Nepal.
13. World Bank (2010). Economics of Adaptation to Climate Change: Synthesis Report. Washington DC. 100pp.
14. World Bank (2009b). Water and Climate Change: Impacts on groundwater resources and adaptation options. Water Unit Energy, Transport, and Water Department. Washington DC. 98pp.

## COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on 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 | 2 | 3 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 2 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 1 | 3 | 1 | 3 | 2 |

**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, CD4, CD5, CD6 |
| CO3 | CD1, CD3, CD5, CD6 |
| CO4 | CD1, CD2, CD4, CD6 |

# SEMESTER I: LABORATORIES
## EARTH RESOURCES / ENVIRONMENT & CLIMATE

**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 | 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 | 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 | 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 | 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 513**
**Course title: AERIAL AND SATELLITE PHOTOGRAMMETRY & IMAGE INTERPRETATION LABORATORIES**

| **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 skills related to :

| | |
|---|---|
| A. | Interpretation and Measurement of 2D and 3D information about various features using Aerial photos, Satellite and UAV data. |
| B. | Utilisation of various analogue and digital photogrammetry based extraction techniques, both manuallay and using computers. |

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

| | |
|---|---|
| **CO1** | Use Pocket Stereoscope and make planimetric measurements from Aerial Photos. |
| **CO2** | Interpret Satellite Images and Aerial photos visually and with stereoscope for delineating various landforms and landcover features. |
| **CO3** | Use photogrammetric techniques and tools under Digital Environment so as to create digital surface models, and extract point, line and polygon features and their position, height, area and volume using Aerial, Satellite and UAV data. |

Lab 1-2 Satellite Image Interpretation of various Terrestrial Features.

Lab 3 Use of Pocket & Mirror Stereoscope, parallax bar and measurement of distance and height

Lab 4-5 Stereoscopic vision and photo interpretation of B/W & Colour aerial photograph

Lab 6 Differential parallax measurement and contouring by parallax bar method

Lab 7 Digital Stereoscopic Model - Non-Oriented Approach

Lab 8 Digital Stereoscopic Model - Interior & Exterior Orientation

Lab 9 Digital Stereoscopic Model - 3D based Plannimetric Measurements

Lab 10 Digital Ortho-Rectification - Relief Displacement Correction

Lab 11 Point, Line & Polygon Feature Extraction using Stereopair from High Spatial Resolution Aerial & satellite images

Lab 12-13 UAV based Data acquisition and Modelling.

# 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 | 2 | 1 |
| **CO2** | 1 | 1 | 3 | 2 | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 2 |

**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 | 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 | 3 | 2 | 1 |
| **CO2** | 2 | 2 | 3 | 3 | 3 |
| **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 | 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 | 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**

**Course code: RS 519**
**Course title: REMOTE SENSING IN CLIMATE CHANGE ANDENVIRONMENTAL IMPACT 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 following abilities:

| | |
|---|---|
| A. | To create report and maps about various environmental features and parameters using satellite data and based on hard copy maps/reports provided by national/global mapping agencies. |
| B. | To carry out various digital image processing techniques and models to quantify continuously changing environmental features. |

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

| | |
|---|---|
| **CO1** | Visually and Digitally differentiate various environmental conditions including vegetated features and Glaciers from satellite data. |
| **CO2** | Use time-series remote sensing data and GIS tools to quantify drought condition/impact, vegetation growth rhythm, Glacier changes and environmental impact. |
| **CO3** | Gather and infer knowledge from various published reports and policies and link with local to regional problems and understand need for appropriate tools and models. |

Lab 1 Visual Interpretation of different types of forests and crops

Lab 2 Shoreline change mapping of Waterbodies

Lab 3 Biomass and Carbon Accounting using RS & GIS

Lab 4 To identify El-Nino and La-Nina years using ONI and SST/Temperature anamoly

Lab 5& 6 Drought Condition Assessment using RS based indices and meteorological data

Lab 7 & 8 Exploring Climatic Research Unit **(**CRU) data set and its utilization of climate change related studies

Lab 9 Evaluation of atmospheric dynamics using virtual ballooning

Lab 10 TRMM based Rainfall Mapping and relating with Ground Meteorological Data

Lab 11 Glacier Condition and Change Assessment using Temporal RS data

Lab 12 Vegetation Phenology using Time-Series RS data

Lab 13 Explore scenarios for future climate using the simple online climate model

# COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

## 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 | 1 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 2 | 3 | 2 | 2 | 3 |

**Low = 1, Medium = 2, High= 3**