ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF ENVIRONMENTAL AND EARTH SCIENCES

(RSEES)

DEPARTMENT OF GEOGRAPHY

M.Sc. in Geoinformatics

Postgraduate Programme as per NEP, 2020

W.E.F

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1. Preamble

The LOCF is designed to emphasize the teaching-learning process at the postgraduate in M.Sc. level in Geoinformatics to sensitize and train the students to develop a sound and systematic approach regarding the mechanism and processes of natural and human activities. The focus is to help the students to understand the latest tools and techniques, which would help in giving a focused and precise understanding of a geographical phenomenon. The purpose is to enhance the capability of the students in perceiving, creating and analyzing sound geographical bases and concepts.

This Learning Outcome based Curriculum Framework is designed to emphasize the teaching and learning process at the postgraduate M.Sc. from teacher centric to student centric by strengthening the quality of teaching and learning in the present day real life scenario at the global, regional and local levels. It has considered learning as an activity of creativity, innovations and analyzing geographical phenomena. The committee prepared the major learning outcomes, which would help the students to understand and critically analyze various dimensions of the geographical issues.

The following objectives would be achieved:

1. To orient the students towards the identification and analysis of various facets of geoinformatics.
2. To develop students' aptitude for acquiring basic skills for preparing specialized maps.
3. To facilitate the students to learn skills of digital cartography.
4. To guide students to learn the science and art of collecting, processing and interpreting the data.
5. To expose the students to the use of the updated technologies of remote sensing, IRNSS, GNSS, Geographical Information System (GIS) and GIS Science.

1.4 Introduction

Learning Outcomes based Curriculum Framework (LOCF) for Geoinformatics under CBCS. Geoinformatics is the science and the technology which develops and uses information science infrastructure to address the problems of geography, cartography, geosciences and related branches of science and engineering, such as Land Surveying. It helps students establish a connection among people, locations, etc. using spatial information and geo-visualization. Geoinformatics has emerged today as an important technology to the decision- makers across a wide range of disciplines, industries and organisations as it enables them to acquire, process, analyse, visualize spatial information and produce outputs. The power of geoinformatics is its ability to acquire spatial data, integrate spatial data with non-spatial data, analyse them, create and visualize different scenarios and produce outputs which can be used for understanding processes and management and decision making.

It is essential to focus on the current socio-spatial problems, issues and challenges to make the students aware of the application of geoinformatics to sort out the societal upcoming problems. It is also essential to rejuvenate ancestral cartographic knowledge to address the current local and global problems. In the light of exponential changes in the field of arts, science and technology, it is to be studied from multifaceted angles. It is important for the policymakers to consider the geospatial aspects with references to the location and in the context of the best utilization of public utilities. It is further expected that if the above said spatial aspects are considered, it will certainly develop the lagging regions and people living therein.

1.4 Approach to Curriculum Planning

Learning Outcomes based Curriculum Framework (LOCF) for geoinformatics curriculum revision incorporates dynamic processes including fundamental and modern techniques, contemporary paradigms such as global initiatives like Sustainable Development Goals (SDGs), Disaster Risk Reduction (DRR), Paris Climate Action and national initiatives like smart cities, Securities of food, water, energy, human health and livelihood, biodiversity, and disaster management. The approaches are to make geoinformatics more scientific and societal-need oriented which could be the panacea to India's developmental challenges. Geoinformatics uses scientific knowledge with the current focus that includes spatio-temporal analysis, skill development, GIScience, sustainable development and human security.

1.2.1 Nature and Extent of Masters Programme in Geoinformatics

A Masters in Geoinformatics is a 2 year course which is divided into 4 semesters as under.

Sl. No.	Year	Mandatory Credits to be secured for the Award
1	After successful completion of 1st Year	40
2	After successful completion of 2nd Year	40

The curriculum inculcates knowledge of essential concepts of geoinformatics together with appropriate techniques using lectures, tutorials, group discussions, presentations, assignment evaluation and lab work. Thus, the pedagogy process includes:

i. Identifying and analysing the physical and human dimensions globally and processes in varied spatiotemporal contexts.
ii. Understanding to integrate spatial data with non-spatial data and analyse to overcome the various global environmental challenges.
iii. Analysing geographic information by using geospatial technologies.
iv. Responding to the global and national challenges and initiatives.

1.2.2 Aims of Masters Programme in Geoinformatics:

The overall objectives of the Learning Outcomes-bases Framework (LOCF) for M.Sc. in Geoinformatics are-

i. Appreciate the relevance of geospatial knowledge to everyday life.
ii. Demonstrate the ability to communicate geographic information by utilising both lecture and practical exercises.
iii. Inculcate the ability to evaluate and solve geographical problems effectively.
iv. Demonstrate the skills in using geographical research tools including spatial statistics, cartography, remote sensing, GIS, IRNSS and GIScience.
v. Based on the field knowledge and advanced technologies, the students should be able to understand the ongoing geographical problems in different regions and levels with appropriate pragmatic solutions.

1.3 Post Graduate Attributes in Geoinformatics

Some of the characteristic attributes of a postgraduate in Geoinformatics include:

GA 1: Technical Competence: Post-graduates in Geoinformatics should have a solid understanding of the principles and concepts of geographic information science, remote sensing, and other related technologies. They should be able to apply this knowledge to solve complex problems and make informed decisions.

GA 2: Analytical Skills: Geoinformatics professionals need to be able to analyze and interpret large datasets and identify patterns and trends that can inform decision-making. They should be able to use statistical and mathematical models to analyze data and develop predictive models.

GA 3: Communication Skills: Geoinformatics professionals should be able to communicate technical information in a clear and concise manner to a range of audiences, including non-technical stakeholders. They should be able to present data in visual formats, such as maps and charts, to communicate complex information effectively.

GA 4: Teamwork: Geoinformatics professionals often work in multidisciplinary teams, including engineers, planners, and scientists. They should be able to collaborate effectively with team members and contribute their expertise to achieve project goals.

GA 5: Project Management: Geoinformatics professionals should be able to manage projects effectively, including developing project plans, setting timelines, managing resources, and monitoring progress. They should be able to adapt to changing project requirements and prioritize tasks to ensure project success.

GA 6: Ethics and Professionalism: Geoinformatics professionals should adhere to ethical principles and standards of professionalism in their work. They should maintain the confidentiality of sensitive data and ensure that their work aligns with legal and ethical standards.

GA 7: Lifelong learning: The core of Geoinformatics is information science infrastructure to address the problems of geography, cartography, geosciences and related branches of science and engineering, which remains relevant for all sectors of knowledge. So, the basic knowledge and the tools of Geoinformatics helps them in their future life and the process of learning will continue throughout life.

1.4 Qualification Descriptors for M.Sc. Programme

The qualification descriptors for the M.Sc. Programme in Geoinformatics shall have the learning attributes such as use of advanced tools and techniques for better comprehension of space and society etc. It also involves awareness among the students regarding the issues of different regions and socio-cultural aspects. The main qualification descriptors for the geoinformatics M.Sc. Programme includes:

i. Demonstration of exhaustive understanding of the basic concepts of Geoinformatics and an awareness of the emerging areas of the field.
ii. Acquisition of in-depth understanding of the applied aspects of Geoinformatics as well as interdisciplinary subjects in everyday life.
iii. Improvement of critical thinking and skills facilitating.
iv. The application of knowledge gained in the field of Geoinformatics in the classroom to the practical solving of societal and environmental problems.
v. Development of intellectual capabilities to get into further research in the discipline.
vi. Acquirement of practical laboratory skills, systematic research design and collection of experimental data.
vii. Exhibition of ability to quantitatively analyse the experimental data and writing project reports.
viii. Development of strong oral and written communication skills promoting the ability to present ideas and also teamwork spirits.

1.5 The Programme Learning Outcomes relating to M.Sc. degree programme in Geoinformatics

The learning outcome is to prepare the students of MSc degree in Geoinformatics, to understand the development of the subject and delve around issues suited to the needs of the contemporary world. It covers a wide range of papers covering various themes and maintains uniformity of structure across universities in the country. Geoinformatics being interdisciplinary in nature integrates learning derived from all basic and applied sciences.

PO-1: Technical Competence: Graduates of a Masters in Geoinformatics should be able to demonstrate advanced technical skills in the collection, analysis, and interpretation of geospatial data using relevant software and tools.

PO-2: Spatial Data Management: Graduates should be able to manage large geospatial datasets, including their acquisition, storage, processing, and retrieval, using appropriate data management techniques.

PO-3: Geospatial Analysis: Graduates should be able to use geospatial analysis techniques to solve complex spatial problems and make informed decisions.

PO-4: Project Management: Graduates should be able to apply project management principles to plan, implement, and evaluate geoinformatics projects effectively.

PO-5: Communication Skills: Graduates should be able to effectively communicate geoinformatics concepts and findings to technical and non-technical audiences, both orally and in writing.

PO-6: Ethical and Legal Issues: Graduates should be able to identify and address ethical and legal issues related to the collection, use, and dissemination of geospatial data.

PO-7: Lifelong Learning: Graduates should have a commitment to continuous learning and professional development in the rapidly evolving field of geoinformatics.

Programme Specific Outcomes

PSO-1: Acquire, store, manage, and retrieve geospatial data using appropriate database management systems and technologies.

PSO-2: Analyze geospatial data using appropriate techniques such as geostatistics, spatial modeling, and spatial data mining.

PSO-3: Visualize geospatial data using appropriate tools such as geographic information systems (GIS), remote sensing software, and web mapping technologies.

PSO-4: Apply geospatial technologies and techniques to solve real-world problems in fields such as urban planning, natural resource management, environmental monitoring, and disaster management.

1.6 Teaching Learning Process

Teaching and learning in this programme involve classroom lectures, tutorials, and remedial classes.

For every core course in each semester, one tutorial class is provided per week as per the structure of the syllabus.

Remedial classes are organized for below mediocre class students who could not pass the particular course as well as those who would like to improve their performance in certain courses, during working days. Classes also could be organized during the long vacation like summer vacation or winter vacation for those students who are genuinely in need of such intensive coaching.

The teaching learning process allows **Direct Assessment** of students in the form of:

1. Written assignments and projects submitted by students the project-based learning
2. Group discussion
3. Home assignments
4. Quizzes and class tests
5. PPT presentations, Seminars, interactive sessions
6. Field visit

Indirect Assessment methods include:

1. Tutorial classes that allow closer interaction between the students and the teacher as each student gets individual attention.
2. Co-curricular activity
3. Mentor Mentee activity

1.6. Programme Evaluation

1. The course shall be spread over 4 (four) semesters with weightage (contact hours) of 20 each per week. Students leaving the course after completion of 2 (two) semesters will be awarded Post Graduate Diploma in Geoinformatics.
2. In addition to end term examinations, student shall be evaluated for his/her academic performance in a
3. Programme through, presentations, analysis, homework assignments, term papers, projects, field work, seminars, quizzes, class tests or any other mode as may be prescribed in the syllabi. The basic structure of each Programme shall be prescribed by the Board of Studies and approved by the Academic Council.
4. Each Programme shall have a number of credits assigned to it depending upon the academic load of the Programme which shall be assessed on the basis of weekly contact hours of lecture, tutorial and laboratory classes, self-study. The credits for the project and the dissertation shall be based on the quantum of work expected.
5. Depending upon the nature of the programme, the components of internal assessment may vary. However, the following suggestive table indicates the distribution of marks for various components in a semester: -

	Components of Evaluation	***Marks***	***Frequency***	***Code***	***Weightage***
A	**Continuous Evaluation**				
i	Analysis/Class test	Combination of any three from (i) to (v) with 5 marks each	1-3	C	45%
ii	Home Assignment		1-3	H	
iii	Project		1	P	
iv	Seminar		1-2	S	
v	Viva-Voce/Presentation		1-2	V	
vi	MSE	MSE shall be of 10 marks	1-3	Q/CT	
vii	Attendance	Attendance shall be of 5 marks	100%	A	5%
B	**Semester End Examination** TOTAL		1	SEE	50% 100%

M.Sc. in Geoinformatics

Programme Structure

1st SEMESTER				
COURSE CODE	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
GEOI164C101	Principles of Remote Sensing; Global Positioning System	400	4	3-1-0
GEOI164C102	Fundamentals of GIS	400	4	3-1-0
GEOI164C103	Cartography & Geo Statistics	400	4	3-1-0
GEOI164C104	Geosciences & Image Interpretation	400	4	3-1-0
GEOI164C115	Practical I	400	4	0-0-4
	Swayam Course (Upcoming)		3/4	
	TOTAL CREDIT FOR 1st SEMESTER	**20+3/4**		
2nd SEMESTER				
COURSE CODE	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
GEOI164C201	Digital Image Processing	500	4	3-1-0
GEOI164C202	Spatial Analysis & Modelling	500	4	3-1-0
GEOI164C204	Geoinformatics in Agriculture, Soil & Land Evaluation	500	4	3-1-0
GEOI164C205	Geoinformatics in Regional and Urban Planning	500	4	3-1-0
dGEOI164C215	Practical II	400	4	0-0-4
	Swayam Course (Upcoming)		3/4	
	TOTAL CREDIT FOR 2nd SEMESTER		**20+3/4**	
TOTAL CREDIT FOR 1st YEAR = 46/48				
3rd SEMESTER				
COURSE CODE	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
GEOI164C301	Advanced Remote Sensing	500	4	3-1-0
GEOI164C302	Research Methodology	500	4	3-1-0
GEOI164C313	Internship	500	8	0-0-8
GEOI164C315	Practical III	500	4	0-0-4
	TOTAL CREDIT FOR 3rd SEMESTER		**20**	
OR 3rd SEMESTER (For students with 3rd and 4th Semester Research)				
	RESEARCH PROJECT – PHASE I	**500**	**20**	
Coursework (12 credits) + Research work (8 credits)				
GEOI164C301	Advanced Remote Sensing	500	4	3-1-0
GEOI164C302	Research Methodology	500	4	3-1-0
GEOI164C313	Research work (Minor)	500	8	0-0-8
GEOI164C315	Practical III	500	4	3-1-0
	Total		**20**	

4th SEMESTER				
COURSE CODE	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
GEOI164C301	Advanced Remote Sensing	500	4	4-0-0
GEOI164C302	Research Methodology	500	4	4-0-0
GEOI164C413	Research work (Major)	500	8	0-0-8
GEOI164C315	Practical III	500	4	4-0-0
OR 4th SEMESTER (For students with 3rd and 4th Semester Research)				
	RESEARCH PROJECT PHASE-2		**20**	
GEOI164C413	Dissertation only (for students who have completed only coursework of 20 credits in 3rd Semester for 'Coursework only' in lieu of Research	500	20	0-0-20
Course work with Research (Course work = 8 credits, Research work = 12 credits)				
GEOI164C301	Advanced Remote Sensing	500	4	4-0-0
GEOI164C302	Research Methodology	500	4	4-0-0
GEOI164C413	Research work (Major)	500	12	4-0-0
TOTAL CREDIT FOR 4th SEMESTER= 20				
TOTAL CREDIT FOR 2nd YEAR = 20+ 20 = 40				

SEMESTER 1

Paper I Core Course	**PRINCIPLES OF REMOTE SENSING & GLOBAL POSITIONING SYSTEM** **L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T)**	**Subject Code:** **GEOI164C 101**

Course Objectives: *This course intends to show the rationale behind the use of remotely sensed data and its advantages and disadvantages and illustrate how GPS methodologies can be used to address spatial analysis from the theoretical and practical perspective.*

Course Outcomes:

After successful completion of course, the students will be able to:

CO1. **Define** basic concepts of remote sensing

CO2. **Explain** principles and applications of various remote sensing techniques including aerial photography

CO3. **Utilize** remote sensing data products for minor and major projects on environmental/ natural resource assessments and mapping, disaster and hazard management, urban planning, and many applications

CO4. **Apply** the different remote sensing data sets collected from various platforms

CO5. **Interpret** Geospatial data in GIS platforms and perform analysis from various sources of data such as Remote Sensing and GPS for geographical research

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Introduction to Remote Sensing: Concepts, Definition, History, Development; Physics of Remote Sensing: Electromagnetic radiation (EMR), Theories of EMR, Laws of Radiation, EM Spectrum, Sources of EMR; Interaction of EMR: Interaction between radiation and matter, Interaction with Earth's Atmosphere, Atmospheric Window, Reflection, Absorption, and Transmission.	10
Unit 2	Spectral Signature: Spectral Signatures for common features, e.g. Snow, Soil, Water and Vegetation; Platform and Sensors: Platforms, Sensors, Orbits: Types of Platform, Types of Sensors- Active and Passive, Cameras and Satellite Orbits, Concept of Resolution, Satellite Imaging modes.	10
Unit 3	Fundamentals of Radiometry: Concept of solid angle, radiometric measurements, observation geometry in RS; Data Products and RS data errors: Satellite Data Generation, Data reception, Type of data products and Aerial Photography Products, FCC and TCC images and their applications, radiometric, geometric and atmospheric errors.	10
Unit 4	Photogrammetry: Basic aerial Photography, Basic geometry of aerial photograph, central and orthographic projections, difference between map and aerial photograph, Types of aerial photographs. Measurements: Scale and ground coverage of aerial photograph, Geometry of Aerial Photographs, Determination of Scale, Use of Parallax, height measurement. Aerial Photo and Image Interpretation: Elements of visual interpretation for aerial photos and satellite imageries: Single, Vertical Stereo Pairs, Derived From PAN, LISS, Wifs, OCM Sensors. Study and Visual Interpretation of Satellite Images for Physical Features, Urban, Forest and Agricultural Uses. Digital Photogrammetry: Concept and Techniques of Digital Photogrammetry.	10
	Total	**40**

Text Books:

1. Jensen, J.R., (2006) "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pte. Ltd., Indian edition, Delhi.
2. George Joseph, (2004) "Fundamentals of remote sensing", Universities press (India) Pte Ltd., Hyderabad.

Reference books:

1. Sabins, F.F. Jr., (2007) Edition. '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
3. Lillesand, Thomas M. and Kiefer, Ralph, W., (2007) "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York
4. Rampal, K.K., (1999) Handbook of Aerial Photography and Interpretation, Concept Publishing Company, New Delhi
5. N.K.Agrawal , (2004) ,Essentials of GPS, Spatial Network Pvt. Ltd
6. Sathish Gopi, (2000), GPS and Surveying using GPS
7. Leica. A., (2003), GPS Satellite Surveying, John Wiley & Sons, use. New York
8. Terry-Karen Steede, (2002), Integrating GIS and the Global Positioning System, ESRI Press

Paper II Core Course	GEOGRAPHIC INFORMATION SYSTEMS L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T)	Subject Code: GEOI164C 102

Course Objectives: *This course aims to make the students interpret the data, tools and technology and applications of Geoinformatics – Remote Sensing, GIS, and GPS and Construct and Analyse maps using Geospatial Technology.*

Course Outcomes:

After the completion of the course, the students will have the ability to:

CO1. **Recall** varied GIS terms, terminologies and techniques.
CO2. **Construct** different types of raster and vector maps.
CO3. **Develop** the skills in preparation of thematic maps at various levels.
CO4. **Analyze** GIS based maps and perform spatial analysis, classify remote sensing satellite based data and prepare large scale maps by using traditional surveying equipment and GPS survey.
CO5. **Assess** the multiple GIS techniques used in various fields and its applications.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Basic concepts of GIS: Definition and history; Components of GIS; Data structure and formats; Spatial data models – Raster and Vector; Data base design - editing and topology creation in GIS, Linkage between spatial and non-spatial data; Data inputting in GIS	12
Unit 2	Integration of Raster & Vector Data; Cartographic Modeling - Map Algebra; Raster Data & its Representation: Types, Data Structure, Data Compression, Data Files, Data Conversions; Raster Data Analysis – Overlay Operations, Slope & Aspects, Statistical Analysis; Geometric Transformations - Affine Transformation and Geometric Transformation Coefficients, RMS Error; Vector data representation: Topological & Non-topological Vector Data, Map scale, Spatial Resolution, Spatial Data Accuracy, Location Data Accuracy and Precision, Vector Data Sources; Comparison between Raster & Vector Data; Feature Based Topological functions: Buffering Overlay Analysis, Distance Measurements; Layer Based Topological Functions	14
Unit 3	Vector Data Query, Attribute Data Query; Logical Expressions, Types of Operations; Relational Database Query: Use of SQL, Descriptive Statistics of Attribute Data; Spatial Data Query, Raster Data Query, Query by Cell Value, Query using Graphical Methods, Charts; Geographic Visualization, Data Classification, Spatial Aggregation, Map Comparison; Problem Identification & Designing a Data Model	10
Unit 4	Application of GIS Techniques in various fields; Web GIS	04
	Total	**40**

Text Books:

1. Burrough, Peter A. and Rachael McDonnell,(1998), ' Principles of Geographical Information Systems' Oxford University Press, New York.
2. C.P.L and Albert K.W.Yeung (2006) "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.

Reference Books:

1. Demers, Michael N. 2000. *Fundamentals of Geographic Information Systems*. John Wiley, Singapore.
2. ESRI 1993. *Understanding GIS.* Redlands, USA
3. George, Joseph 2003. *Fundamentals of Remote Sensing*. Universities Press (Pvt.) Ltd, Hyderabad.
4. Girard, M-C. and Girard, C. M. 2003. *Processing of Remote Sensing Data*. Oxford & IBH, New Delhi.
5. Heywood, Ian 2003. *An Introduction to Geographical Information Systems*. 2nd ed. Pearson Publ. Co., Singapore.
6. Kang-tsung Chang (2007),'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
7. Longley, P., Goodchild, M.F., Maguire, D. and Rhind, D. 1999. *Geographic Information Systems. Principles, Techniques, Management, Applications*. John Wiley, New York.
8. Magwire, D. J., Goodchild, M.F. and Rhind, D. M., (2005),'Geographical Information Systems: Principles and Applications', Longman Group, U.K.
9. Martin, D. 1996. *Geographic Information Systems: Socioeconomic Implications*. Routledge, London.
10. Ralston, B. A. 2002. *Developing GIS Solutions with Map Objects and Visual Basic*. OnWord Press: Thompson Learning, New York & Singapore.
11. Reddy, M. Anji 2001. *Textbook of Remote Sensing and Geographic Information Systems*. B. S. Publs., Hyderbad.

Paper III Core Course	CARTOGRAPHY & GEOSTATISTICS			Subject Code:
	L-T-P-C: 3-1-0-4	Credit Units: 4	Scheme of Evaluation: (T)	GEOI164C 103

Course Objectives: *This course focuses on the basics of cartography and cartographic techniques along with the diagrammatic representation of geographical data.*

Course Outcomes:

After successful completion of the course, the students will be able to:

CO1. **Define** about map and its types, map scale, coordinate system and details of topographic maps.

CO2. **Interpret** fundamentals of cartographic designs.

CO3. **Construct** digital cartographic maps using data structures.

CO4. **Analyze** the importance of database queries and infer the results.

CO5. **Interpret** the results of various geostatistical analysis in GIS platforms.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Introduction to cartography: nature and scope; Approximation of Earth, Map Projection and Coordinate system: Concepts, Types and Uses; Categories & Characteristics of maps, Study of different types of maps, Survey of India national series maps Interpretation of topographic maps; Basics of Map scales; Indexing and Numbering of topographical maps	12
Unit 2	Fundamentals of Cartographic Design, colour, pattern, lettering, compilation, border information, aesthetics; Generalization: Semantic & Geometric, symbolization, dot, isopleth and choropleth mapping; Multivariate and dynamic mapping; Map production, methods of map printing; Visualization of geospatial data: Design aspects, Multiscale and geometric aspects scale, dissemination of (visualized) geospatial data, Graphic Symbology & Variables; Data products, use and users of products	12
Unit 3	Digital Cartography - Elements of digital Cartography; Analog to Digital Conversion of Data; Conventional mapping VS Digital Mapping; Nature of Data, Database and Data structures; Data Input: data capture, digitization and scanning; Digital database creation: Point features, Line features, Polygon features; Data Editing-Removal of errors – Overshoot & Undershoot, Snapping; Data Collection and Integration, Non-spatial data attachment working with tables; Dissolving and Merging	12
Unit 4	Data base query: Reclassification, overlay cross tabulation, editing, assigning attribute values, extraction of attribute values, histogram, area and perimeter calculation, profile generation, probability classification; Mathematical operations: Image overlay, scalar image operations, image attribute transformation; Distance operators: Distance analysis (spherical distance, cost distance), buffer analysis, direction variable cost distance, dispersion distance, least cost path analysis, spatial allocation and reallocation, Thiessen Polygon; Context operators: Surface analysis, filtering pattern analysis, grouping watershed, determination, hinterland determination; Statistics: Regression analysis (multiple, logistic, pattern analysis, trend surface analysis, spatial auto correlation, quadrant analysis, weighted mean, centre/ standard radius, compaction index, sampling (random, systematic and stratified), standard scores method.	12
	Total	**48**

Text Books:

1. Keates, J.S., (2008): Cartographic Design and production, London, Longman
2. Ramesh, P. A., (2000): Fundamentals of Cartography, Concept Publishing Co., New Delhi.

Reference Books:

1. Rampal, K.K., (2004): Mapping and Compilation, Concept Publishing Co.,New Delhi.
2. Anson, R.W.& Ormeling, F.J., (2008), Basic Cartography, Vol. I&II ed., Elsevier Applied Science Publishers, London.
3. Robinson A.H. & Morrison J.L, (1995) Elements of Cartography, John Wiley & Sons
4. Singh, R.L & Dutt. P.K, (2008),"Elements of Practical geography", Students Friends Allahabad
5. Peterson, M.P., (1995) "Interactive and Animated Cartography" Upper Sadde River, NJ: Prentice Hall.
6. Clark, I. (1979), Practical Geostatistics, Applied Science Publishers, London
7. Davis, J.C. (1973), Statistics and Data Analysis in Geology, Wiley, New York.
8. Matheron, G.F, (1963) Principles of Geostatistics: Economic Geology vol.58
9. Stein, A. (1998), Spatial Statistics for Soils and the Environment, ITC lecture notes.

Paper IV Core Course	GEO SCIENCES & IMAGE INTERPRETATION L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T)	Subject Code: GEOI164C 104

Course Objectives: *The objective of the course is to provide the students with an understanding about the fundamental concept of Geosciences and image interpretation.*

Learning Outcomes:
After the completion of the course, the students will have the ability to:

CO1. **Define** concepts of earth system and elements of photo interpretation with special reference to geological studies.
CO2. **Infer** basic understanding of visual and digital satellite image processing.
CO3. **Apply** fundamental knowledge for developing the image characteristics of major landforms.
CO4. **Analyze** and apply geographical data in managing natural hazards and planning process.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Concept of Earth System, Lithosphere, Biosphere, Hydrosphere & Atmosphere; Elements of Photo Interpretation in Geological Studies- lithotypes and structural features	10
Unit 2	Visual and Digital Satellite Image Interpretation; Elements of Image Interpretation; Development of Interpretation Keys; Ground Truth Verification	10
Unit 3	Fundamental Concepts: Geomorphic Agents and Processes; Development of Drainage Patterns and their Significance; Image Characteristics of Major Landforms: Fluvial, Aeolian, Glacial and Marine	10
Unit 4	Natural Hazard Risk Management; Regional & Urban Planning; Agricultural, Soil and Land Evaluation; Water Resources	10
	Total	**40**

Text Books:

1. Murk & Skinner, (1999). Geology Today - Understanding Our Planet, John Wiley And Sons Inc, New York
2. Lillisand, T. M. and Keifer, R. W., (2007). Remote Sensing and Image Interpretation', John Willey and Sons, New York, Fourth Edition

Reference books:

1. Pandey, S. N. , (1987). Principles and Applications of Photogeology. New Delhi: Eastern Wiley.
2. Jenson, J.R., (2006). Remote Sensing of the Environment – An Earth Resource Perspective, Prentice Hall Inc.
3. Drury, S.A. , (2004). Image Interpretation in Geology, Chapman & Hall, India.
4. Thornbury, W. D., (I969): Principles of Geomorphology, John Wiley and Sons, New York
5. Sabins, Floyd F., (2007). Remote Sensing: Principles and Interpretation, 2nd Ed., Freeman, New York.

Paper V Core Course	PRACTICAL I			Subject Code: GEOI164C115
	L-T-P-C: 0-0-4-4	Credit Units: 4	Scheme of Evaluation: (P)	

Course Objectives: *The course aims at increasing the practical knowledge of the students in the field of GIS and Remote sensing and its application in Geographical studies*

Course Outcomes:

By the end of this course the students will be able to:

CO1. **Define** the principles and concepts involved in GIS and Remote sensing practical.

CO2. **Classify** the nature, characteristics and sources of geospatial data.

CO3. **Develop** the skills and technical capabilities of the students.

CO4. **Simplify** the application of the concepts related to Geomorphology, Climatology and Population Geography.

CO5. **Inspect** geospatial tools and technologies to create and **analyse** geospatial data for natural resource assessments, planning and management related applications.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit I	**Lab Work:** Exercise 1: a) Data download (Toposheets, Open Street maps) b) Geo-referencing & Reprojection: image to image rectification, keyboard entry rectification - setting projection c) Raster Mosaicking and Clipping Exercise 2: Creating and Managing Vector Data: a) Adding vector layer b) Geodatabase Creation & digitizing entities like point, line and polygon data c) Vector Layer Formatting Exercise 3: Working with attributes and Data Organization (location, attributes, consistency, scale)	12
Unit 2	Exercise 4: Relational Data Base Query Exercise 5: a) Importing Spread sheets or CSV files b) Graphical Representation of Spatial data Exercise 6: Map algebra – raster processing tools	12
Unit 3	Exercise 7: a) Methods of data analysis: Buffer analysis b) surface interpolation, reclassification Exercise 8: Construction of Map scales: Simple, Comparative and Diagonal Exercise 9: Construction of different types of map projection; Conical projection, Cylindrical Projection, Zenithal Projection	12
Unit4	Exercise 10: Preparation of Base Map Exercise 11: Designing, Symbolization, Pattern and Shading techniques	4
		40

Books Recommended

1. Date, C.J., 1995 : An Introduction to Data Base System, 6th edition, Reading Messachusetts; Adderson Werley.
2. Fraser Taylor, D.R., (ed.), 1980 : Progress in Contemporary Cartography, John Wiley, Chichester U.K.
3. Fraser Taylor, D.R., (ed.), 1983 : Graphic Communication and Design in Contemporary Cartography, John Wiley & Sons Ltd. New York.
4. Jones, C., 1997 : Geographic Information Systems and Computer Cartography, Longman, London.
5. Kraak, M-J., and Ormeling, F., 2004: Cartography: Visualization of Geospatial Data, Pearson Education.
6. Misra, R.P., et al 2014: Fundamentals of Cartography, Concept Publishers, Delhi.

Semester-II

Paper I Core Course	DIGITAL IMAGE PROCESSING			Subject Code:
	L-T-P-C: 3-1-0-4	Credit Units: 4	Scheme of Evaluation: (T+P)	GEOI164C 201

Course Objectives: *The course aims to explain the digital image processing system and analysing resources and infrastructure using Geospatial Technologies and develop practical knowledge and skill in advanced technologies.*

Course Outcomes:

After the completion of the course, the students will have the ability to:

CO1. **List** the basic concepts of digital images and its characteristics.

CO2. **Interpret** image enhancement and filtering techniques.

CO3. **Apply** multi-band enhancement techniques for better classification.

CO4. **Analyse** and understand the basics of pattern recognition and its classifiers.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	INTRODUCTION: Concepts about digital image and its characteristics, Spectral, Spatial, Radiometric and Temporal resolution, Visual vs. Digital methods, Image data storage and retrieval, Image restoration and Noise Abatement, Radiometric and Geometric correction technique, Interpolation methods – linear and nonlinear transformation for geometric corrections	14
Unit 2	IMAGE ENHANCEMENT & FILTERING TECHNIQUES: Look-up Tables (LUT) and Types of image displays and FCC; Image Enhancement Techniques: Radiometric and Spatial; Contrast stretching: Linear and non-linear methods; Spatial Filtering: High and Low frequency, Image smoothing,	12
Unit 3	MULTI-BAND ENHANCEMENT TECHNIQUES & CLASSIFICATION: Band ratio, Types of Vegetation indices; Principal Component Analysis, Multi dated data analysis and Change detection; Digital Image Classification: Supervised & Unsupervised, Accuracy Assessment, Error Matrix	12
Unit 4	PATTERN RECOGNITION: Concept of Pattern Recognition, Multi-spectral pattern recognition; Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers; Kriging	10
	Total	**48**

Text Books:

1. Sabins, Floyd F. (2007), Remote Sensing: Principles and Interpretation, H. Freeman and C., New York.
2. Thomas M. Lillesand & Kiefer, Ralph W. (2007), Remote Sensing and Image Interpretation, John Wiley & Sons, New York.

Reference books:

1. Jensen, JR. (2006), Remote Sensing of the Environment- An Earth Resources Perspective, Prentice Hall Inc.
2. Rencz, Andrew N. , (1999), Remote Sensing for the Earth Sciences: Manual of Remote Sensing, 3rd ed., John Wiley & Sons, Inc., New York.
3. Curran, P., (1985), Principles of Remote Sensing, Longman, London.
4. Campbell, James B., (2006), Introductory Remote Sensing: Principles and Concepts, Routledge.
5. Gibson, P.J., (2000), Introduction to Remote Sensing, 2nd ed., Taylor & Francis, London.
6. Cracknell, A.P. & Hayes, L.W B., (2007), Introduction to Remote Sensing, Taylor & Francis, London.

Paper II Core Course	SPATIAL ANALYSIS & MODELLING	Subject Code:
	L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T+P)	GEOI164C 202

Course Objectives: *This course intends to show the rationale behind the use of remotely sensed data and its advantages and disadvantages and illustrate how GIS/GPS methodologies can be used to address spatial analysis from the theoretical and practical perspective.*

Course Outcomes:

After successful completion of the course, the students will be able to:

CO1. **Define** the basic concepts of GIS and modelling.

CO2. **Interpret** spatial data analysis techniques.

CO3. **Utilize** geostatistical analysis techniques for spatial interpolation.

CO4. **Apply** this knowledge for decision making through decision support system framework.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	INTRODUCTION TO GIS ANALYSIS & MODELLING Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools; Raster-Based and Vector-Based GIS Modeling, Binary Models, Index Models, Regression Models, Process Models; Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing	12
Unit 2	SPATIAL DATA ANALYSIS TECHNIQUES Classification Scheme of Vector-Based and Raster-Based GIS Operations; Raster–Based Techniques: Methods of Reclassification, Overlay Analysis, Slope and Aspects, Buffering, Cost-Distance Calculation; Vector-Based Techniques: Map Manipulation Techniques, Buffering, Overlay Analysis, Network Analysis; Digital Terrain Analyses and Modeling: TIN and DEM, Surface Representation & Analysis	12
Unit 3	GEOSTATISTICAL ANALYSIS TECHNIQUES Introduction to Spatial Interpolation: Control Points; Global Methods: Trend Surface Analysis, Regression Models; Local Methods: Thiessen Polygons, Density Estimation, Inverse Distance Weighted Interpolation; Kriging: Ordinary Kriging (Semivariance, Semivariogram), Universal Kriging	12
Unit 4	INTRODUCTION TO DSS GIS and decision support system, Introduction to decision making process and decision support systems, Introduction of a framework for planning and decision making, Spatial Decision Making; Development of DSS, DSS Architecture; Principles and components of multiple-criteria decision making; Main multiple-criteria evaluation methods/techniques; Spatial multiple criteria decision making; Multiple-criteria decision making in spatial data analysis; Introduction to AHP, Basic Principles of AHP; Effect Table, Pair Wise comparison, Standardization, Consistency, Wieghtage, performance score, Different method in PWC	12
	Total	**48**

Text Books:

1. Bonczek, R.H., C.W. Holsapple, and A.B. Whinston, (1981), Foundations of Decision Support Systems, Academic Press, New York. Basic text on DSS
2. Geoffrion, A.M., (1983). "Can OR/MS evolve fast enough? Interfaces 13:10. Source for six essential characteristics of DSS

Reference Books:

1. House, W.C. (ed.), (1983). Decision Support Systems, Petrocelli, New York. Basic DSS text
2. Sprague, R.H., (1997). "A framework for the development of decision support systems, "Management Information Sciences Quarterly 4:1-26. Source for DSS development model
3. Sprague, R.H., and Carlson, E.D., (1982). Building Effective Decision Support Systems, Prentice-Hall, Englewood Cliffs NJ. Basic DSS text
4. Burrough, Peter A. and Rachael McDonnell., (1998), Principles of Geographical Information Systems. Oxford University Press, New York
5. Laurini, Robert and Derek Thompson. , (1992), Fundamentals of Spatial Information Systems. Academic Pr., London
6. Kluwer Fotheringham A S, O'Kelly M E., (1998), Spatial Interaction Models: Formulations and Applications.
7. Paul Longley, Michael Goodchild, David Maguire and David Rhind:, (2005), Geographical Information Systems. Principles, Techniques, Applications and Management. John Wiley & Sons.

Paper IV Core Course	Geoinformatics in Agriculture, Soil & Land Evaluation	Subject Code:
	L-T-P-C: 3-1-0-4 Credit Units: 4 Scheme of Evaluation: (T)	GEOI164C 204

Course Objectives: *This course intends to provide students with an understanding of the different types of spatial data and technologies used in Geoinformatics and their applications in agriculture, soil & land evaluation.*

Learning Outcomes:

After the completion of the course, the students will have the ability to:

CO1. **Recall** the basic concepts and terminology related to Geoinformatics in agriculture, soil & land evaluation.

CO2. **Explain** the principles and methods of Geoinformatics and how they can be applied to agriculture, soil & land evaluation.

CO3. **Utilize** Geoinformatics-based approaches to develop management plans for crops, soil health, and land use planning.

CO4. **Evaluate** the effectiveness and efficiency of Geoinformatics-based approaches to agricultural and environmental management.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Estimation & spectral analysis of crops and damage assessment: Spectral Properties of Crops and Yield Parameters, Identification of Crops and Acreage Estimation., Vegetation Indices, Production Forecasting through Digital Analysis, Monitoring, Condition, and Damage Assessment, Detection of Pests and Diseases, Damages due to Droughts and Floods, Water-logging and Salinity, Stress Detection.	12
Unit 2	Soil Classification and Mapping: Soil Types in India, Soil Survey Methods, Soil Classification, Problems with Soil Identification, Mapping of Soils using Remote Sensing and GIS techniques	12
Unit 3	Land Evaluation & Assessment: Land Evaluation, Role of Remote Sensing in Soil Conservation., Principle and Methods of Land Assessment, Agriculture and Soil Development, RS & GIS in Land Evaluation	12
Unit 4	Case Studies: GIS for Drawing out Action Plans & Recent Development in Agro-Climatic Modelling, Watershed Planning, Remote Sensing in Agriculture & Soil studies	12
	Total	**48**

Text Books:

1. Steven, M.D. and Clark, J.A., 1991, Application of Remote Sensing in Agriculture, Butterworths, London
2. Ghassem Asrar, 1989. Theory and application of optical remote sensing. John Wiley & Sons, New York

Reference books:

1. Space Applications Centre- Manual of procedure for Forest mapping and Damage Detection using satellite data, Report No. IRS-UP/SAC/FMDD/TN/16/90, 1990: pp-58.
2. Space Applications Centre –Status Report on Crop Acreage and Production Estimation, Report No. RSAM/SAC/CAPE/SR/ 25/90, October 1990, pp-253.
3. Brockington, N.R., (1979): "Computer Modelling in Agriculture", Oxford University Press
4. Siva Vandana, (2002), "Sustainable agriculture and food security", Sage Publications New Delhi.

Paper: DSE – 2	Geoinformatics in Regional & Urban Planning L-T-P-C: 3-1-0-4 Credit Units: 4 (T) Scheme of Evaluation:	Subject Code: GEOI164C205

Course Objectives: *The course aims to provide students with an understanding of the different types of spatial data and technologies used in Geoinformatics and their applications in regional and urban planning.*

Learning Outcomes:

After the completion of the course, the students will have the ability to:

CO1. **Recall** the basic concepts and terminology related to Geoinformatics in regional and urban planning.
CO2. **Interpret** and analyze different types of spatial data and technologies used in Regional & Urban Planning.
CO3. **Apply** Geoinformatics tools and techniques to collect, process, analyze, and visualize spatial data for regional and urban planning.
CO4. **Critique** and propose improvements to Geoinformatics-based regional and urban planning systems.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Basic Concept: Importance & Relevance of Remote Sensing data for Urban and Regional Planning, Visual and Digital Data Analysis Techniques, Scale and Resolution concepts, Scope and Limitations of Remote Sensing Application to Urban and Regional Planning	14
Unit 2	Regional and Urban Planning: Urban and Regional Mapping, Base Map Preparation, Regional, City, Intra –City, Scale & Methodology, Urban and Regional Plan Formulation, Application of Remote Sensing Techniques in Regional Plan, Master Plan	14
Unit 3	Urban Analysis: Urban Analysis, Urban Growth, Trend Analysis, Change Detection, Slum Development, Housing Typology and Density Analysis, Population Estimation, Information system, Database Organisation- Large Scale Data Entry, Interpretation Manipulation- Retrieval- Attribute Information for Urban Planning.	10
Unit 4	Case Studies: Analysis of Urban Land Use Change, Preparation of Master Plan in City Development, Object-oriented GIS Data Modelling for Urban Design, Delineation of socio-infrastructure database into GIS for land use planning	10
	Total	**48**

Text Books:

1. Arnoff, S (1989); Geographical Information Systems: A Management Perspective, WDL Publications, Canada
2. Brench M.C. (1972), City planning and Aerial Information, Harvard University, Cambridge

Reference Books:

1. Burrough, P.A (1988), Principles of Geographical Information Systems for land Resources Assessment, Oxford University Press
2. Subudhi A.P, Sokhi, Roy (2001), Remote Sensing and GIS, Application in Urban and Regional Studies, IIRS, Dehra Dun
3. Subudhi, A.P (1992), Design of Automated Land Use Information System for Town & Country planning, Institute of Town planners, New Delhi.

Paper I Core Course	PRACTICAL II			Subject Code:
	L-T-P-C: 0-0-4-4	Credit Units: 3	Scheme of Evaluation: (P)	GEOI164C 215

Course Objectives: *The course aims at increasing the practical knowledge of the students in the field of GIS and Remote sensing and its application in Geographical studies*

Course Outcomes:

By the end of this course the students will be able to:

CO1. **Define** the principles and concepts involved in GIS and Remote sensing practical.

CO2. **Classify** the nature, characteristics and sources of geospatial data.

CO3. **Develop** the skills and technical capabilities of the students.

CO4. **Simplify** the application of the concepts related to Geomorphology, Climatology and Population Geography.

CO5. **Inspect** geospatial tools and technologies to create and **analyse** geospatial data for natural resource assessments, planning and management related applications.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit I	**Lab Work:** Exercise 1 Georeferencing of satellite images based on a georeferenced map Exercise 2 Stacking of images (Image composition) with various spectral bands and generating True, False and Pseudo Colour Composite. Exercise 3 Mosaic of image and clipping the same or any other image by vector polygon boundary	14
Unit 2	Exercise 4 Enhancement using different filtering techniques, Image Fusion Exercise 5 Satellite imagery and feature identification based on interpretation keys	10
Unit 3	Exercise 6 Interpretation of Satellite Imagery in different Bands Exercise 7 Band ratio (NDVI, NDWI, NDSI, NDMI) Exercise 8 Digital Image Classification: Supervised, Unsupervised and accuracy assessment.	12
Unit4	Exercise 9: Interpretation of Thermal Image and Drawing of Isotherms Exercise 10 Generation of slope, profiles from contour digitization from toposheet. Exercise 12 GPS: GPS Survey, Data Import, Processing and Mapping	12

Books Recommended

1. Date, C.J., 1995 : An Introduction to Data Base System, 6th edition, Reading Messachusetts; Adderson Werley.
2. Fraser Taylor, D.R., (ed.), 1980 : Progress in Contemporary Cartography, John Wiley, Chichester U.K.
3. Fraser Taylor, D.R., (ed.), 1983 : Graphic Communication and Design in Contemporary Cartography, John Wiley & Sons Ltd. New York.
4. Jones, C., 1997 : Geographic Information Systems and Computer Cartography, Longman, London.
5. Kraak, M-J., and Ormeling, F., 2004: Cartography: Visualization of Geospatial Data, Pearson Education.
6. Misra, R.P., et al 2014: Fundamentals of Cartography, Concept Publishers, Delhi.

SEMESTER-III

Paper I Core Course	ADVANCED REMOTE SENISING			Subject Code:
	L-T-P-C: 3-1-0-4	Credit Units: 4	Scheme of Evaluation: (T)	GEOI164C 301

Course Objectives: The objective of this paper is to understand the basic concepts of Remote Sensing and to impart to students the skills necessary for remote sensing analysis and interpretation**.**

Course Outcomes:

After the completion of the course, the students will have the ability to:

CO1. get knowledge to the advanced Satellite of Remote Sensing, Hyperspectral Remote Sensing, LIDAR Remote Sensing and their different application in terrestrial and vegetation mapping.
CO2. acquire skills in handling instruments, tools, techniques and modelling while using Remote Sensing Technology.
CO3. get familiarized about various image enhancement and image processing techniques.
CO4. get opportunity of employability opportunity in space organization.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	**THERMAL REMOTE SENSING:** Principles of thermal remote sensing, black body, radiant temperature, radiation from Earth's objects, thermal conductivity, thermal capacity, thermal inertia, thermal diffusivity, Thermal Radiometers, scanners, calibration of scanners, mapping with Thermal scanners, Imaging Spectrometer, Application of Thermal Remote Sensing.	14
Unit 2	**HYPER SPECTRAL REMOTE SENSING** Introduction to Hyperspectral Remote Sensing Sensors/Imaging Spectrometers, Hyperspectral Satellite Systems, Hyper spectral image analysis: Atmospheric correction, Analysis Technique of hyper spectral remote sensing, Biophysical modeling, Image transmission & compression. Spectroscopy, Image cube, Hyperian/HYSI, Spectral matching, Digital Spectral Data, Libraries, Application of Hyper spectral data, MODIS	12
Unit 3	**LIDAR REMOTE SENSING** Fundamental of LIDAR remote sensing, LIDAR Data Processing, LIDAR Data Management And Applications,(Topographic Mapping ,flood inundation analysis, line-of-sight analysis, Forestry, various types of LIDAR sensors-, vegetation metric calculations, Corridor mapping system,) Terrestrial And Bathymetric Laser Scanner Satellite and its classification. Sun synchronous orbit and geostationary orbit, Remote sensing satellites in operation: LANDSAT, SPOT, IRS, INSAT, GEOSAT, IKONOS, QUICK BIRD, NOAA, TERRA their sensor characteristics and application.	12
Unit 4	**MICROWAVE & RADAR REMOTE SENSING***:* Concept and principles of Microwave Remote Sensing, SLAR, SAR and Scaterometer, Application of Microwave Remote Sensing. Outlines of Radar Image Interpretations. **Image Interpretation:** Visual and Digital Interpretation techniques - Basic concepts of visual interpretation, tone, color, texture, pattern, shape and Contextual features. Digital Image Interpretation-	10
	Total	**48**

Text Books:

3. Sabins, Floyd F. (2007), Remote Sensing: Principles and Interpretation, H. Freeman and C., New York.
4. Thomas M. Lillesand & Kiefer, Ralph W. (2007), Remote Sensing and Image Interpretation, John Wiley & Sons, New York.

Reference books:

7. Jensen, JR. (2006), Remote Sensing of the Environment- An Earth Resources Perspective, Prentice Hall Inc.
8. Rencz, Andrew N. , (1999), Remote Sensing for the Earth Sciences: Manual of Remote Sensing, 3rd ed., John Wiley & Sons, Inc., New York.
9. Curran, P., (1985), Principles of Remote Sensing, Longman, London.
10. Campbell, James B., (2006), Introductory Remote Sensing: Principles and Concepts, Routledge.
11. Gibson, P.J., (2000), Introduction to Remote Sensing, 2nd ed., Taylor & Francis, London.
12. Cracknell, A.P. & Hayes, L.W B., (2007), Introduction to Remote Sensing, Taylor & Francis, London.
13. SchowengerdR .A. 1995 Techniques for Image processing and classification in Remote Sensing, Academic Press. New York.
14. Siegel, B.S. and Gillespie, A.R. 1994, (eds). Remote sensing and Image Interpretations, John Wiley and Sons, New York.

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Paper I Core Course	RESEARCH METHODOLOGY			Subject Code:
	L-T-P-C: 3-1-0-4	Credit Units: 4	Scheme of Evaluation: (T)	GEOI164C 302

Course Objectives:

The course aims to make the students understand the basics of qualitative and quantitative research, literature review, data collection, identification of research problem, formulate research objectives and research questions, formulation of hypothesis and testing, framing of questionnaires, techniques of collection of both qualitative and quantitative data and their analysis.

Course Outcomes:

After the completion of course, the students will have ability to:

CO1. **Define** the concepts and tools of research.
CO2. **Infer** ideas that can be taken up for research work through literature review.
CO3. **Develop** hypothesis and research questions.
CO4. **Identify** appropriate data collection and sampling techniques.
CO5. **Interpret** the various types of data along with **critical evaluation**.
CO6. **Design and develop** a scientific research report

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Research: Definition, Types (Pure and Applied) Classification, Literature review. Research methodology in geosciences; Defining a research problem; Statement of the problem; Objectives, and hypothesis/ research questions, Database and methodology, significance, review of research works and bibliography and references.	14
Unit 2	Routes of Explanation: Inductive and Deductive, Hypothesis, Theories, Laws and Models, Research Question, Objectives and Significance of Research, Research Design: Data Collection and Analysis	12
Unit 3	Presentation of Research Findings: Types, role and significance; Questionnaire design (Open, Closed, Structured, And Non-structured), data collection, Post field processes: construction of data matrix, data processing and analysis; Role of quantitative techniques in Geography. Report Writing and Presentation, . Scientific Journals (Impact Factor, Citation), Introduction to Web of Science, SCOPUS, , Mendeley and Google scholar	12
Unit 4	Ethics in Scientific Research: Plagiarism- classification and prevention; Intellectual property rights; Research report writing: Structural components and presentation. Preliminary idea about URKUND, TURNITIN, DRILLBIT	10
	Total	**48**

References

Text Books:

1. Harvey, D, 1969: Explanation in Geography, Scientific Publisher, Jodhpur.
2. Lenon, B., Cleves, P. 2015. Geography Fieldwork and Skills, Harper-Collins.

Reference Books:

3. Evans, M., (1988): "Participant Observation: The Researcher as Research Tool" in Qualitative Methods in Human Geography, eds. J. Eyles and D. Smith, Polity.
4. Special Issue on "Doing Fieldwork" The Geographical Review 91:1-2 (2001).
5. Stoddard, R. H., (1982): Field Techniques and Research Methods in Geography, Kendall/Hunt.
6. Wolcott, H., (1995): The Art of Fieldwork, Alta Mira Press, Walnut Creek, CA.
8. Northey, N., Draper, D., Knight, D.B. 2015. Making Sense in Geography and Environmental Sciences:A Student's Guide to Research and Writing, 6th ed, Oxford University Press.
9. Parsons, T., Knight, P.G. 2015. How To Do Your Dissertation in Geography and Related Disciplines,3rd ed, Routledge.

Paper II Core Course	RESEARCH (MINOR) / INTERNSHIP			Subject Code:
	L-T-P-C: 0-0-8-4	Credit Units: 20	Scheme of Evaluation: (P)	GEOI164C 313

Course outcome:
CO1: The knowledge gained can successfully be utilised to generate thematics maps and to solve the problems related to earth and its environment.
CO2: Students can carry out consultancy work independently
CO3: They can join various government/private organisations.

Course Objectives: *The course aims to enable students to apply GIS to real-world problems, using data from a range of sources, including remote sensing, GPS, and survey data.*

Course Outcomes:
After successful completion of the course, the students will be able to:

CO1. **Recall** the basic principles of research design, methods, and ethics.
CO2. **Interpret** and analyze different types of research methods and data collection techniques.
CO3. **Utilize** research-based approaches to develop a hypothesis or research question and design a research project.
CO4. **Analyze** and evaluate the accuracy, reliability, and limitations of data collected and used in the research project.
CO5. **Critique** and propose improvements to research design and methods.
CO6. **Design** and develop a research project proposal, including research question/hypothesis, methods, data collection, and analysis techniques.

Learning Outcomes:

Note: Submission of project report in prescribed format and on specified date is mandatory. Equal weightages of marks for each stage of the work (upto 3rd stage) for internal evaluation of the project by the supervisor (60% of end semester examination). 40% of the total marks of end semester examination is for viva-voce and final presentation to be evaluated by an external examiner.

Text Books:

As per the list of given in syllabus based on topic selected

Reference Books:

As per the list of given in syllabus based on topic selected

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Identification of research problem / topic on any one of the following aspects based on the internship programme during the 3rd semester. This may be any kind of geographical studies: a. Agriculture, Industry, Mining related issues b. Environmental problems of the locality including disasters and hazards c. Natural resources assessments, planning and management d. Ecological crisis, Climate change and consequences e. Rural / Urban Ecosystems; f. Terrain / basin / watershed characterization and evaluation including integrated development studies *(This list is indicative only, the student may consult the assigned teacher as project supervisor / guide. Project supervisor / guide to each student will be allocated)*. The topic selection / modification may be done just before the 3rd Semester End Examination so that the data collection can be done during semester break. A fresh project proposal / modified project proposal of project done in 4th semester is to be submitted by each student (within 2nd week of the commencement of 4th semester classes) by mentioning the following:- a. Project title b. Introduction to the problem c. Aims / objectives d. Objectives and Research questions e. Database and Methodology f. Study of relevant literature g. Organization of study	12
Unit 2	Project proposal presentation by each student using PowerPoint during 3rd week of the commencement of the course of 4th semester.	12
Unit 3	Reporting of data collection, tabulation, processing, mapping/charting and analysis by each student using PowerPoint during 5th week of the commencement of the course of 4th semester.	12
Unit 4	Preparation of project report in prescribed format during 6th – 8th week of the commencement of course of 2nd semester. Submission of the report after a week of the announcement of routine for 4th End Semester Examination. Final project presentation by each student using PowerPoint during on the scheduled date of viva-voce examination of this paper. *Marks for external evaluation = Viva-voce + Presentation = 100*	12
	Total	**48**

Paper II Core Course	PRACTICAL III			Subject Code: GEOI164C315
	L-T-P-C: 0-0-4-4	Credit Units: 4	Scheme of Evaluation: (P)	

Course Objectives: *The course aims at increasing the practical knowledge of the students in the field of GIS and Remote sensing and its application in Geographical studies*

Course Outcomes:

By the end of this course the students will be able to:

CO1. **Define** the principles and concepts involved in GIS and Remote sensing practical.

CO2. **Classify** the nature, characteristics and sources of geospatial data.

CO3. **Develop** the skills and technical capabilities of the students.

CO4. **Simplify** the application of the concepts related to Geomorphology, Climatology and Population Geography.

CO5. **Inspect** geospatial tools and technologies to create and **analyse** geospatial data for natural resource assessments, planning and management related applications.

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	**Lab Work:** Exercise 1 Image manipulation / enhancements and interpretation and feature identification Exercise 2 Classification- Visually interpreted by vector polygons, Supervised and Unsupervised Exercise 3 Unsupervised classification and recoding of enhanced image and derivation of statistics	14
Unit 2	Exercise 4 Preparation of various thematic maps: Drainage – TIN – DEM – slope - aspect – land use/ land cover Exercise 5 Mapping of temporal changes in river courses using Remote sensing and GIS techniques Exercise 6 Spatial and Non-Spatial Data: Spatial: Linking Features Attributes, Ways to View Data, Metadata Non-Spatial Understanding Tables, Field Types, Table Manipulations, Table Relationship, Joins, Relates, Creation of Graphs and Reports	12
Unit 3	Exercise 7: Preparation of soil map, - land capability assessment (using Analytical Hierarchy Process) - soil erosion estimation by using RUSLE/USLE model Exercise 8: Vegetation cover mapping from satellite images, Computation of NDVI, SAVI , NDWI, NDBI from 1C/1D/ Resourcesat/ LANDSAT data/ SAR data Exercise 9: Temporal Land use / Land cover studies, change detection analysis and accuracy assessment Exercise 10: Digital classification for forest cover mapping and change detection studies, estimation of above ground biomass and Carbon Stock	12
Unit 4	Exercise 11: Time-series data (climatic attributes, river discharge, forest cover etc) analysis by using statistical techniques Exercise 13: Network Analysis - shortest path – best path – service area – OD cost matrix - Location and Allocation - route tracing – proximity analysis – site suitability –address matching – (using ArcGIS software) Exercise 12: Introduction to Differential GPS (DGPS): Principle and Function. Use of DGPS in Topographical Survey. Exercise 13: Introduction to Drone Survey and Mapping	10
		48

SEMESTER-IV

Paper II Core Course	**RESEARCH PROJECT (MAJOR)** **L-T-P-C: 0-0-12-20 Credit Units: 4 Scheme of Evaluation: (P)**	**Subject Code: GEOI164C 413**

Course outcome:
CO1: The knowledge gained can successfully be utilised to generate thematics maps and to solve the problems related to earth and its environment.
CO2: Students can carry out consultancy work independently
CO3: They can join various government/private organisations.

Course Objectives: *The course aims to enable students to apply GIS to real-world problems, using data from a range of sources, including remote sensing, GPS, and survey data.*
Course Outcomes:
After successful completion of the course, the students will be able to:

CO1. **Recall** the basic principles of research design, methods, and ethics.
CO2. **Interpret** and analyze different types of research methods and data collection techniques.
CO3. **Utilize** research-based approaches to develop a hypothesis or research question and design a research project.
CO4. **Analyze** and evaluate the accuracy, reliability, and limitations of data collected and used in the research project.
CO5. **Critique** and propose improvements to research design and methods.
CO6. **Design** and develop a research project proposal, including research question/hypothesis, methods, data collection, and analysis techniques.

Learning Outcomes:

weightages of marks for each stage of the work (upto 3rd stage) for internal evaluation of the project by the supervisor (60% of end semester examination). 40% of the total marks of end semester examination is for viva-voce and final presentation to be evaluated by an external examiner.
Text Books:
As per the list of given in syllabus based on topic selected
Reference Books:
As per the list of given in syllabus based on topic sel

Detailed Syllabus:

Modules	Topics and Course Content	Periods
Unit 1	Identification of research problem / topic on any one of the following aspects based on the internship programme during the 3rd semester. This may be any kind of geographical studies: a. Agriculture, Industry, Mining related issues b. Environmental problems of the locality including disasters and hazards c. Natural resources assessments, planning and management d. Ecological crisis, Climate change and consequences e. Rural / Urban Ecosystems; f. Terrain / basin / watershed characterization and evaluation including integrated development studies *(This list is indicative only, the student may consult the assigned teacher as project supervisor / guide. Project supervisor / guide to each student will be allocated).* The topic selection / modification may be done just before the 3rd Semester End Examination so that the data collection can be done during semester break. A fresh project proposal / modified project proposal of project done in 4th semester is to be submitted by each student (within 2nd week of the commencement of 4th semester classes) by mentioning the following:- a. Project title b. Introduction to the problem c. Aims / objectives d. Objectives and Research questions e. Database and Methodology f. Study of relevant literature g. Organization of study	12
Unit 2	Project proposal presentation by each student using PowerPoint during 3rd week of the commencement of the course of 4th semester.	12
Unit 3	Reporting of data collection, tabulation, processing, mapping/charting and analysis by each student using PowerPoint during 5th week of the commencement of the course of 4th semester.	12
Unit 4	Preparation of project report in prescribed format during 6th – 8th week of the commencement of course of 2nd semester. Submission of the report after a week of the announcement of routine for 4th End Semester Examination. Final project presentation by each student using PowerPoint during on the scheduled date of viva-voce examination of this paper. *Marks for external evaluation = Viva-voce + Presentation = 100*	12
	Total	**48**

Note: Submission of project report in prescribed format and on specified date is mandatory. Equal