# BIRLA INSTITUTE OF TECHNOLOGY

**CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM**

***(Effective from Academic Session: Monsoon 2022)***

# M.Sc. Geoinformatics

# Department of Remote Sensing

## INSTITUTE VISION

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

## INSTITUTE MISSION

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

## DEPARTMENT VISION:

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

## DEPARTMENT MISSION

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

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To prepare the students in identifying, analysing and solving geospatial problems.
2. To train the students in developing practical and executable solutions to the challenges of growing field of Remote Sensing and GIS.
3. To impart the students with strong base of knowledge that makes them suitable both for industries as well as for teaching and research.
4. To inculcate the students with the sensitivity towards ethics, public policies and their responsibilities towards the society.

## PROGRAMME OUTCOMES (POs)

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

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

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

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

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

## PROGRAMME COURSE STRUCTURE (ALL SEMESTERS)

### SEMESTER - I

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

### SEMESTER – II

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

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

## SEMESTER – III

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

SEMESTER – IV

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

**Grand TOTAL =82 credits**

## *ELECTIVES

| Course No. | Course Title |
|---|---|

**ELECTIVE-I (Spring Session)**

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

**ELECTIVE-II (Monsoon Session)**

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

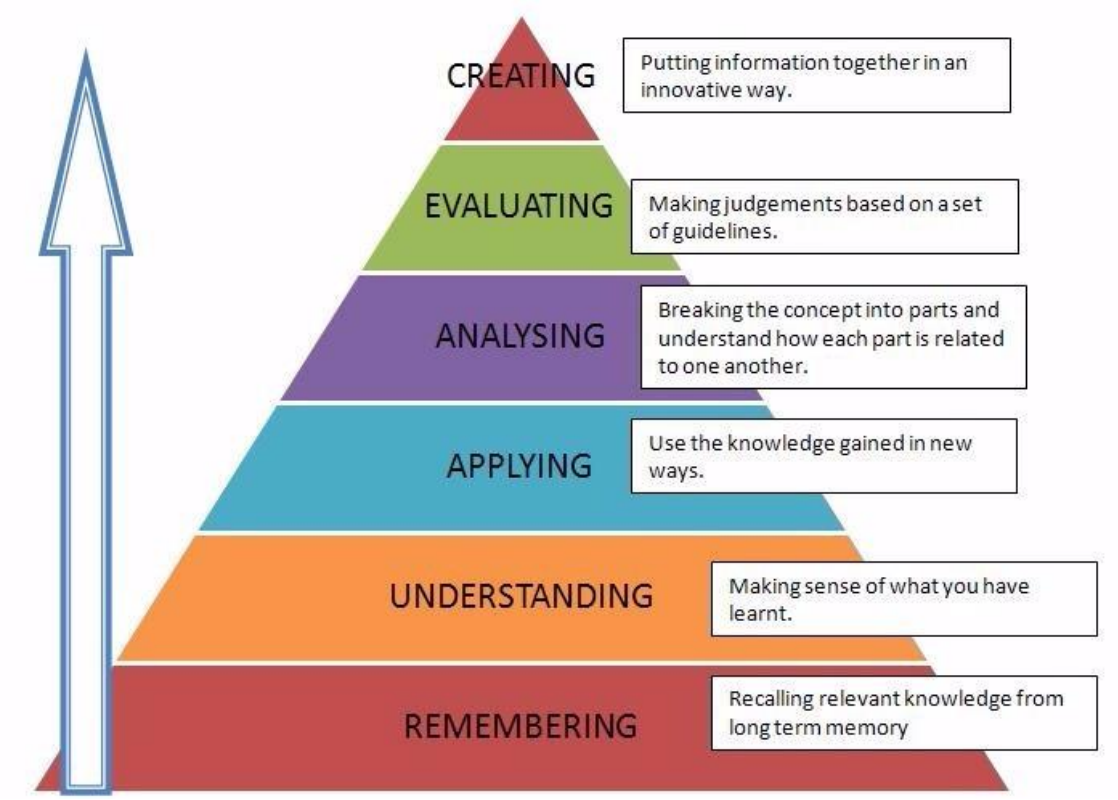
**Project (Part – I) –** Focus on Problem definition, Literature Review, Data Collection, Objectives and Research Questions Formulation and Detailed Work Plan, and partial fulfillment of initial objectives.

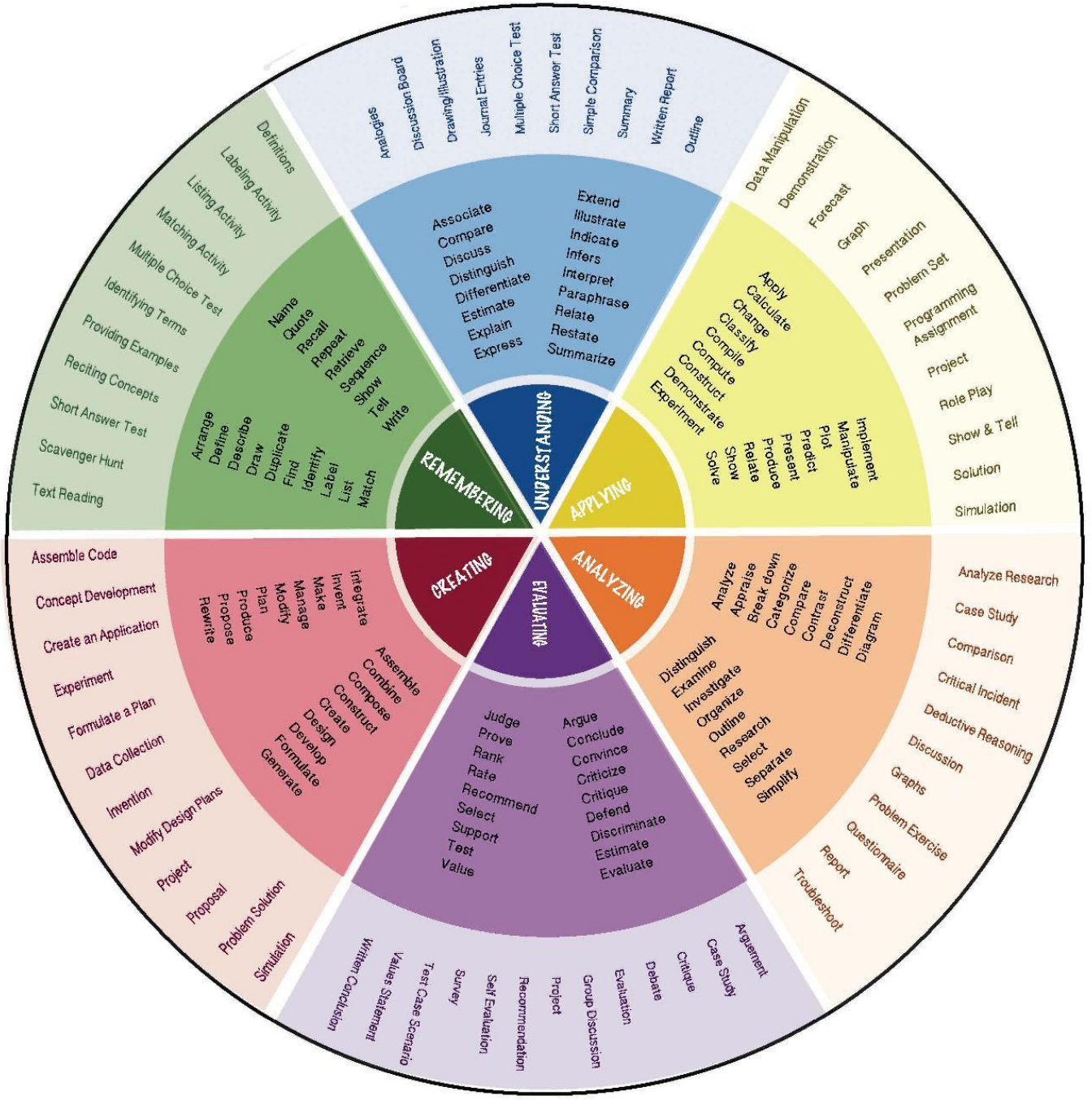
**Project (Part – II) –** Focus on systematic execution of work plan, data processing, analysis, interpretation, inferences and fulfillment of objectives and research questions, and report preparation, and finally leading to a research publication.

**BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:**

*Preamble*

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




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
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 Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate

**COURSE INFORMATION SHEET**

**SEMESTER – I**

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

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

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

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

**Course Objectives**

This course aims to:

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

**Course Outcomes(CO)**

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

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

**SYLLABUS**

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

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

**TEXT BOOKS:**

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

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

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

**REFERENCE BOOKS:**

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

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

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

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

**Indirect Assessment –**

1. Student Feedback on Course Outcome

**Mapping of Course Outcomes onto Program Outcomes**

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Mapping Between COs and Course Delivery (CD) methods**

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

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

**Course code: GI 502**
**Course title: GEOGRAPHIC INFORMATION SYSTEM**

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

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

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

**Course Objectives:**

This course aims to:

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

**Course Outcomes (CO):**

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

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

**SYLLABUS**

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

**TEXT BOOKS:**

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

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

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

**REFERENCE BOOKS:**

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

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

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

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

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

**Indirect Assessment –**

1. Student Feedback on Course Outcome

**Mapping of Course Outcomes onto Program Outcomes**

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Mapping Between COs and Course Delivery (CD) methods**

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

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

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

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

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

**Course Objectives:**

This course aims to:

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

**Course Outcomes (CO)**

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

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

**SYLLABUS**

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

**TEXT BOOKS:**

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

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

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

**REFERENCE BOOKS:**

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

**Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure**

**Direct Assessment**

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

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

**Indirect Assessment –**

1. Student Feedback on Course Outcome

**Mapping of Course Outcomes onto Program Outcomes**

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Mapping Between COs and Course Delivery (CD) methods**

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

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

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

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

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

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

**Course Objectives:**

This course aims to:

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

**Course Outcomes (CO):**

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

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

**SYLLABUS**

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

## Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on Course Outcome

### Mapping of Course Outcomes onto Program Outcomes

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Mapping Between COs and Course Delivery (CD) methods**

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

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

# Laboratory related subjects

**Course code: GI 505**

**Course title: PRINCIPLES OF REMOTE SENSING LABORATORY**

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

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

**Class schedule per week: 4**

**Class: M. Sc.**

**Semester / Level: 01/05 (Monsoon)**

**Branch: GEOINFORMATICS**

**Course Outcomes (CO):**

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

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

**List of Laboratories**

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

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

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on Faculty

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Laboratory experiments |

### MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Course code: GI 506**

**Course title: GEOGRAPHIC INFORMATION SYSTEM LABORATORY**

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

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

**Class schedule per week: 4**

**Class: M. Sc.**

**Semester / Level: 01/05 (Monsoon)**

**Branch: GEOINFORMATICS**

**Course Outcomes (CO):**

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

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

**List of Laboratories**

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

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

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on Faculty

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Laboratory experiments |

### MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Course code: GI 507**

**Course title: DIGITAL CARTOGRAPHY AND GNSS LABORATORY LABORATORY**

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

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

**Class schedule per week: 4**

**Class: M. Sc.**

**Semester / Level: 01/05 (Monsoon)**

**Branch: GEOINFORMATICS**

**Course Outcomes (CO):**

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

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

**List of Laboratories**

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

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

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on Faculty

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Laboratory experiments |

### MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

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

**Correlation Levels 1, 2 or 3 as defined below:**

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

**Course code: GI 508**

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

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

**Class schedule per week: 4**

**Class: M. Sc.**

**Semester / Level: 01/05 (Monsoon)**

**Branch: GEOINFORMATICS**

**Course Outcomes (CO):**

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

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

**List of Laboratories**

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

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

### Direct Assessment

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

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

**Indirect Assessment –**

1. Student Feedback on Faculty

**Course Delivery Methods**

| | |
|---|---|
| CD1 | Laboratory experiments |

## MAPPING BETWEEN COURSE OUTCOMES AND PROGRAMME OUTCOMES

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

**Correlation Levels 1, 2 or 3 as defined below:**

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