Vidyasagar University
Midnapore-721102, West Bengal

The Syllabus for
Post-Graduate Programme
in

REMOTE SENSING & GEOGRAPHIC INFORMATION SYSTEM (RS & GIS)

[w.e.f. 2025-26]

Brief history

Remote Sensing and GIS has been developed as a powerful technology for mapping and analyzing earth resources. Although it has been widely used as a mapping tool and well-known for its application in various fields of earth sciences, but it has emerged as a new subject with immense potentiality and opportunity in recent days. The Department of Remote Sensing and Geographical Information System was established in 2003 with the view to cater the increasing demand of qualified and skilled manpower in this rapid growing field. It is one of the first Remote Sensing & GIS departments in West Bengal to start the course of Remote Sensing and GIS at Post Graduate and Doctoral levels. The Alumni of this Department have occupied responsible positions in India and abroad. Our students have unique opportunity to undertake their dissertation collaboratively with renowned state and central government agencies and research institutes and they are encouraged to carry out innovative research during their project period. Several Remote Sensing and GIS related Research and Consultancy Projects have been undertaken by the faculty members of the Department.

Program Outcomes (POs)

The Master of Science (M.Sc.) degree is designed to produce postgraduate students who are highly skilled, knowledgeable, and responsive to the demands of their respective fields. The core program outcomes (POs) for M.Sc. graduates are as follows:

- Advanced Knowledge: Graduates gain an in-depth understanding of their specific field of study, including theoretical foundations, practical applications, and current trends.
- Research Skills: Students develop robust research skills, enabling them to formulate, design, and conduct scientific research. This includes proficiency in using modern research methodologies, critical analysis, and data interpretation.
- Technical Proficiency: They are trained in the use of advanced tools and technologies relevant to their discipline, enhancing their analytical and problem-solving capabilities.
- Communication Skills: M.Sc. graduates are equipped with the skills to effectively communicate complex information in a clear and concise manner, both in writing and verbally, to both specialist and non-specialist audiences.
- Ethical Practices: Students are instilled with a strong sense of ethical responsibility, ensuring that their professional activities are conducted with integrity and adhere to applicable standards and regulations.
- Professional Competence: Graduates demonstrate the ability to work independently and as part of a team, managing projects efficiently and making informed decisions that reflect expert knowledge and judgment.
- Innovation and Creativity: The program encourages innovation and critical thinking, enabling graduates to contribute novel solutions to problems in their fields.
- Lifelong Learning: Graduates are prepared to engage in continuous learning, adapting to changes and pursuing further educational opportunities to remain relevant in their professions.

These outcomes prepare graduates not only to excel in their immediate roles but also to contribute effectively to the advancement of their fields and to address broader societal challenges.

Programme Specific Outcomes

The Master of Science (M.Sc.) degree in Remote Sensing and Geographic Information Systems (GIS) equips students with a comprehensive skillset and knowledge base that prepares them for diverse professional roles and further research in the field. The specific program outcomes include:

- Technical Proficiency: Graduates will demonstrate advanced proficiency in the principles and applications of remote sensing and GIS. This includes competency in data acquisition, processing, analysis, and interpretation.
- Analytical Skills: Students will develop strong analytical skills, enabling them to tackle complex spatial problems using geospatial technologies. They learn to integrate multiple data sources and apply quantitative and qualitative analysis techniques.
- Problem-Solving Abilities: The curriculum fosters the ability to design and implement GIS projects and remote sensing campaigns that address real-world issues, emphasizing strategic problem-solving and decision-making skills.
- Research Capability: Graduates will be capable of conducting independent research, utilizing advanced tools and methodologies in remote sensing and GIS. This includes designing research proposals, managing projects, and synthesizing findings coherently.
- Technological Adaptability: Keeping pace with rapid technological advancements in the field, students will gain proficiency in the latest remote sensing software and GIS tools, ensuring they remain adaptable and industry-relevant.
- Communication Skills: Effective communication is pivotal, and graduates will be adept at presenting complex geospatial information to diverse audiences, including scientists, policymakers, and the general public.
- Professional Development: The program prepares students for a professional career in various sectors, including government, academia, private industry, and non-profit organizations, by inculcating a strong ethos of ethical practice and continuous professional development.
- Collaborative Experience: Through collaborative dissertations and projects with state and central government agencies, as well as renowned research institutes, students gain valuable teamwork and leadership experience.

These outcomes ensure that graduates not only enter the workforce as highly qualified GIS and remote sensing professionals but also contribute innovatively to their fields of expertise.

DIVISION OF MARKS

Total Marks : 1100

SEM I Marks : 275

SEM II Marks : 275

SEM III Marks : 275

SEM IV Marks : 275

Theoretical Marks : 525 (SEM I: 175, SEM II: 175, SEM III: 175)

Practical Marks : 300 (SEM I: 100, SEM II: 100, SEM III: 100)

Dissertation : 175 marks (SEM IV)

Grand Viva : 100 marks (SEM IV)

M.Sc. in RS & GIS

SEMESTER	COURSE CODE	COURSE TITLES	Full Marks	No of Lectures (hours)	CREDIT (Lecture – Tutorial - Practical) (L-T-P)
I	RSGC401X0	FUNDAMENTALS & PHYSICS OF REMOTE SENSING	25	20	2 (1-1-0)
	RSGC402X0	PLATFORMS AND SENSORS	25	20	2 (1-1-0)
	RSGC403X0	FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM	25	20	2 (1-1-0)
	RSGC404X0	DIGITAL CARTOGRAPHY	25	20	2 (1-1-0)
	RSGO405VC	INDIAN KNOWLEDGE SYSTEM	25	20	2 (1-1-0)
	RSGC406X0	SURVEYING AND NAVIGATIONAL SATELLITE SYSTEM	25	20	2 (1-1-0)
	RSGC407X0	INTRODUCTION TO PYTHON PROGRAMMING FOR GEOSPATIAL ANALYSIS	25	20	2 (1-1-0)
	RSGO408NC	VIDYASAGAR: LIFE AND PHILOSOPHY	Compulsory Non-credit course		
	RSGC409X9	FUNDAMENTALS OF IMAGE PROCESSING & INTERPRETATION (Practical)	25	40	2 (0-0-2)
	RSGC410X9	FUNDAMENTALS OF GIS (Practical)	25	40	2 (0-0-2)
	RSGC411X9	COMPULSORY FIELD SURVEY (Practical)	25	40	2 (0-0-2)
	RSGC412X9	PYTHON PROGRAMMING (Practical)	25	40	2 (0-0-2)
	TOTAL		**275**	**300**	**22**
II	RSGC451X0	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	25	20	2 (1-1-0)
	RSGC452X0	IMAGE ENHANCEMENT & TRANSFORMATION	25	20	2 (1-1-0)
	RSGC453X0	INFORMATION EXTRACTION FROM SATELLITE IMAGES	25	20	2 (1-1-0)
	RSGC454X0	THERMAL AND MICROWAVE REMOTE SENSING	25	20	2 (1-1-0)
	RSGC455X0	HYPERSPECTRAL REMOTE SENSING AND LIDAR	25	20	2 (1-1-0)
	RSGC456X0	ADVANCED GIS	25	20	2 (1-1-0)
	RSGC457X0	MODELING SPATIAL DATABASE AND ANALYSIS	25	20	2 (1-1-0)
	RSGC458X9	DIGITAL IMAGE PROCESSING (Practical)	25	40	2 (1-1-0)
	RSGC459X9	ADVANCED REMOTE SENSING: DATA PROCESSING AND APPLICATION (Practical)	25	40	2 (0-0-2)
	RSGC460X9	ADVANCED GEOGRAPHIC INFORMATION SYSTEM (Practical)	25	40	2 (0-0-2)
	RSGC461X9	MODELING SPATIAL DATABASE AND ANALYSIS (Practical)	25	40	2 (0-0-2)
	TOTAL		**275**	**300**	**22**
III	RSGO501X0	MASSIVE OPEN ONLINE COURSES (MOOC)/SWAYAM	50	40	4 (2-2-0)
	RSGC502X0	APPLICATION OF GEO-INFORMATICS	25	20	2 (1-1-0)
	RSGC503X0	SPATIAL DATA SCIENCE AND SDSS	25	20	2 (1-1-0)
	RSGC504X0	FUNDAMENTAL OF RESEARCH AND GEOSPATIAL PROJECT MANAGEMENT	25	20	2 (1-1-0)

SEMESTER	COURSE CODE	COURSE TITLES	Full Marks	No of Lectures (hours)	CREDIT (Lecture – Tutorial - Practical) (L-T-P)
	SPECIAL PAPER: **The students have to select any one of the following subjects (A-J), as proposed by the department, likely to be offered as elective special papers.**				
	RSGE505A0	THEORETICAL CONSIDERATIONS OF GEO-INFORMATICS IN COASTAL MANAGEMENT	25	20	2 (1-1-0)
	RSGE506B0	POTENTIAL APPLICATION AREAS OF RS/GIS IN COASTAL MANAGEMENT	25	20	2 (1-1-0)
	RSGE507C0	GEO-INFORMATICS IN WATERSHED MANAGEMENT	25	20	2 (1-1-0)
	RSGE508D0	REMOTE SENSING IN WATER RESOURCE EVALUATION	25	20	2 (1-1-0)
	RSGE509E0	FUNDAMENTALS OF EARTH SYSTEM	25	20	2 (1-1-0)
	RSGE510F0	APPLICATION OF GEO-INFORMATICS IN EARTH SCIENCE	25	20	2 (1-1-0)
	RSGE511G0	FUNDAMENTAL CONCEPTS OF HAZARDS AND DISASTERS	25	20	2 (1-1-0)
	RSGE512H0	APPLICATION OF GEO-INFORMATICS IN HAZARDS AND DISASTERS MANAGEMENT	25	20	2 (1-1-0)
	RSGE513I0	FUNDAMENTAL CONCEPTS OF SOIL AND AGRICULTURAL SCIENCE	25	20	2 (1-1-0)
	RSGE514J0	APPLICATION OF GEO-INFORMATICS IN SOIL AND AGRICULTURE	25	20	2 (1-1-0)
	RSGE515K0	GEO-INFORMATICS IN URBAN, RURAL DEVELOPMENT & REGIONAL PLANNING A THEORETICAL CONSIDERATIONS	25	20	2 (1-1-0)
	RSGE516L0	POTENTIAL APPLICATION AREAS OF RS/GIS IN URBAN, RURAL DEVELOPMENT & REGIONAL PLANNING	25	20	2 (1-1-0)
	RSGE517M0	THEORETICAL CONSIDERATIONS IN EVIRONMENTAL SCIENCE AND MANAGEMENT	25	20	2 (1-1-0)
	RSGE518N0	APPLICATION OF REMOTE SENSING AND GIS IN EVIRONMENTAL SCIENCE AND MANAGEMENT	25	20	2 (1-1-0)
	RSGE519O0	GEO-INFORMATICS IN RESOURCE MANAGEMENT	25	20	2 (1-1-0)
	RSGE520P0	APPLICATION OF REMOTESENSING AND GIS IN RESOURCE MANAGEMENT	25	20	2 (1-1-0)
	RSGE521Q0	GEO-INFORMATICS IN TRANSPORT NETWORK ANALYSIS	25	20	2 (1-1-0)
	RSGE522R0	APPLICATION OF REMOTESENSING AND GIS IN TRANSPORTATION	25	20	2 (1-1-0)
	RSGE523S0	GEO-INFORMATICS IN UTILITY MANAGEMENT	25	20	2 (1-1-0)
	RSGE524T0	APPLICATION OF REMOTE SENSING AND GIS IN UTILITY MANAGEMENT	25	20	2 (1-1-0)
	RSGC525X9	APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISSION SUPPORT SYSTEM (Practical)	25	40	2 (0-0-2)
	RSGC526X9	GENERATION OF CASE STUDIES & COMMUNITY ENGAGEMENT (COMPULSORY FIELD STUDY) (Practical)	25	40	2 (0-0-2)
	RSGC527X9	GEOSTATISTICS (Practical)	25	40	2 (0-0-2)
	RSGC528X9	PRACTICAL (based on selected Special Paper)	25	40	2 (0-0-2)
	TOTAL		275	300	22
IV	RSGC551X0	DISSERTATION EXAMINATION	100	120	8 (0-0-8)
	RSGC552X9	DISSERTATION-VIVA	75	60	6 (0-0-6)
	RSGC553X9	GRAND -VIVA	100	120	8 (0-0-8)
	TOTAL		275	300	22
	GRAND TOTAL		**1100**	**1200**	**88**

The total credit for the course is 88 and the total mark is 1100.

Distinctive features of course content:

- **Value-added course: RSGO405VC, RSGC406X0, RSGC407X0**
- **Employability / entrepreneurship/ skill development: RSGC401X0, RSGC402X0, RSGC403X0, RSGC404X0, RSGO405VC, RSGC406X0, RSGC407X0, RSGC409X9, RSGC410X9, RSGC411X9, RSGC459X9, RSGC460X9, RSGC461X9, RSGO501X0, RSGC502X0, RSGC528X9, RSGC551X0, RSGC552X9**
- **Ethics, environment & sustainability: RSGC502X0, RSGC503X0, RSGE509E0, RSGE510F0**
- **The new course introduced: RSGC456X0, RSGC461X9, RSGC502X0, RSGC526X9**
- **Field Survey (academic excursion): RSGC411X9, RSGC527X9**
- **Internship (optional): RSGC551X0**

Important Note:

- *The intake capacity of each special paper (SEM-III) will be decided by the Departmental Committee before commencement of SEM-III classes.*
- *First class 60 %, Second Class 50 %, No third class. Min marks for passing Theory 20, Practical 13.*
- *Field work & community engagement is compulsory for Students of semester – I and III*
- *Internal assessment will be based on seminar presentation, class tests, quiz and assignments.*
- *Students will get maximum 5 months to complete his/her dissertation work in semester-IV.*
- *Students may visit their field of study during dissertation work at their own expenses.*
- *Students may have to carry out Dissertation works in an outstation institution at their own expenses.*
- *Grand viva will be based on the overall understanding of the subject.*

SEM I PAPERS

SEM -I THEORY

RSGC401X0: Fundamentals & Physics of Remote Sensing:
Course Outcome:
After completion of this course, students will be able to:

- Students will learn the concept, scope, and operational process of remote sensing systems, along with their characteristics, advantages, and limitations.
- They will be able to interpret the principles of electromagnetic radiation (EMR) by relating wavelength, frequency, and energy, and analyze EMR spectrum, atmospheric windows, and spectral signatures for remote sensing applications.
- Students will acquire knowledge on application of radiation laws (Stefan–Boltzmann, Wien's, and Kirchhoff's) to differentiate between black body and real body radiation, and solve numerical problems related to radiant and kinetic temperatures.
- The concept on energy interactions within the atmosphere including scattering, absorption, transmission, and their impact on remote sensing data quality.
- They will be able to evaluate energy interactions with Earth's surface features by interpreting spectral reflectance curves and signatures of vegetation, soil, and water for resource monitoring and environmental studies.

RSGC401X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Fundamentals & Physics of Remote Sensing:

i. *Concept and Scope of Remote Sensing:* Definitions, Process and Characteristics of Remote Sensing System, Advantages and limitations.
ii. *Concept of Electromagnetic Radiation (EMR):* Wavelength-frequency-energy relationship of EMR, EMR Spectrum and its properties, EMR wavelength regions and their applications, Atmospheric windows, Interaction of EMR with matter, Spectral signatures.
iii. *Fundamental laws governing the science*: Sources of Energy, Radiation laws: Stefan-Boltzmann law, Wien's law, Kirchhoff's law etc., Black body and Real body, Radiant temperature & Kinetic temperature ***(Numerical problems of all above)***
iv. *Energy Interaction in the atmosphere:* Scattering, absorption, transmission, atmospheric windows
v. *Energy Interactions with Earth Surface Features:* Spectral Reflectance Curve, Concept of signatures

Internal Assessment (5)

RSGC402X0: Platforms and Sensors:
Course Outcome:
After completion of this course, students will be able to:

- Describe sensor materials and scanning systems including framing, whiskbroom, push-broom, and side-looking scanners used in remote sensing.
- Differentiate types and characteristics of sensors (imaging vs. non-imaging, active vs. passive) and evaluate their resolution properties (spectral, spatial, radiometric and temporal), scale, and multi-band concepts including false colour composites.

- Analyze remote sensing platforms and satellite orbits (ground, airborne, space borne) and explain orbital characteristics such as coverage, passes, pointing accuracy, and types of orbits (geostationary, sun synchronous, shuttle, Molniya, quasi-zenith).
- Apply orbital mechanics and satellite basics by using Kepler's laws to calculate orbital parameters (major axis, eccentricity, velocity, period, escape velocity) and understand payloads and launch vehicle systems.
- Evaluate space imaging satellite systems and their applications by studying multispectral, hyperspectral, radar, and lidar sensors, along with specifications of popular satellites (IRS, Landsat, SPOT, IKONOS, Cartosat, QuickBird, OrbView, GeoEye, Pléiades).

RSGC402X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Platforms and Sensors:

i. *Introduction:* Sensor materials, Sensor System - Framing and Scanning System, Whiskbroom scanners, Push-broom scanners, Side Looking scanner

ii. *Types and Characteristics of Sensor:* Imaging and non-imaging sensors, Active and passive sensors, Resolution of Sensors - *Spectral*, Spatial, Radiometric & Temporal, Scale, Mapping unit, multi-band concepts and False Colour Composites

iii. *Remote Sensor Platforms and Satellite Orbits:* Ground, Airborne and Space borne Platforms, Orbital Characteristics – Coverage, Passes, Pointing Accuracy, Geostationary, sun synchronous, shuttle orbit. Semi synchronous orbit (Molniya orbit) and Quasi-zenith satellite orbit

iv. *Satellite Basics:* Kepler's laws, Major-Semimajor axis & Eccentricity, Velocity, Period (Numerical problems), Historical development, Launch Vehicle, Escape Velocity Payload.

v. *Space Imaging Satellites:* Early history of space imaging; Multispectral and Hyperspectral sensors, Radar, Lidar; Specification of some popular satellites – IRS, Landsat and SPOT series; High resolution satellites – IKONOS, Cartosat, Quickbird, OrbView, GeoEye, Pléiades, WorldView; Other latest earth resource satellites.

Internal Assessment (5)

RSGC403X0: Fundamentals of Geographic Information System:
Course Outcome:
After completion of this course, students will be able to:

- Fundamental Understanding of GIS Concepts: Students will understand the basic concept of Geographic Information Systems (GIS) and identify its key components, applications, advantages, and limitations.
- Differentiate Data Types: Students will be able to distinguish between spatial and attribute data, and analog vs. digital formats, understanding the importance of spatial elements.
- Explain Data Structures: Students will be able to explain the differences between raster and vector data structures, along with their advantages and disadvantages in various applications.
- Manage GIS Data: Students will develop skills to create GIS databases, understand file organization, implement data rectification, and utilize data input methods like digitizing and geocoding.
- Identify Modern Trends: Students will be able to identify and discuss current trends in GIS technology, discussing 3D GIS, Web GIS, and Mobile GIS, and their implications

for spatial analysis and mapping.

RSGC403X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Fundamentals of Geographic Information System:

i. *Basic Concepts:* definition of GIS, Components of GIS, Areas of GIS application, Advantage and Limitation of GIS
ii. *GIS Data:* Spatial and Attribute Data, Analog vs. Digital data, Spatial/Graphical elements of GIS, Nature and Source of data in GIS: Spatial and Attribute data capture and linking
iii. *Information Organization and Data Structures:* Raster and Vector data structures, advantages and disadvantages
iv. *Creating GIS Database:* GIS Software, file organization and formats, Rectification; Methods of Data Input: Keyboard entry, Manual digitizing, Semi-automatic digitizing, Automatic digitizing, Geocoding, Map Composition
v. *Data Editing:* Detecting and correcting errors, Re-projection, Transformation and Generalization, Edge matching and Rubber sheeting, Topology
vi. *Modern Trends in GIS:* 3D GIS, Web GIS and Mobile GIS

Internal Assessment (5)

RSGC404X0: Digital Cartography

Course Outcome:

After completion of this course, students will be able to:

- Comprehend Digital Cartography: Students will be able to articulate the concept of digital cartography and evaluate its advantages and disadvantages compared to traditional mapping practices.
- Concepts and Classifications of Map: Students will be able to identify various map types, understand map scales, and learn about coordinate systems and projections, including LCC and UTM.
- Measure Geographic Variables: Students will understand nominal, ordinal, interval, and ratio scales to measure geographic variables, enhancing mapping and analytical skills.
- Differentiate Data Type: Students will be able to distinguish between qualitative and quantitative data, discrete and continuous data, and understand absolute and derived data in digital cartography.
- Implement Digital Mapping Techniques: Students will develop skills in cartographic design and apply visual variables (shape, color, pattern) to create dot maps, choroplethic maps, and isarithmic mapping, developing effective map-making capabilities.

RSGC404X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Digital Cartography:

i. *GIS and Digital Cartography*: Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography
ii. *Concept of Map:* Defining Map, Classification of maps, Map Scales, Coordinate System and Projections, Lambert Conformal Conic (LCC) and Universal Transverse Mercator (UTM) projection
iii. *Measurement of Geographic Variables:* Nominal, Ordinal, Interval and Ratio Scales
iv. *Types of data*: Qualitative vs. Quantitative data, Discrete vs. Continuous data, Absolute vs. Derived data

v. *Digital Mapping:* Cartographic Design, Concept of Visual Variables (Shape, Size, Orientation, Hue, Value, Chroma, Pattern), RGB colour model, Symbols, Map Lettering, Map Compilation, Map Generalization (Classification, Simplification, Exaggeration, Symbolization, Induction)

vi. Mapping Statistical Surface: Dot map, Choroplethic and Isarithmic Mapping, Dasymetric Mapping, Multivariate and Dynamic Mapping

Internal Assessment (5)

RSGO405VC: INDIAN KNOWLEDGE SYSTEM

Course Outcome:

After completion of this course, students will be able to:

- T he students will learn the very rich and versatile knowledge system and cultural heritage.
- T hey will also learn the historical prospective of ideas occurrence in the ancient Society, and implication to the concept of material world, and religious, social, and cultural beliefs.
- T ribal knowledge as well as indigenous and traditional learning methods which will cover and include mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as governance, polity and conservation

RSGO405VC: INDIAN KNOWLEDGE SYSTEM

Full Marks: 25 Number of lectures to be delivered for each module is 20.

Indian Knowledge System (IKS):

i. Introduction and foundational concepts of IKS: various streams of knowledge in India and classification of ancient Indian texts, Psychology from Indian perspective, Yoga and Indian Linguistics: Introduction to Yoga; theory of emotions, Paṇini's contribution to linguistics, Indian.

ii. Mathematics and Astronomy: An overview of Indian mathematics, Development of arithmetic geometry and Trigonometry, Vedic Mathematics and Indian Astronomy, Medicinal traditions in India.

iii. An Introduction to Āyurveda, Indian Architecture and Planning, Traditional measurement system used in Vāstuśāstra and Economics, Management and Governance from Indian perspectives.

- ***Internal Assessment (5)***

RSGC406X0: Surveying and Navigational Satellite System:

Course Outcome:

After completion of this course, students will be able to:

- Recognize the importance of field surveys and ground truth data collection for validating and enhancing the accuracy of remotely sensed data.
- Students will be able to apply conventional field survey techniques such as plane and geodetic surveying (traversing, triangulation, levelling), topographic and cadastral mapping, and operate modern instruments like Total Station.
- They will be able to explain the fundamentals of Global Navigational Satellite Systems (GNSS), including GPS, NAVSTAR, GLONASS, and IRNSS, and analyze their space, control, and user segments.

- Differentiate GPS positioning techniques (absolute vs differential), and evaluate GPS surveying methods, DGPS data processing, and factors influencing positional accuracy.
- Select and operate reference station equipment including GPS receivers, antennas, and radio communication systems for high-accuracy geospatial data acquisition.

RSGC406X0:

Full Marks: 25 Number of lectures to be delivered for each module is 20.

Surveying and Navigational Satellite System:

iv. *Validation of Data:* Importance of Field Survey, Collection of Ground Truth.

v. The Planet Earth, Geoids, Concept of Spherical Geometry and Geodesy, Reference Spheroid and Mean Sea Level. Introduction to different spheroid / ellipsoid systems with special reference to Everest and WGS-84 - Geometric Constants.

vi. *Introduction to conventional field survey techniques:* Plane and Geodetic Surveying (Traversing, Triangulation and Levelling), Topographic, Cadastral; Total Station

vii. *Global Navigational Satellite System:* Introduction, Satellite constellation, GPS signals and data, Geopositioning-Basic Concepts. GPS, NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS), Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning

viii. *GPS Surveying Methods and Accuracy:* Methods: PPK, RTK, Positioning Modes, Factors Affecting signal error & GPS Accuracy.

ix. *Reference Station:* Selection of Reference Station, CORS & NTRIP, Reference Station Equipment: GPS receiver, GPS antenna, Radio Antenna.

Internal Assessment (5)

RSGC407X0: Introduction to Python Programming for Geospatial Analysis:

Course Outcome:

After completion of this course, students will be able to:

- Understand Python Basics: Students will learn the fundamentals of Python, including setting up the programming environment, understanding syntax, data types, and data structures.
- Utilize Control Structures: Students will be able to implement control structures by using conditional statements and loops to facilitate decision-making and iteration in their programming tasks.
- Master Functions and Modules: Students will learn call functions, work with modules and packages, and import libraries, gaining familiarity with libraries specifically for remote sensing and GIS applications.
- File Handling Skills: Students will develop skills in reading from and writing to files, manage different file formats, and handle exceptions to ensure robust programming practices.
- Apply Programming Concepts: Students will be able to integrate the acquired skills to solve practical problems in remote sensing and GIS, enhancing their programming and analytical capabilities.

RSGC407X0:

Introduction to Python Programming for Geospatial Analysis:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Introduction to Python Programming:

i. Introduction to Python programming, syntax and data types, Data structures.

ii. Control Structures, Conditional statements, Loops.
iii. Defining and calling functions, Modules and packages, Importing and using libraries, Introduction to Libraries for Remote Sensing and GIS.
iv. Reading and writing files, Summarization, visualization and basic descriptive statistical analysis from data.

Internal Assessment (5)

SEM -I PRACTICAL

RSGC409X9 (Practical)
FUNDAMENTALS OF IMAGE PROCESSING & INTERPRETATION (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2hours. Pattern of setting questions: 20 marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Course Outcome:

After completion of this course, students will be able to:

- Perform file import, export, and format conversion for handling remote sensing and GIS datasets across different platforms.
- Create and interpret False Colour Composites (FCCs) for visual identification of land features and resource mapping.
- They will be able to apply image registration, geocoding, and map projections to align satellite images with geographic coordinate systems and generate regions of interest (ROIs).
- Students will have efficiency in image subsetting, clipping, and mosaicking of aerial photographs and satellite imagery for area-specific analysis.
- Analyze image statistics and histograms, and generate spectral signature curves for feature identification and classification in digital image processing.

i. Familiarization with hard copy and soft copy images, Introduction to different GIS and RS software, Concept of bands and channels, True colour, false colour and standard false colour composite, Physical and cultural features identification from imageries, Ground based observation equipment -Radiometer, Spectrophotometer, Use of spectro-radiometer for ground truth.

ii.

Topic to be covered	**Available Software's**
File export import/ translation, Conversion of file formats	
False colour composite and visual identification	
Image registration / Geo coding, Projection, Creating Region of Interest	
File sub setting /clipping Mosaic Air photo and Images	
Feature identification and signature curve generation	
Image Statistics, Histogram	

(20)

Practical Notebook and Viva Voce (5)

RSGC410X9 (Practical)
FUNDAMENTALS OF GIS (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2hours. Pattern of setting questions: 20 marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Course Outcome:

After completion of this course, students will be able to:

- Geo-Database Creation: Students will learn to create and manage geo-databases, including importing, exporting, and subsetting data effectively for spatial analysis.
- Geo-Referencing and Projections: Students will understand geo-referencing techniques and the process of changing projections to ensure accurate spatial representation of geographic data.
- Digitization Techniques: Students will acquire skills in digitizing geographic features by creating points, lines, and polygons to build accurate and detailed spatial datasets.
- Attribute Table Management: Students will manage attribute tables effectively, applying techniques for thematic mapping to visualize and analyze spatial relationships within the data.
- Map Composition Skills: Students will engage in map composition and representation, learning best practices for designing informative and visually appealing maps for various audiences.

Topic to be covered	
Creating Geo-Database: Import, Export, subset	
Managing Geo-Database, Geo-referencing & Changing Projection	
Digitization: Point, Line, Polygon	**Available Software's**
Managing attribute table and thematic mapping	
Map composition and representation	

(20)

Practical Notebook and Viva Voce (5)

RSGC411X9 (Practical)
COMPULSORY FIELD SURVEY

Course Outcome:

After completion of this course, students will be able to:

- **Prepare base maps** from Survey of India Toposheets and delineate various topographical features for geospatial analysis.
- **Operate GPS receivers** by performing initial settings, creating codes and attribute tables, and collecting point, line, and area data using different datum's.
- **Process and manage GPS data** including area calculation, post-processing, attribute table creation, and data export using GPS Pro software.
- **Integrate GPS data with GIS platforms** to generate spatial outputs and enhance mapping applications.
- **Conduct field validation of satellite imagery** to verify remotely sensed data and improve classification accuracy.

RSGC411X9 (Practical)
COMPULSORY FIELD SURVEY (25 marks)

Full Marks: 25. Compulsory field survey

Field survey and field report preparation (compulsory) using following methods

i. Preparation of Base map from Survey of India Toposheets, Use of India topographical sheets for delineation of different features.

ii. Introduction to a GPS and initial setting, creating codes and attribute table for GPS receiver, Point Data collection using GPS with different datum, Line data collection using GPS and measurements, GPS data collection for area calculation, Post processing of the GPS data, Creating attribute table in GPS software and Export functions, GPS and GIS integrations output preparation

iii. Field validation of satellite imagery. (20)

iv. Viva voce and Report presentation (5)

RSGC412X9 (Practical)
PYTHON PROGRAMMING (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches). Examination Time: 2 hours. Pattern of setting questions: 20 marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Course Outcome:

After completion of this course, students will be able to:

- Demonstrate foundational Python proficiency by writing scripts using basic syntax, data types, operators, and control structures.
- Apply Python data structures such as lists, tuples, and dictionaries, and utilize libraries like NumPy and Pandas for efficient data management and statistical analysis.
- Create data visualizations using Matplotlib to generate plots, graphs, and charts for interpreting datasets.
- Analyze relationships between variables using correlation techniques and apply

statistical methods to support data-driven decision-making.

- Develop modular and reusable Python code to solve real-world problems through structured programming and automation of data analysis tasks.

RSGC412X9 (Practical)
PYTHON PROGRAMMING (25 marks)

i. Setting up the environment, Basic syntax and data types, Variables and operators, Simple input and output operations.
ii. Data Structures: Working with lists, tuples, - Slicing and indexing List comprehensions.
iii. Conditional Logic and Loops: Writing scripts with if, elif, and else, implementing for and while loops, Combining loops with conditional statements.
iv. Functions and Modules: Defining and calling user-defined functions- Importing and using standard and external libraries, Introduction to NumPy and Pandas.
v. Reading from and writing to text files (.txt), Working with CSV files using Pandas, File export import.
vi. Descriptive Statistics: Summarizing data using Pandas (.describe(), etc.), Calculating mean, median, mode, and standard deviation. Creating various plots using Matplotlib.

(20)

Practical Notebook and Viva Voce (5)

SEM II PAPERS

SEM -II THEORY

RSGC451X0: Fundamentals of Digital Image Processing:

Course Outcome:

After completion of this course, students will be able to:

- Explain Image Formation: Understand digital image creation, including sensing, acquisition, sampling, quantization, and basic pixel relationships.
- Apply Mathematical Tools: Utilize linear/nonlinear operations, matrix algebra, and probability to transform and model image data.
- Analyze Image Statistics: Interpret histograms and scattergrams using univariate and multivariate statistics, including central tendency, Kurtosis, and correlation matrices.
- Execute Pre-processing: Perform geometric and radiometric corrections, including image rectification, registration, and calibration, to mitigate data errors.
- Implement Resampling: Apply intensity interpolation and resampling techniques to maintain data fidelity during image restoration and transformation.

RSGC451X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Fundamentals of Digital Image Processing:

i. *Introduction:* Definition of digital image, Source of Data, Data loading, Image Restoration, Image Reduction and Magnification. Image Sensing and Acquisition, Digital Image Formation Model, Image Sampling and Quantization, Representing Digital Images, Basic Relationships Between Pixels

ii. *Basic Mathematical Tools Used in DIP:* Linear Versus Nonlinear Operations, Arithmetic Operations, Set and Logical Operations, Vector and Matrix Operations, Probability and Random Variables.

iii. *Digital Image Characteristics:* Image histogram and scattergram and their significance, Univariate Image Statistics: Central Tendency, Dispersion, shape of the data distribution (Kurtosis), Multivariate Image Statistics: Variance-Covariance matrix, Correlation matrix, and their significance.

iv. *Image Pre-processing:* Sources of Geometric Errors and their Correction: Image Rectification and Registration, Resampling/ Intensity Interpolation Techniques, Internal and External Radiometric Errors and their corrections, Radiometric Calibration.

Internal Assessment (5)

RSGC452X0: Image Enhancement & Transformation:

Course Outcome:

After completion of this course, students will be able to:

- Implement Image Enhancement: Apply linear and non-linear intensity transformations, including Min-Max, Logarithmic, and Power-law (Gamma) stretches, to optimize image contrast and color composites.

- Manipulate Histograms: Execute histogram equalization, matching, and intensity level slicing to standardize image brightness and perform binary thresholding for feature extraction.
- Execute Spatial Filtering: Utilize spatial correlation and convolution techniques to apply lowpass (smoothing) and highpass (sharpening) filters for noise reduction and edge enhancement.
- Perform Image Transformations: Conduct advanced data processing using Principal Component Analysis (PCA), discriminant analysis, and color space conversions.
- Generate Indices and Fusion: Calculate spectral indices like NDVI and NDWI, and perform image fusion to integrate multi-source remote sensing data.

RSGC452X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20

Image Enhancement & Transformation:

i. Image Enhancement: Image Reduction and Magnification, Colour Composite, Contrast Enhancement: Linear and Non-linear methods (The Basics of Intensity Transformations, Min max linear stretch, Piecewise linear Contrast Stretch, Image Negative, Percentage linear and Standard deviation contrast stretch), Logarithmic Stretch, Power-law (Gamma) Stretch.

ii. Image Histogram and Thresholding: Histogram Equalisation, Histogram Matching (Specification), Thresholding (binary jump), Intensity level slicing.

iii. Spatial Enhancement: Spatial Correlation and Convolution, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters.

iv. Image Transformation: Principal Component Analysis (PCA), Discriminant Analysis, Colour transformations (RGB - IHS, CMYK), Indices (Band Ratios, NDVI, NDWI), Image Fusion.

Internal Assessment (5)

RSGC453X0: Information Extraction from Satellite Images:

Course Outcome:

After completion of this course, students will be able to:

- Calibrate the data by collecting field information, interpreting spectral signatures, and preparing training and verification datasets.
- They will be able to differentiate thematic image classification approaches including spectral, spatial, and temporal pattern recognition, and evaluate the strengths and limitations of parametric and non-parametric classifiers.
- They will have knowledge to apply unsupervised classification algorithms such as ISODATA and K-means to automatically categorize remotely sensed data.
- Students will be able to implement supervised classification methods including Minimum Distance, Parallelepiped, Maximum Likelihood, and Mahalanobis Distance classifiers for land cover mapping.
- Students will be able to utilize advanced classification techniques and assess accuracy using hybrid methods, ANN, SVM, decision trees, fuzzy classifiers, OBIA, and perform accuracy evaluation through error matrices, Kappa statistics, and change detection analysis.

RSGC453X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Information Extraction from Satellite Images:

i. *Ground Truthing:* Ground Truth Collection for Image Classification, Spectral Signature, Data Calibration, Interpretation of target Properties, Training, Verification.

ii. *Thematic Image Classification:* Spectral Pattern Recognition, Spatial Pattern Recognition, Temporal Pattern Recognition, Parametric and Non-Parametric classifiers, Hard and Soft Classification System, Advantage and Disadvantages of Different Classifiers

iii. *Image Classification:* Unsupervised Classification methods - Isodata, K-mean; Supervised Classification methods - Minimum Distance to Mean, Parallelepiped, Maximum Likelihood, Mahalanobis Distance

iv. *Advanced Classification Techniques:* Hybrid Classification, ANN, Spectral Mixture Analysis, Fuzzy Classifiers, Spectral Angle Mapper, Decision Tree, Support Vector Machine, Object Based Classification.

v. *Accuracy Assessment:* Reference Data, Sampling techniques, Error of Commission and Omission, Error Matrix, Kappa Statistics and Change Detection Analysis

Internal Assessment (5)

RSGC454X0: Thermal and Microwave Remote Sensing:

Course Outcome:

After completion of this course, students will be able to:

- Explain the principles of thermal remote sensing by applying physical radiation laws, understanding blackbody radiation, emissivity, and thermal infrared atmospheric windows, and analyzing terrain–thermal interactions.
- Students will be able to interpret thermal remote sensing imageries including detectors, radiometers, scanners, and apply geometric and radiometric calibration for thermal data analysis.
- Students will be able to describe the fundamentals of microwave remote sensing and compare active and passive microwave systems with their advantages and applications.
- The will acquire knowledge on microwave interactions with Earth's surface including attenuation, surface and volume scattering, vegetation and water response, and evaluate the role of antennas, platforms, and environmental factors.
- Students will be able to apply radar remote sensing techniques by understanding polarization, spatial resolution, image geometry, relief displacement, shadows, speckle effect, and advanced systems like SLAR, SAR, and differential interferometry for Earth observation applications.

RSGC454X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Thermal and Microwave Remote Sensing:

i. *Thermal Remote Sensing:* Basic Principles, Physical Laws, Blackbodies and Emissivity, Thermal Infrared Radiation Properties, Thermal Infrared Atmospheric Windows, Interaction of Thermal Radiation with Terrain Elements.

ii. *Thermal Data Processing:* Thermal Energy Detectors, Thermal Radiometers, Thermal Scanners, Interpreting Thermal Scanner imaginary, Geometric Characteristics of Thermal Scanner Image, Applications.

iii. *Microwave Remote Sensing:* Basic Principles, Microwave Remote Sensing and its advantages, Active and Passive Microwave Systems.

iv. Attenuation of Microwave, Surface Scattering, Volume Scattering, Types of Antenna, Platforms and sensors, RADAR Environmental Considerations: Surface Roughness Characteristics, Electrical Characteristics, Vegetation and Water response to Microwave energy

v. Radar Operation, Polarization, Spatial Resolution, Radar Image Geometry, Relief Displacement, Shadows and Speckle effect, Side Looking Airborne Radar (SLAR) Operation, Synthetic Aperture Radar (SAR), Differential Interferometry, Applications.

Internal Assessment (5)

RSGC455X0: Hyperspectral Remote Sensing and LIDAR:

Course Outcome:

After completion of this course, students will be able to:

- Comprehend Hyperspectral Remote Sensing: Understand the principles, advantages, disadvantages, and differences between hyperspectral and multispectral systems, including sensor specifications.
- Learn Data Processing Techniques: Acquire skills in atmospheric corrections, bad band and line removal, and information extraction methods like endmember collection and image classification.
- Explore Applications in Various Fields: Investigate practical applications of hyperspectral data in agriculture, water management, soil analysis, and mining to derive valuable insights.
- Understand LIDAR Technology: Grasp the fundamental principles of LIDAR, including laser scanning systems, types of returns, and post-processing for accuracy enhancement.
- Analyze LIDAR Applications: Examine LIDAR applications in vegetation monitoring and urban infrastructure, recognizing its significant impact on environmental analysis and urban planning.

RSGC455X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Hyperspectral Remote Sensing and LIDAR:

i. *Hyperspectral Remote Sensing:* Basic Concept, Advantages and Disadvantages, Multispectral vs. Hyperspectral Remote Sensing, Basic principles of Spectroscopy, Hyperspectral sensors and platforms, Sensor specifications

ii. *Hyperspectral Data Processing and Information Extraction:* Atmospheric Corrections-Empirical and Physics based Approaches, Bad band and Bad line removal; Information extraction: Endmember collection, Minimum Noise Fraction, Pixel Purity Index, N-D visualizer, ground truthing through Spectro-radiometer, Image Classification techniques

iii. *Application of Hyperspectral Data:* Application in Agriculture, Water, Soil and Mining

iv. *LIDAR:* Basic Principles and advantages, Laser and Scanning System, Laser Location, LIDAR Antenna Attitude, Types of LIDAR returns, LIDAR post processing of multiple returns, Accuracy of LIDAR measurements, The Laser Vegetation Imaging Sensor

v. *Applications of LIDAR Data:* Areas of Applications with special reference to Vegetation and Urban Infrastructure

Internal Assessment (5)

RSGC456X0: Advanced GIS

Course Outcome:

After completion of this course, students will be able to:

- Understand and explain advanced GIS data storage structures such as spaghetti model, topological model, and quadtree, and their role in spatial data representation.
- Describe and compare different database models including hierarchical, network, and relational models, and apply appropriate data organization techniques such as chain coding, run-length coding, and block coding.
- Evaluate spatial data quality by analyzing uncertainty, positional and attribute accuracy, logical consistency, completeness, and lineage in GIS databases.
- Identify sources of errors in GIS databases, including measurement, processing, and overlay errors, and assess their impact on spatial analysis and decision-making.

RSGC456X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Advanced GIS

i. *Data Storage:* Spaghetti Model, Topological Model, Quadtree
ii. *Database Modelling:* Hierarchical Model, Network Model, Relational Model
iii. *Data Organization:* Chain Coding, Run-length Coding, Block Coding
iv. *Data Quality in GIS:* Uncertainty in GIS data, Positional and Attribute Accuracy, Logical consistency, Completeness Lineage,
v. *Errors in GIS:* Sources of Errors in GIS data base: Obvious sources from natural variations & original measurements, Errors through processing, errors associated with overlaying of polygons, Data Quality parameters

Internal Assessment (5)

RSGC457X0: Modeling Spatial Database and Analysis

Course Outcome:

After completion of this course, students will be able to:

- Understand the concepts of spatial databases, geodatabase models, and database management systems, including entities, relationships, primary keys, and database structures used in GIS.
- Apply spatial database management and GIS query techniques, including attribute queries, spatial queries, and data manipulation methods for efficient storage, retrieval, and management of spatial data.
- Perform spatial analysis using GIS tools such as overlay operations, buffering, neighbourhood analysis, connectivity analysis, interpolation, and weighted analysis for solving real-world geographic problems.
- Develop basic spatial models using map algebra, functional operations, and flowcharting techniques to support spatial decision-making and geospatial problem solving.

RSGC457X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Modeling Spatial Database and Analysis

i. Role of databases in GIS, Methods of GIS analysis, Selection of GIS applications, Basics of the Geodatabase Model Geodatabase concepts. Types of Geo-database used in GIS.

ii. *Spatial Database Management:* Concept of Spatial Database, Database Management System, Basic Concepts of Entity, Relationship and Primary Key, Database Structure.

iii. *Spatial Analysis:* Types of Spatial Analysis, Data services, Measurement in GIS, Query – Query by Attributes, Spatial Queries, Attribute based Operation, Neighbourhood Analysis, Connectivity Analysis, Overlay and Coverage Rebuilding, Geo-coding.

iv. Data Manipulation Techniques, Overlay Operations and Buffering, Neighbourhood functions, Interpolation methods, Factors and Weights, Methods of Spatial analysis.

v. Introduction to Modeling & Flowcharting, Map Algebra – Types, Operators & Operations, Functional Operations, Surface Modeling.

Internal Assessment (5)

SEM -II PRACTICAL

RSGC458X9 (Practical)
DIGITAL IMAGE PROCESSING (25 marks)
Course Outcome:
After completion of this course, students will be able to:

- Apply geometric and atmospheric corrections to improve the positional and radiometric accuracy of satellite images.
- Students will be able to enhance and filter imagery using advanced image processing techniques for better visualization and feature extraction.
- Students will learn implementation of advanced classification algorithms for accurate land use/land cover mapping and resource assessment.
- Conduct accuracy assessment and ground truthing using spectroradiometer data, and evaluate classification reliability through statistical measures.
- Perform raster calculations and modeling by applying algorithms for spatial analysis, simulation, and predictive modeling in remote sensing applications.

RSGC458X9 (Practical)
DIGITAL IMAGE PROCESSING (25 marks)

Full Marks: 25.At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20 marks compulsory questions are to be set. 5marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Topic to be covered	
Geometric and Atmospheric Correction	**Available Software's**
Image enhancement and filtering	
Advanced classification techniques	
Accuracy assessment, ground truthing with spectroradiometer	
Algorithm Liberation, Raster calculation, Modeling.	

(20)

Practical Notebook and Viva Voce (5)

RSGC459X9 (Practical)
ADVANCED REMOTE SENSING: DATA PROCESSING & APPLICATIONS (25 marks)

Course Outcome
After completion of this course, students will be able to:

- Develop proficiency in atmospheric and radiometric correction, image enhancement, and filtering techniques for multispectral optical data, along with hyperspectral data processing, including bad band removal and the application of FLAASH models.
- Explain the collection and identification of endmembers, and perform advanced hyperspectral data analysis techniques such as Minimum Noise Fraction (MNF) transformation and Pixel Purity Index (PPI).
- Conduct various image classification methods—unsupervised, supervised, and advanced techniques—and evaluate classification accuracy using metrics like the contingency matrix and class separability measures.
- Understand and generate Stereo-SAR Digital Elevation Models (DEMs) and interpret radar imagery through speckle suppression, interferogram generation, and texture

analysis.

RSGC459X9 (Practical)

ADVANCED REMOTE SENSING: DATA PROCESSING & APPLICATIONS (25 marks)

Full Marks: 25.At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20 marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Topic to be covered	
Atmospheric and Radiometric Correction, Image enhancement and filtering of multispectral optical data	**Available Software's**
Hyperspectral data processing, Bad band and bad line removal, FLAASH model, Endmember collection, MNF, PPI	
Image classification (Unsupervised, Supervised and advanced)	
Accuracy assessment, Class separability & contingency Matrix	
Stereo-SAR DEM generation, Rader image interpretation: Speckle suppression, Interferogram generation, Texture analysis, Texture & Object based classification.	

(20)

Practical Notebook and Viva-Voce (5)

RSGC460X9 (Practical)

ADVANCED GEOGRAPHIC INFORMATION SYSTEM

Course Outcome:

After completion of this course, students will be able to:

- Perform vector data management operations including export, editing, and handling attribute tables for geospatial datasets.
- Create thematic maps, charts, and diagrams by applying query operations in vector layers using SQL.
- Apply vector-based spatial analysis techniques such as network analysis, neighbourhood functions, buffering, and proximity analysis (Thiessen polygons).
- Use GIS software tools to carry out vector data processing and geospatial modeling tasks effectively.
- Conduct topographic and morphometric analysis by generating contours, isopleths, and deriving terrain-related information.

RSGC460X9 (Practical)

ADVANCED GEOGRAPHIC INFORMATION SYSTEM (25 marks)

Full Marks: 25.At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Topic to be covered	
Vector data Export, Vector Editing, Managing Attribute Table, Thematic Maps	
Charts and Diagrams generation Select and Query in vector layers, Use of SQL,	
Network, Neighbourhood, Buffer, Proximity [Thiessen polygon]	**Available Software's**
Topographic & Morphometric analysis: Contours & Isopleths generation.	

(20)

Practical Notebook and Viva Voce (5)

RSGC461X9 (Practical)

MODELING SPATIAL DATABASE AND ANALYSIS

Course Outcome:

After completion of this course, students will be able to:

- Perform image-to-image geo-referencing and create different types of geodatabases with proper topology building.
- Inspect and correct spatial database errors and apply data manipulation techniques to maintain data accuracy and consistency.
- Develop GIS-based terrain models such as Digital Elevation Model (DEM), Digital Terrain Model (DTM), and Triangulated Irregular Network (TIN) for topographic analysis.
- Apply vegetation, built-up, water, and terrain indices such as NDVI, NDBI, SAVI, NDWI, and TWI for environmental monitoring and resource assessment.
- Integrate geospatial data into GIS-based models to support environmental analysis, decision-making, and sustainable resource management.

RSGC461X9 (Practical)

MODELING SPATIAL DATABASE AND ANALYSIS (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches). Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Topic to be covered	**Available Software's**
Creation of Different types of Geo-Data base, Topology building, Errors Inspections, Corrections of errors in spatial database, Data manipulation techniques.	
Fishnet Creation, Raster values Extraction.	
Model Building, GIS based models: DEM, DTM, TIN etc. Different environmental modelling: NDVI, NDBI, SAVI, NDWI, TWI etc.	
Network Model & Network Analysis	

(20)

Practical Notebook and Viva-Voce (5)

SEM III PAPERS

SEM -III THEORY

RSGO501X0: MASSIVE OPEN ONLINE COURSES (MOOC)/SWAYAM

Full Marks: 40

Internal Assessment (10)

Students are required to complete a 4-credit, post-graduate (PG) level MOOC. The specific course must be selected from the available offerings on the SWAYAM platform for the current academic session.

RSGC502X0: Application of Geo-Informatics

Course Outcome:

After completion of this course, students will be able to:

- Students will acquire skills to access, integrate, and analyze diverse geospatial data, enabling the creation of meaningful information layers for solving spatial problems and supporting decision-making.
- They will learn to interpret and apply geospatial techniques to map, analyze, and model natural hazards and disasters such as earthquakes, landslides, floods, droughts, forest fires, and cyclones for risk assessment and management
- Students will utilize remote sensing and GIS methods for agricultural, soil, water resource, and forest management, including habitat analysis, soil quality monitoring, and biomass estimation.
- They will understand application of geospatial techniques for analyzing surface and sub-surface water data, and implement hydrological modeling techniques for effective water resource management
- They will explore GIS and remote sensing tools to identify forest types, estimate canopy cover, tree height, biomass along with urban spatial analysis, focusing on urban growth, green spaces.

RSGC502X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Geo-Informatics:

i. *Natural hazards and disasters:* Application of geospatial techniques in mapping and modeling Earthquake, Landslide, Flood, Drought, Forest fires, Cyclone
ii. *Agriculture and soils:* Crop inventory mapping, crop type identification, environmental factors for aquaculture development, mapping and monitoring soil quality
iii. *Water resources:* Surface and sub-surface water resource evaluation, different hydrological modeling for water resource management
iv. *Forestry:* Identification of forest type, canopy cover and height estimation, biomass estimation
v. *Urban studies:* Mapping built-up area and expansion, urban planning, urban green space dynamics, urban climate

Internal Assessment (5)

RSGC503X0: Spatial Data Science and SDSS

Course Outcome:

After completion of this course, students will be able to:

- The students will understand the fundamental concepts of Spatial Data Science, including its application areas, key machine learning (ML) and deep learning (DL) techniques, and their role in predictive analysis, along with challenges faced in ML and DL applications.
- They will explore advanced trends in spatial data analytics, such as Geospatial Artificial Intelligence and the utilization of Big Data within GIS, recognizing their potential to enhance spatial analysis and decision-making.
- The students will be able to comprehend the principles and characteristics of Spatial Decision Support Systems (SDSS), including types of decision problems, decision-making phases, and integration of GIS within SDSS frameworks.
- They will learn multicriteria decision analysis (MCDA), including the use of criterion standardization, weighting via pairwise comparison, and decision rules such as the Simple Additive Weighting method.
- The students will be able to apply spatial decision-making tools and techniques to real-world problems, facilitating informed and effective spatially-enabled decisions.

RSGC503X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Spatial Data Science and SDSS:

i. *Introduction to Spatial Data Science:* Basic concept and application areas, Key Elements and types of Machine Learning (ML) techniques, predictive analysis through ML, Deep Learning (DL) methods and application areas, Challenges in ML and DL

ii. *Advanced Trends in Spatial Data Science:* Geospatial Artificial Intelligence, concept of Big Data, Potentialities of Big Data in GIS

iii. *GIS and Spatial Decision Support Systems:* Concept and characteristics of Spatial Decision Support Systems (SDSS), Types of Decision Problems, Phases of Decision-Making Process, Spatial Decision Support Systems (SDSS) and GIS, Elements and Structure of Multicriteria Decision Analysis (MCDA)

iv. *Analytic Hierarchy Process:* Standardization of Criterion Maps, Criterion Weighting through Pairwise Comparison method, Decision Rules-Simple Additive Weighting method

Internal Assessment (5)

RSGC504X0: Fundamental of Research and Geospatial Project Management

Course Outcome:

After completion of this course, students will be able to:

- Identify and define research problems effectively and recognize the importance of literature review in formulating research objectives.
- Apply statistical inference techniques including hypothesis testing, model calibration, and validation in research studies.
- Design appropriate sampling strategies for spatial and temporal data collection by understanding steps, methods, and applications of sampling design.
- Implement project management principles by understanding its elements, techniques, and the role of project managers in geospatial and research projects.

- Adopt ethical practices in research by avoiding plagiarism, following research ethics guidelines, and addressing ethical challenges in the use of Artificial Intelligence (AI).

RSGC504X0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Fundamental of Research and Geospatial Project Management

i. *Research Problem:* Identification and Techniques of defining a research problem, significance of literature review
ii. *Statistical Inference for Research:* Concepts and Procedure concerning testing of Hypothesis, Model Calibration and Validation
iii. *Sampling Design:* Steps in Sampling Design, Types of Sampling and their applications in research, Collection of Spatial and Temporal data.
iv. *Project Management* : Definition and elements of Project management, Techniques of Project Management, Roles and attributes for project manager
v. *Research Ethics*: Fundamental ethical practices in research, Types of Plagiarism, Research ethics and artificial intelligence (AI)

Internal Assessment (5)

ELECTIVE SPECIAL PAPER THEORY: (The students have to select any one of the following subjects (A-J), as proposed by the department, likely to be offered as elective special papers)

(*EXAMINATION TIME: 2 HOURS)*

Course Outcome: Students will be able to analyze various tasks to solve the problems in a specified domain.

RSGE505A0: Theoretical Considerations of Geo-Informatics in Coastal Management

RSGE506B0: Potential Application areas of RS /GIS in Coastal Management

RSGE507C0: Geo-informatics in Watershed Management

RSGE508D0: Remote Sensing in Water resource Evaluation

RSGE509E0: Fundamentals of Earth System Science

RSGE510F0: Application of Geo-informatics in Earth System Science

RSGE511G0: Fundamental Concepts of Hazards and Disasters

RSGE512H0: Application of Geo-informatics in Hazards and Disasters Management

RSGE513I0: Fundamental Concepts of Soil and Agricultural Science

RSGE514J0: Application of Geo-informatics in Soil and Agriculture

RSGE515K0: Geo-Informatics in Urban, Rural Development & Regional Planning a Theoretical Considerations

RSGE516L0: Potential Application Areas of RS/GIS in Urban, Rural Development & Regional Planning

RSGE517M0: Theoretical Considerations in Environmental Science and Management

RSGE518N0: Application of Remote sensing and GIS in Environmental Science and Management

RSGE519O0: Geo-Informatics in Resource Management

RSGE520P0: Application of Remote Sensing and GIS in Resource Management

RSGE521Q0: Geo-Informatics in Transport Network Analysis

RSGE522R0: Application of Remote Sensing and GIS in Transportation

RSGE523S0: Geoinformatics in Utility Management

RSGE524T0: Application of Remote Sensing and GIS in Utility Management

RSGE505A0: Theoretical Considerations of Geo-Informatics in Coastal Management

Course Outcome:

After completing this course, students will be able to:

- **Explain** the principles of coastal morphodynamics, including micro, macro, and biogenic forms, and classify coasts based on processes and sediment characteristics.
- **Analyze** coastal biogeography with reference to seaweeds, mangroves, dune vegetation, and corals, and **evaluate** the sources, impacts, and management of coastal pollution through integrated coastal management approaches.
- **Assess** natural coastal hazards such as sea level rise, erosion, sedimentation, and tropical cyclones, and **critically examine** the impacts of coastal engineering structures with strategies for sustainable management.
- **Apply** modern techniques (field, remote sensing, GIS, and modeling) to monitor changes in coastal processes and landforms.
- **Evaluate and design** sustainable management strategies for human utilization of coasts (navigation, mining, fishing, oil exploitation, reclamation, and tourism) while minimizing environmental impacts.

RSGE505A0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Theoretical Considerations of Geo-Informatics in Coastal Management

i. Coastal morpho dynamics: Micro, macro and biogenic forms. Systems of change in coasts: cyclical and progressive. Classification of coasts based on processes and sediment characteristics.

ii. Coastal biogeography with special reference to sea weeds, mangroves, dune vegetation and corals, Coastal pollution: Sources, impacts and management, Integrated Coastal Management: Concepts, techniques and applications.

iii. Natural coastal hazards and their management: Sea level rise, erosion, sedimentation and tropical cyclones, Coastal engineering and its impacts: Ports and harbours, measures for prevention of erosion and sedimentation.

iv. Techniques of monitoring changes in coastal processes and landforms.

v. Human utilisation of coasts, environmental impacts and management: Navigation, mining, fishing and fish-processing, off-shore oil exploitation, reclamation and tourism.

Internal Assessment (5)

RSGE506B0: Potential Application areas of RS /GIS in Coastal Management

Course Outcome:

After completing this course, students will be able to:

- **Identify and evaluate** major environmental issues along the Indian coast and propose suitable management practices.
- **Apply** remote sensing techniques and tools for effective **Coastal Zone Management (CZM)**.
- **Monitor and analyze** surface waters in Coastal Regulatory Zones (CRZ) for regulatory and conservation purposes.
- **Assess** suspended minerals and chlorophyll concentration in coastal waters to understand ecological productivity and water quality.
- **Measure and interpret** Sea Surface Temperature (SST) using modern techniques to study climatic and oceanographic processes.

RSGE506B0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Potential Application areas of RS /GIS in Coastal Management

i. Indian coast: Major environmental issues, problems and their management
ii. Application of Remote Sensing with special reference to Coastal Zone Management
iii. Monitoring Surface waters in Coastal Regulatory Zone (CRZ)
iv. Study of Suspended mineral in water
v. Study of Chlorophyll in water
vi. Measurement of Sea Surface Temperature (SST)

Internal Assessment (5)

RSGE507C0: Geo-Informatics in Watershed Management:
Course Outcome:
After completing this course, students will be able to:

- **Differentiate and analyze** the interactions between surface water and groundwater through hydrogeological interpretation and water deciphering techniques.
- **Conduct** quality inventory and monitoring, and **apply** parametric watershed modeling for assessing water quantity and hydrologic parameters.
- **Explain and perform** morphometric analysis to characterize watershed features and hydrological processes.
- **Apply** hydro-morphogeologic techniques to identify groundwater potential zones and locate aquifers in alluvial, sedimentary, and hard rock terrains.
- **Design and evaluate** watershed management strategies, incorporating soil and water conservation techniques for sustainable resource utilization.

RSGE507C0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Geo-Informatics in Watershed Management:

i. Surface water-ground water, water deciphering
ii. Quality inventory and monitoring, quantity assessment – Parametric watershed modeling – dimensional consideration of basic dynamics – evaluation of hydrologic parameters
iii. Concept of watershed, Morphometric Analysis
iv. Hydro-morphogeologic interpretation techniques for targeting ground water potential zones in alluvial, sedimentary and hard rock areas, location of aquifer
v. Watershed management, techniques of soil and water conservation.

Internal Assessment (5)

RSGE508D0: Remote Sensing in Water resource Evaluation:
Course Outcome:
After completing this course, students will be able to:

- **Assess** drought and flood conditions through floodplain mapping, soil moisture analysis, water quality monitoring, and snow/cloud mapping using geospatial techniques.
- **Estimate** aquatic biodiversity, runoff, and soil loss to evaluate ecosystem health and watershed sustainability.
- **Select and justify** suitable sites for storage and diversion projects, including dam sites, tunnels, and canal alignments based on geomorphic and hydrologic criteria.

- **Analyze** real-world case studies to integrate theory with practical applications in water resource planning and management.

RSGE508D0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Remote Sensing in Water resource Evaluation:

i. Drought & flood Assessment, flood plain mapping, soil moisture, water quality, snow & cloud mapping.
ii. Estimation of Aquatic biodiversity, Runoff and soil loss estimation.
iii. Site location for storage and diversion projects, dam site selection, tunnel and canal alignment
iv. Case Studies.

Internal Assessment (5)

RSGE509E0: Fundamentals of Earth System

Course Outcome:

After completing this course, students will be able to:

- **Explain** the Earth System components (lithosphere, hydrosphere, atmosphere, biosphere) and **analyze** their interactions with tectonic processes, earthquakes, and volcanic activity.
- **Identify and classify** igneous, sedimentary, and metamorphic rocks along with their field and image-based characteristics.
- **Interpret** major rock structures (folds, faults, joints, lineaments) using field data and satellite imagery.
- **Apply** geomorphological concepts to analyze landform development, drainage patterns, and the role of geomorphic agents and processes.
- **Evaluate** satellite image characteristics of different landforms for geological and geomorphological mapping.

RSGE509E0

Full Marks: 25. Number of lectures to be delivered for each module is 35.

Fundamentals of Earth System:

i. *The Earth System:* Concept of Earth System, lithosphere, biosphere, hydrosphere & atmosphere, plate tectonic theory and its relationship to earthquakes, and volcanic activity.
ii. *Rock Types:* igneous, sedimentary and metamorphic rocks, their characteristics, types and forms, delineation on satellite images.
iii. *Rock Structures:* Folds, faults, joints and lineaments, field characteristics, delineation on satellite images and analysis.
iv. *Geomorphology:* Fundamental concepts, geomorphic agents and processes, drainage patterns, classification of landforms. Image characteristics of major landforms.

Internal Assessment (5)

RSGE510F0: Application of Geo-informatics in Earth Science

Course Outcome:

After completing this course, students will be able to:

- **Interpret** visual and digital satellite imagery using elements of image interpretation and digital enhancement techniques for lithological and structural mapping.
- **Apply** digital terrain models in geo-technical engineering for the selection of dam sites, road alignments, and canal construction with environmental considerations.

- **Utilize** multivariate data modeling techniques in geosciences for disaster management, including landslide hazard zonation.
- **Integrate** Rock Information Systems and GIS-based multivariate analysis for mineral targeting and resource exploration.

RSGE510F0

Full Marks: 25. Number of lectures to be delivered for each module is 35.

Application of Geo-informatics in Earth Science:

i. *Visual/ Digital Satellite Image Interpretation:* Elements of image interpretation, Digital image enhancement techniques for lithological discrimination. Application of Remote Sensing in Geological Mapping (both Lithological and Structural)
ii. Geo-technical Engineering & Environmental Management, Digital terrain models for selection of dam site, road, and canal construction.
iii. *Multivariate data modelling:* Concept and application in geosciences: Disaster Management, Landslide hazard zonation
iv. *Mineral targeting:* Rock Information System, GIS based multivariate analysis in mineral targeting.

Internal Assessment (5)

RSGE511G0: Fundamental Concepts of Hazards and Disasters

Course Outcome:

After completing this course, students will be able to:

- **Differentiate** types of hazards and disasters (natural and human-induced), and **analyze** their spatial distribution and zonation.
- **Evaluate** the historical perspective and socio-economic impacts of disasters in India with reference to national losses.
- **Explain and assess** the principles of disaster management and the roles of government, NGOs, and community participation within India's organizational framework.
- **Apply** geoinformatics tools and techniques for disaster monitoring, mitigation, and management.

RSGE511G0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Fundamental Concepts of Hazards and Disasters:

i. *Introduction:* Types of hazards and disasters, characterization, zonation of hazards, natural and human induced disasters.
ii. Disaster and National losses, historical perspective of disasters in India.
iii. *Disaster Management:* Fundamental concept of Disaster Management, government, NGOs and peoples participation disaster management. Existing organization structure for managing disasters in India.
iv. Geoinformatics in disaster mitigation.

Internal Assessment (5)

RSGE512H0: Application of Geo-informatics in Hazards and Disasters Management

Course Outcome:

After completing this course, students will be able to:

- **Explain and analyze** different geological hazards such as landslides, earthquakes, mining hazards, volcanic, groundwater, and glacial hazards.
- **Evaluate** the causes and impacts of hydro-meteorological hazards including floods,

dam bursts, cloud bursts, cyclones, coastal hazards, and droughts.

- **Assess** environmental hazards such as deforestation, forest fires, soil degradation, desertification, and pollution (air, water, and soil).
- **Apply** geospatial techniques for hazard monitoring, zonation mapping, and early warning systems to support disaster preparedness and mitigation.

RSGE512H0:

Full Marks: 25. Number of lectures to be delivered for each module is 35.

Application of Geo-informatics in Hazards and Disasters Management:

i. *Geological Hazards:* Landslide, Earthquake, Mining hazards (subsidence, flooding etc.), Volcanic hazards, Groundwater hazards, Glacial hazards
ii. *Hydro meteorological Hazards:* Flash floods, River floods, Dam burst, Cloud burst, Cyclones, Coastal hazards and Drought
iii. *Environmental hazards:* Forest hazards (Deforestation, Degradation and Forest fire), Land, soil degradation, desertification and Pollution (Water, air and soil)
iv. *Geospatial Applications:* Monitoring and hazard zonation mapping, early warning of natural hazard

Internal Assessment (5)

RSGE513I0: Fundamental Concepts of Soil and Agricultural Science

Course Outcome:

After completing this course, students will be able to:

- **Explain** crop yield parameters and spectral properties of crops, and **apply** remote sensing for crop identification and acreage estimation.
- **Utilize** vegetation indices and digital analysis techniques for production forecasting, monitoring crop conditions, and assessing agricultural case studies.
- **Describe and implement** soil survey methods, soil classification, and land evaluation approaches.
- **Apply** remote sensing techniques for mapping saline and alkaline soils and for sustainable agricultural land management.

RSGE513I0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Fundamental Concepts of Soil and Agricultural Science:

i. Crops, Introduction – Yield parameters- spectral properties of crops- identification of crops and acreage estimation
ii. Vegetation indices production forecasting through digital analysis monitoring and condition assessment – case studies.
iii. Soils, Introduction –Soil Survey methods- soil Classification – land Evaluation- Saline, alkaline soils- mapping using RS data

Internal Assessment (5)

RSGE514J0: Application of Geo-informatics in Soil and Agriculture

Course Outcome:

After completing this course, students will be able to:

- **Identify and analyze** soil problems such as erosion, sedimentation, and degradation, and **evaluate** soil conservation measures using case studies.
- **Detect and assess** crop damage caused by pests, diseases, droughts, floods, waterlogging, and salinity through geospatial and field techniques.

- **Apply** integrated survey methods with a watershed approach for sustainable agriculture, forestry, and resource management.
- **Utilize** GIS tools for preparing action plans in watershed management and agro-climatic modeling.
- **Evaluate** recent developments and case studies in integrated land and water resource planning for sustainable development.

RSGE514J0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Geo-informatics in Soil and Agriculture:

i. Problems soil identification and mapping – Soil sedimentation and erosion- Soil conservation case studies.
ii. Damage assessment, Detection of pest and diseases- damages due to droughts and floods – water-logging and salinity- stress detection.
iii. Integrated surveys, Integrated surveys for sustainable development – watershed approach – Agriculture and forest development,
iv. GIS for drawing out action plans- case studies and recent development in Agro- climatic modelling –watershed planning.

Internal Assessment (5)

RSGE515K0: Geo-Informatics in Urban, Rural Development & Regional Planning a Theoretical Considerations

Course Outcome:

After completing this course, students will be able to:

- **Define and explain** key concepts of urbanization, urbanism, and the growth of urban settlements, with an emphasis on their processes and bases.
- **Analyze** the historical trajectory of urbanization in India and **evaluate** metropolitan development patterns with special reference to West Bengal.
- **Assess** major urban environmental problems and propose strategies for sustainable urban management.
- **Explain and compare** theoretical frameworks of rural development and rural economies under different production systems in developed and developing contexts.
- **Apply and evaluate** growth pole theories and examine regional environmental issues within the broader framework of development geography.

RSGE515K0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Geo-Informatics in Urban, Rural Development & Regional Planning a Theoretical Considerations:

i. Concepts and definitions: urban, urbanization and urbanism,
ii. Origin & growth of urban settlements; bases & process of urbanisation
iii. Urbanization in India: a historical perspective
iv. Features of metropolitan development (with special reference to India), Urban Environmental Problems in West Bengal
v. Theoretical framework of rural development and geographical perspective: Rural economy under different production systems – experiences of developed and developing world with examples.
vi. Growth Pole theories and the developing world, Regional Environmental Issues.

Internal Assessment (5)

RSGE516L0: Potential Application Areas of RS/GIS in Urban, Rural Development & Regional Planning:

Course Outcome:

After completing this course, students will be able to:

- **Analyze** the causes, distribution, and spatial patterns of rural settlements, including nodal service centres, market centres, and the rural–urban continuum.
- **Apply** remote sensing techniques for studying urban landscapes and their spatial dynamics.
- **Evaluate** demographic and infrastructural aspects such as population estimates, housing quality, site suitability, traffic, and parking through geospatial approaches.
- **Conduct** change detection studies to monitor urban and rural transformations using remote sensing.
- **Utilize** remote sensing applications in biological systems to assess environmental and ecological conditions.

RSGE516L0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Potential Application Areas of RS/GIS in Urban, Rural Development & Regional Planning:

i. Analysis of rural settlement: Cause and effect associations, distribution of rural settlement with special reference to size and spacing; Rural service centres – Nodal settlement of market centres and growth centres – Studies on rural urban continuum.
ii. Brief introduction of Remote Sensing applications on Urban landscape
iii. Population estimates, housing quality studies, site selection processes, traffic and parking studies,
iv. Urban & rural change detection studies, Remote sensing applications in Biological systems.

Internal Assessment (5)

RSGE517M0: Theoretical Considerations in Environmental Science and Management

Course Outcome

After completing this course, students will be able to:

- **Explain and analyze** the relationship between water and the environment, and apply remote sensing for monitoring water quality, pollution sources, runoff, snow cover, and flood prediction.
- **Assess** soil-related problems such as erosion, salinity, degradation, and flood damage using Remote Sensing and GIS.
- **Identify and evaluate** the impacts of insects and diseases on soils and crops through geospatial analysis.
- **Examine** urban and rural environmental issues including industrial pollution, chemical effluents, land reclamation, solid waste disposal, and mining pollution.
- **Apply** geospatial tools for environmental monitoring, impact assessment, and sustainable resource management.

RSGE517M0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Theoretical Considerations in Environmental Science and Management:

i. Water and the environment, R.S. of fluorescence- water quality- water pollution- pollution sources- water runoff, Remote Sensing and Water quality management –snow surface cover-flood prediction

ii. Soils and land forms- insects and disease- soil erosion- salinity- flood damage- soil limitation –soil degradation using Remote Sensing and GIS.

iii. Urban environment, General consideration rural structure- urban areas- Impact of industrial pollution- chemical effluents, land reclamation- disposal of solid waste- mining pollution

Internal Assessment (5)

RSGE518N0: Application of Remote sensing and GIS in Environmental Science and Management

Course Outcome:

After completing this course, students will be able to:

- **Explain and apply** ecological concepts in relation to spectral reflectance of vegetation for stress monitoring, forest conservation, wildlife studies, and non-point source pollution assessment using GIS.
- **Utilize** various environmental monitoring sensors (optical, radar, thermal) for studying the marine environment, including oil slick mapping, chlorophyll detection, fisheries resource assessment, and coastal processes.
- **Apply** remote sensing techniques for air pollution monitoring, weather forecasting, and climatological studies with emphasis on emissivity characteristics and case-based applications.
- **Measure and analyze** atmospheric parameters such as temperature, composition, wind flows, and circulation patterns using meteorological satellite data.
- **Evaluate** the applications of geospatial techniques in environmental conservation, marine studies, and global climate monitoring for sustainable resource management.

RSGE518N0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Remote sensing and GIS in Environmental Science and Management:

i. Ecology and ecosystem, Conservation and resource management – spectral reflectance from vegetated surface- Stress monitoring- forest conservation- wild life studies- GIS for monitoring non print source pollution.

ii. Marine environment, Sensors for environmental monitoring sensors – visible and outside visible wave length – absorption spectrometers – selection of ground truth sites- sea truth observations –Radar techniques for sensing ocean surfaces- thermal measurements – application of sensing, mapping oil slicks – Chlorophyll detection- Fisheries resources- Coastal marine studies- determination of temperature and sea state.

iii. Air pollution and global climatology, R.S. technique for Air quality monitoring- case studies- weather forecasting and climatology- emissivity characteristics.

iv. Measurement of atmospheric temperature- composition- constituent distribution and concentration- composition- constituent distribution and concentration- wind flows and air Circulation- Hurricane tracking – meteorological satellite systems.

Internal Assessment (5)

RSGE519O0: Geo-Informatics in Resource Management

Course Outcome:

After completing this course, students will be able to:

- **Differentiate** natural and cultural resources, and **classify** them into renewable and non-renewable categories.
- **Apply** remote sensing–based land use/land cover mapping techniques for resource monitoring and sustainable management.
- **Analyze** strategies for conservation of natural resources within the framework of

sustainable development.

- **Interpret** soil and mineral resource characteristics using geospatial approaches.
- **Assess** the impacts of soil degradation and surface mining on land resources through remote sensing applications.

RSGE519O0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Geo-Informatics in Resource Management:

i. Resources classification systems, natural and cultural resources, renewable and non-renewable resources.
ii. Resource Conservation: Remote sensing based Land use- Land cover mapping for resource monitoring and management Sustainable development of natural resources.
iii. Land Resources: Introduction to soil, mineral resources, remote sensing in mapping soil degradation, impact of surface mining on land resources,

Internal Assessment (5)

RSGE520P0: Application of Remote Sensing and GIS in Resource Management

Course Outcome:

After completing this course, students will be able to:

- **Apply** remote sensing techniques for assessment of agricultural, forest, and wildlife resources, and **analyze** issues in forest density, type mapping, and management.
- **Evaluate** surface and sub-surface water resources, water mining, and pollution problems using geospatial tools for sustainable water resource management.
- **Explain and assess** conventional (coal, oil, nuclear) and non-conventional energy resources, and **utilize** GIS for energy resource management and planning.
- **Implement** geoinformatics-based models such as forest fire modeling, wildlife habitat assessment, soil erosion, and land resource prioritization.
- **Integrate** remote sensing and GIS approaches for comprehensive natural resource monitoring, conservation, and sustainable management.

RSGE520P0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Remote Sensing and GIS in Resource Management:

i. Bio-Resources: Remote sensing application in agriculture, forest resources and wildlife habitat assessment. Mapping of forest density and type, issues in forest management.
ii. Water Resources: Remote sensing application in surface and sub-surface water resources evaluation, water mining and pollution, issues in water resources management.
iii. Energy Resources: Coal, oil and nuclear energy, non-conventional energy resources, future potential and requirement of energy resources. GIS in energy resources management.
iv. Geoinformatics Models in Resource Management: Forest Fire Modeling, Wild Life Habitat Assessment Modeling, Soil Erosion Modeling, Land Resources Development Prioritization Modeling.

Internal Assessment (5)

RSGE521Q0: Geo-Informatics in Transport Network Analysis

Course Outcome:

After completing this course, students will be able to:

- **Explain** the fundamentals of transportation planning, including behavioral aspects and public transportation operations and technology.
- **Analyze** different mass transportation systems through traffic studies, capacity

evaluation, and transportation economics and finance.

- **Evaluate** issues of traffic safety and control in urban and regional transportation planning.
- **Apply** concepts of network analysis and network models to solve problems in utilities, transportation, and multi-modal freight systems.
- **Utilize** GIS-based network models for transportation planning, decision-making, and optimization.

RSGE521Q0

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Geo-Informatics in Transport Network Analysis:

i. Introduction to Transportation Planning, Behavioral Issues in Transportation Studies, Public Transportation Operations and Technology
ii. Transportation Systems: Mass Transportation Systems, Traffic Studies and Capacity, Transportation Economics and Finance, Traffic Safety and Control
iii. Network Analysis and Transportation: Concept of networks and Network models, Network analysis, Important applications, utilities and transportation, using network model in GIS, Multi-modal Freight Transportation Systems Analysis

Internal Assessment (5)

RSGE522R0: Application of Remote Sensing and GIS in Transportation

Course Outcome:

After completing this course, students will be able to:

- **Apply and evaluate** transportation models, simulation techniques, and discrete choice modeling for travel demand forecasting.
- **Analyze** urban transportation networks and **design** transportation facilities using intelligent transportation system (ITS) approaches.
- **Demonstrate** principles of geometric design for efficient and safe transportation systems.
- **Plan and assess** large-scale transportation projects including airports, ports, and urban transport systems.
- **Examine and critique** real-world applications and case studies in transportation modeling and planning.

RSGE522R0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Remote Sensing and GIS in Transportation:

i. Transportation Modelling: Transportation Models, Simulation Analysis , Discrete Choice Modeling for Travel Demand Forecasting
ii. Intelligent Transportation Systems: Urban Transportation Networks , Geometric Design of Transportation Facilities, Transportation Design
iii. Planning and Execution: Airport Design and Planning , Port Design and Planning , Urban Transport planning
iv. Applications and case studies

Internal Assessment (5)

RSGE523S0: Geoinformatics in Utility Management

Course Outcome:

After completing this course, students will be able to:

- **Describe** essential services and utilities, and **develop** spatial databases through geospatial data acquisition and integration.
- **Apply** techniques of spatial data manipulation, query processing, and visualization for geospatial analysis.
- **Design and manage** geospatial systems and projects, ensuring efficient data handling and application development.
- **Utilize** GIS for solving real-world problems related to public utilities such as electricity, gas, water supply, and sewerage.
- **Evaluate** the role of geospatial technologies in planning, managing, and optimizing urban and regional utility services.

RSGE523S0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Geoinformatics in Utility Management:

i. Utility, Description of all essential services and utilities, Database development and Data Acquisition, Acquiring and integrating geospatial data, Spatial Data Bases
ii. Spatial Data Manipulation and Analysis, Geospatial system analysis and design, Geospatial technology project , management ,Query Processor and Visualization
iii. Applications and Problem solving with GIS Electricity, Gas, Water supply, Sewerage system

Internal Assessment (5)

RSGE524T0: Application of Remote Sensing and GIS in Utility Management

Course Outcome:

After completing this course, students will be able to:

- **Analyze** urban and regional issues related to solid waste disposal, telecommunication, public health, safety, and crime using geospatial tools.
- **Apply** modeling techniques in utility applications to support infrastructure planning and management.
- **Evaluate** infrastructure aims and objectives in the context of sustainable development.
- **Interpret and assess** environmental laws and regulations governing infrastructure utilities.
- **Examine** real-world case studies to understand modern infrastructure tools and their applications.

RSGE524T0:

Full Marks: 25. Number of lectures to be delivered for each module is 20.

Application of Remote Sensing and GIS in Utility Management:

i. Solid waste disposal, Telecommunication, Public health and safety, Crime analysis
ii. Modelling in utility applications**,** Infrastructure aims and objectives, Environmental law and regulations governing infrastructure utilities, Modern infrastructure tools
iii. Case study

Internal Assessment (5)

SEM -III PRACTICAL

RSGC525X9 (Practical)
APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISION SUPPORT SYSTEM

Course Outcome:

- Students will analyze terrain morphometry utilize Digital Elevation Models (DEM), perform hydro-geomorphological interpretations and soil erosion using empirical models from satellite imagery.
- Students will learn application of satellite imagery for mapping and monitoring cropping intensity, waterbodies and urban growth.
- The course covers generating criterion maps and applying linear transformation methods to standardize and prepare data for spatial decision-making.
- Students will learn to assign weights through ranking, rating, pairwise comparison, and trade-off analysis, culminating in site suitability assessments using the Simple Additive Weighting method within Spatial Decision Support Systems.

RSGC525X9 (Practical)
APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISION SUPPORT SYSTEM (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

i. Morphometric analysis of terrain, Cut and Fill analysis using DEM, Watershed Delineation; identification of waterbodies using spectral indices
ii. Identification of Cropland, Estimation of Cropping Intensity using Multi-temporal Satellite imagery, Detection of waterbodies
iii. Mapping and monitoring urban growth, detection of spatio-temporal changes in urban areas
iv. Generating Criterion Maps, Linear Transformation Methods for Standardization of Criterion Maps
v. Estimation of Weights: Ranking, Rating, Pairwise Comparison and Trade-off analysis method; Decision Rules-Simple Additive Weighting method
vi. Application of Spatial Decision Support System in Vulnerability Analysis

(20)

Practical Notebook Viva-voce (5)

RSGC526X9 (Practical)
GENERATION OF CASE STUDIES & COMMUNITY ENGAGEMENT (COMPULSORY FIELD STUDY)

Course Outcome:

After completion of this course, students will be able to:

- **Generate pre-field thematic maps** using multi-seasonal remote sensing imagery for planning field investigations.
- **Conduct ground truthing and systematic field data collection** to validate remotely sensed outputs.
- **Integrate post-field data with pre-field analyses** to enhance the reliability of geospatial interpretations.

- **Prepare professional field reports** by synthesizing data, maps, and analysis results in a structured format.
- **Demonstrate communication and analytical skills** through viva-voce presentations based on fieldwork outcomes.

RSGC526X9 (Practical)
GENERATION OF CASE STUDIES & COMMUNITY ENGAGEMENT (COMPULSARY FIELD STUDY) (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

i. Generation of pre-field theme maps using multi-seasonal image of an area – ground truthing and field data collection -- Validation of the output based on post field data
ii. Output generation – finalization of Field Report and Viva-Voce

(25)

RSGC527X9 (Practical)
GEOSTATISTICS (25 marks)

Course Outcome:

- Students will gain proficiency in statistical software, performing time series analysis, creating charts and scatter plots with regression lines, and applying bi-variate and multiple correlation techniques.
- They will understand and conduct significance testing, calculate mean centers of populations, and interpret Z-scores for spatial data analysis.
- Learners will learn to perform Principal Component Analysis (PCA) for data reduction and feature extraction in multivariate spatial datasets.
- The course covers geostatistical interpolation methods such as Inverse Distance Weighting (IDW) and Kriging, implemented through GIS software for spatial prediction.
- Students will extract image statistics and perform regression analysis using R programming, integrating statistical insights into remote sensing and GIS workflows.

RSGC527X9 (Practical)
GEOSTATISTICS (25 marks)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

iii. Introduction of Statistical Software: Time series, Charts, Scatter plot with regression line, Variance, Bi-variate and Multiple Correlation, Linear regression & Residual mapping, RMSE, Significance test, Mean Centre of Population, Z-Score
iv. Principal Component analysis
v. Role of Interpolation, Methods of Interpolation – Global and Local Deterministic Methods,
vi. Density Estimation, Inverse Distance Interpolation and Krigging.
vii. Extraction of image statistics and regression analysis using R studio.

(20)

Practical Notebook and Viva-Voce (5)

RSGC528X9

BASED ON ELECTIVE SPECIAL PAPER THEORY: (The students have to select any one of the following subjects (A-J), as proposed by the department, likely to be offered as elective special papers)

Full Marks: 25. At least even number of periods to be assigned (preferably in batches).Examination Time: 2 hours. Pattern of setting questions: 20marks compulsory questions are to be set. 5 marks are to be allocated for Evaluation of Practical Notebook and Viva-voce. Right hand side parentheses indicate lecture / demonstration hours.

Generation of Case Studies

Based on primary or secondary data case studies to be generated on respective themes, Validation of the output based on post field data, Output generation – finalization (20)

Practical Notebook and Viva-Voce (5)

SEM IV

RSGC551X9, RSGC552X9, RSGC553X9: (275 marks)

RSGC551X9: DISSERTATION EXAMINATION (100)

Course Outcome:

- Students will develop the ability to identify and define a focused research problem within the geospatial domain.
- They will acquire skills to formulate research objectives and identify appropriate geospatial methodologies to address the problem.
- Learners will design and implement a geospatial research approach, utilizing GIS and remote sensing tools for data analysis and solution development.
- They will critically evaluate and interpret geospatial data results, drawing actionable insights for real-world applications.
- Students will effectively present and document their research findings, demonstrating the capacity to develop practical geospatial solutions for assigned problems.

Dissertation consisting of relevance of the problem to be studied and its aims and objectives, Methodology adopted to study such problem

Chapter Scheme:

- Problem Definition
- Objective
- Review of Literature
- Database and Methodology
- Result and Discussion

RSGC552X9: DISSERTATION VIVA (75)

Course Outcome:

- Students will develop the ability to identify and define specific, manageable research problems within the geospatial domain.
- They will formulate clear objectives and select appropriate geospatial tools and techniques to address their research questions.
- Learners will design and execute a research methodology, applying GIS, remote sensing, and spatial analysis methods to develop effective solutions.
- They will critically analyze their findings, interpret results, and derive practical, data-driven insights.
- Students will effectively communicate their research through well-structured PowerPoint presentations and viva voce examinations, demonstrating their understanding and problem-solving skills.

Presentation:

On satisfactory completion of the taught component of the course, students will normally proceed to the M.Sc. Research dissertation which must be completed by the end of fourth semester. This should be a substantial piece of research work, which both reinforces the skills learned in the taught component of the course and provides a genuine opportunity to undertake valuable research. Each student is required to defend his / her thesis through a presentation in front of an external expert and faculty and students.

RSGC553X9: GRAND-VIVA **(100)**

Course Outcome:

- Students will demonstrate a comprehensive understanding of the core concepts and principles of the subject during the grand viva.
- They will effectively articulate their knowledge, research work, and applications related to the course in front of external and internal examiners.
- Learners will showcase their ability to synthesize key topics, answering questions confidently and accurately.
- They will demonstrate critical thinking and problem-solving skills through discussion and clarification of their coursework and research.
- Students will exhibit professionalism, communication skills, and confidence in presenting and defending their work before examiners.

Grand Viva:

The grand viva will assess the student's comprehensive understanding of the entire subject, encompassing core concepts, methodologies, and applications. It will require the student to confidently articulate their knowledge, answer questions clearly, and demonstrate critical thinking skills. The evaluation will be conducted in front of both external and internal examiners, who will scrutinize the student's grasp of the course material, research work (if applicable), and ability to respond to diverse queries, ensuring a thorough assessment of their competency.

LIST OF REFERENCES:

RSGC401X0: FUNDAMENTALS & PHYSICS OF REMOTE SENSING

TEXT BOOKS:

1. Jensen, J.R., 2000. Remote sensing of the environment: An earth resource perspective, Prentice Hall, Upper saddle river, NJ,
2. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
3. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
4. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India
5. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.

REFERENCE BOOKS:

1. Avery, T.E., and G.L.Berlin, Fundamental of remote sensing and airphoto interpretation,5thed, Macmillan, New York,1992
2. Barrett,E.C., and L.F.Curtis, Introduction to environmental remote sensing, 3rded, Chapman and Hall, New York,1992
3. Canada Center for Remote Sensing, Remote Sensing Tutorial
4. Cracknelll, A.P., and L.W.B.Hayes, Introduction to remote sensing, Taylor and Francis, Washington, DC,1991
5. Curran, P.J. (1980) Mulltispectral remote sensing of vegetation amount, Progress in Physical Geography, 4:315
6. Curran, P.J. (1988) Principles of Remote Sensing, ELBS Edn. Longman Group UK Ltd.
7. Guha, P.K. (2003) Remote Sensing for the Beginner, Affiliated East-West Press Pvt. Ltd., New Delhi
8. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
9. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
10. John, R. J., Introductory Digital Image Processing – A Remote Sensing Perspective, Prentice Hall Series
11. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.
12. Nag P. and Kudrat M., Digital Remote Sensing, New Delhi, Concept Publishing.
13. Reeves, Robert G., "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA
14. Richards J.A. and Jia X. (2006) Remote Sensing Digital Image Analysis: An Introduction, 4th ed., Springer

RSGC402X0: PLATFORMS AND SENSORS

TEXT BOOKS:

1. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
2. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India
3. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
4. Introduction to the Physics and Techniques of Remote Sensing — Elachi & Van Zyl (3rd ed., 2021)
5. Remote Sensing: Theory and Applications — P. K. Garg (2024)
6. Remote Sensing of the Environment: An Earth Resource Perspective — Jensen (2nd ed., 2007)

REFERENCE BOOKS:

1. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.11
2. Remote Sensing Handbook, edited by Prasad S. Thenkabail (Three-volume set)
3. Manual of Remote Sensing, 3rd Edition (multi-volume series)
4. Introduction to Remote Sensing, 5th Edition (Campbell & Wynne)
5. Remote Sensing and Image Interpretation, 7th Edition (Lillesand, Kiefer, & Chipman)
6. Understanding Earth Observation: The Electromagnetic Foundation of Remote Sensing (Domenico Solimini)
7. Remote Sensing: Principles and Applications, 2nd Ed. (A. N. Patel & Surendra Singh, 2024)
8. Textbook of Remote Sensing and Geographical Information Systems, 4th Ed. (Anji Reddy, 2022)

RSGC403X0: FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM

TEXT BOOKS:

1. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.
2. C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.
3. Chakraborty and Sahoo, 2008, Fundamentals of Geographic Information Systems, Viva Books Private Limited, India
4. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. Ed. 1991, 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.

REFERENCE BOOKS:

1. Chaisman, N. 1992: Exploring Geographical Information Systems, John Wiley and Sons Inc., New York: 198p.
2. Chrisman, N.R. (1997) Exploring Geographic Information Systems. John Wiley andSons.
3. DeMers, M.N.,Fundamentals of geographic information system, Wiley, New York, 1997
4. ESRI (2004) ESRI Cartography: Capabilities and Trends, Redlands, CA, White Paper.
5. Foresman,T.W.(ed)History of GIS, Prentice-Hall, Upper saddle river, NJ,1998
6. Humhold.W.E., 1991. An introduction to urban geographic information system, Oxford University press, New York
7. Ian Masser& Michael Blakemore., 1991, Handling Geographical Information: Methodology and Potential Applications, Ed.
8. Kang-tsung Chang 2002, 'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
9. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (eds.) (1991) Geographical Information Systems: Principles and Applications. Avon, Longman Scientific and Technical.
10. Martin, D. (1991) Geographical Information Systems and their Socioeconomic Applications. London, Routledge.
11. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.
12. Peuquet, D.J. and Marble, D.F. (eds.) (1990) Introductory Readings in Geographic Information Systems. London, Taylor and Francis.

RSGC404X0: DIGITAL CARTOGRAPHY

TEXT BOOKS:

1. Anson, R.W. &Ormeling, F.J. (1993), Basic Cartography, Vol. 1, 2nd ed., Elsevier Applied Science Publishers, London.
2. Robinson A.H. & Morrison J.L, (1995) Elements of Cartography, John Wiley & Sons
3. Kellaway, G.P. 1979: Map Projections, 1st Indian edition, B.I. Publication, Delhi.

REFERENCE BOOKS:

1. Imus D. and Dunlavey P. (2002) Back to the Drawing Board: Cartography vs the Digital Workflow, MT, Hood, Oregon.
2. Keates, J.S. (1973): Cartographic Design and production, London, Longman
3. Harvey, F. 2008, A Primer of GIS: Fundamental Geographic and Cartographic Concepts, The Guilford Press, New York.
4. MacEachren A.M. (1994) Some Truth with Maps: A Primer on Symbolization and Design, University Park: The Pennsylvania State University.
5. Menno-Jan Kraak&FerojanOrmeling, 2003, Cartography – Visualisation of Geospatial data, 2ndEdn, , Pearson Education Ltd.
6. Mishra, R.P. and. A. Ramesh, Fundamentals of Cartography , Concept Publishing House, New Delhi – 110059
7. Monkhouse F.J. and Wilkinson, H.R. 1971. : Maps and Diagrams: Their Compilation and Construction, B.I. Publications Private Limited, New Delhi: 527p.
8. Peterson, M.P. (1995) "Interactive and Animated Cartography" Upper Sadde River, NJ: Prentice Hall.
9. Ramesh, P. A. (2000): Fundamentals of Cartography, Concept Publishing Co., New Delhi.
10. Slocum T. (2003) Thematic Cartography and Geographic Visualization, Upper Saddle River, New Jersey: Prentice Hall.
11. Wilford J.N. (2000) The Mapmakers, Vintage Books.
12. Rampal, K.K. (1993): Mapping and Compilation, Concept Publishing Co.,New Delhi.
13. Roy, P. 1988 : An Analytical Study of Map Projections, Volume 1, Kolkata:

RSGO405VC: INDIAN KNOWLEDGE SYSTEM

TEXT BOOKS:

1. An Introduction to Indian Philosophy by Satishchandra Chatterjee (2012), ISBN NO:978-8129111951
2. Ancient Indian Knowledge System: Archaeological Perspective by Dr. Vasant Shinde(2017), ISBN NO: 978-8193141090
3. State and Government in Ancient India by A. S. Altekar (2016), ISBN NO: 978-8120810099
4. Indian Cultures as Heritage: Contemporary Pasts by Romila Thapar (2018), ISBN NO:978-9384067359
5. Ancient Indian Sciences by Swami Chidatman Jee Maharaj (2009), ISBN NO: 978-8126136148

REFERENCE BOOKS:

6. Political Thought in Ancient India: Emergence of the State, Evolution of Kingship Based on the Saptanga Theory (Reconstructing Indian History and Culture) by G. P. Singh (2003), ISBN NO: 978-8124600016
7. Indians: A Brief History of a Civilization by Namit Arora (2021), ISBN NO: 978-0670090433
8. Maths Sutra: The Art of Indian Speed Calculation by Gaurav Tekriwal (2015), ISBN NO:978-0143425021
9. Principles and Applications of Vastu Shastra: The Ancient Indian Science Of Architecture and Layout For Today's Modern World by Dr. B.V. Raman (2020), ISBN NO: 978-1608692637
10. Echoes of Ancient Indian Wisdom by Dr. Shantha N Nair (2010), ISBN NO: 978-8122310207

RSGC406X0: SURVEYING AND NAVIGATIONAL SATELLITE SYSTEM

TEXT BOOKS:

1. Global Positioning System: Signals, Measurements, and Performance (Revised Second Edition) — Misra & Enge
2. Global Positioning System: Principles And Applications: Satheesh Gopi (2017), Tata Mcgraw-Hill Publishing Company Limited.
3. GPS Principles and Applications: A.Ganesh & R. Narayanakumar (2019), Satish Serial Publishing House.
4. Advanced Surveying: Total Station, GIS and Remote Sensing: Satheesh Gopi, Pearson Education India.
5. GPS and GNSS for Land Surveyors (5th Edition) – Jan Van Sickle (2024)
6. Understanding GPS/GNSS: Principles and Applications – Kaplan & Hegarty (3rd Edition, 2017)
7. GPS: Theory and Practice – Hoffman-Wellenhof et al.
8. Hussain, S.K. and Nagaraj, M.S. 1992 :Text Book of Surveying, S. Chand & Co. Ltd., New Delhi:
9. Kanetkar, T.P. and Kulkatni, S. V. 1.988: Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan, Pune: 608p.
10. Terry-Karen Steede, 2002, Integrating GIS and the Global Positioning System, ESRI Press

REFERENCE BOOKS:

1. GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and more by Hofmann-Wellenhof, Bernhard, Lichtenegger, Herbert, Wasle, Elmar, SPRINGER.
2. GPS: Theory, Algorithms and Applications by GuochangXu, Artech House, 2009.
3. Introduction to GPS: The Global Positioning System, by Ahmed El-Rabbany, ARTECH House.
4. Kochher, C.L. 1993 : A Text Book of Surveying, S.K. Katariya& Sons, Delhi:
5. Leicka. A.: GPS Satellite Surveying, John Wiley & Sons, use. New York
6. N.K.Agrawal Essentials of GPS, Spatial Network Pvt Ltd 2004
7. Principles of GNSS, Inertial, and Multi-sensor Integrated Navigation Systems by Paul D. Groves, ARTECH House.
8. Punmia, B.C, Surveying (vol I, and II), Standard book House, Nayasarak, New Delhi
9. Saha, Pijushkanti& P. Basu, 2004, Advanced Practical Geography – A Laboratory Manual Books & Allied (P) Ltd.
10. Sarkar, A. 1997 : Practical Geography: A Systematic Approach, Orient Longman Ltd., Hyderabad:
11. Sheffield, C. (1983) Man on Earth, Sidgwick and Jackson, London
12. Shepherd, F.A. 1983 : Engineering Surveying, Edward Arnold, London:
13. Singh, N. Surveying, Tata McGraw-Hill Publishing Company Ltd., New Delhi:
14. Singh, R.L &Dutt. P.K, “Elements of Practical geography”, Students Friends Allahabad
15. Singh, R.L. and Singh, R.P.B. 1991: Elements of Practical Geography, Kalyani Pub. New Delhi: 421p.
16. Steers, J.A. 1965 : An Introduction to Map Projections, 14th ion, University of London Press, London:
17. Terry-Karen Steede, 2002, Integrating GIS and the Global Positioning System, ESRI Press
18. Understanding GPS: Principles and Applications by Elliott D.Kaplan, Artech House, 2005.
19. Venkatramaiah, C. 1996: A Textbook of Surveying, Universities Press / Orient Longman Ltd., Hyderabad: 76p.
20. Alvi, Z. 1995: Statistical Geography: Methods and Applications, Rawat Pub. New Delhi: 194p.
21. Elfic, M.H., Fryer, J.G. Brinkner, R.C. and Wolf, P.R. 1994: Elementary Surveying, 8th edition, Harper Collins Publishers, London: 510 p.
22. Floyd F.S. Remote Sensing: Principles and Interpretation New York, WH Freeman and Company.
23. Springer Handbook of Global Navigation Satellite Systems — Teunissen & Montenbruck (2017)
24. Walford, P., 1995: Geographical Data Analysis, John Wiley and Sons Inc., New York: 446p.

25. www.trimble.com/index.htm

RSGC407X0: INTRODUCTION TO PYTHON PROGRAMMING FOR GEOSPATIAL ANALYSIS

TEXT BOOKS:

1. E Balaguruswamy " Programming in ANSI C " TMH 2nd Edition 2000
2. EvangelosPetroutsos "Mastering Visual Basic 6.0" , BPB Publications, Edition 1998
3. MohmmedAzam"Programming with VB 6.0 ",Vikash Publishing House Pvt. Ltd.
4. Rajaraman Y., "Fundamentals of Computers", Prentice Hall of India, New Delhi, 1999.

REFERENCE BOOKS:

1. Mano, M., Digital Logic and Computer Design
2. Pal, S.K. 1999: Statistics for Geoscientists, Concept publishing Company, New Delhi: 423p.
3. Peter Norton and Michael Groh, "Guide to Visual Basic 6", Techmedia, SAMS, Seventh Edition
4. R G Dromey, "How to solve it by Computer", PHI, Edition 1999
5. Scott Warner, "Teach Yourself Visual Basic 6.0", TMH, 1999.
6. Walford, P., 1995: Geographical Data Analysis, John Wiley and Sons Inc., New York: 446p.
7. YashwantKanetkar, "Let us C", BPB Publications, 2001

RSGC451X0: FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

TEXT BOOKS:

1. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
2. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
3. Gonzalez, R.C. and Woods, R.E. (2018) Digital Image Processing. 4th Edition, Pearson Education, New York, 1022 p.
4. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
5. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
6. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India

REFERENCE BOOKS:

1. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
2. Campbell, James B., Introductory Remote Sensing: Principles and Concepts, Routledge.
3. Castleman, K.R. (1979) Digital Image Processing. Prentice Hall Inc, New Jersey.
4. Cracknelll, A.P., and L.W.B.Hayes, Introduction to remote sensing, Taylor and Francis, Washington, DC,1991
5. Curran, P.J. (1980) Mulltispectral remote sensing of vegetation amount, Progress in Physical Geography, 4:315
6. Curran, P.J. (1988) Principles of Remote Sensing, ELBS Edn. Longman Group UK Ltd.
7. Gibson, P.J., Introduction to Remote Sensing, 2nd ed., Taylor & Francis, London.
8. John R.J. (2000). Introductory Digital Image Processing: Remote Sensing Perspective, New Jerysey, Prentice Hall.
9. Nag P. and Kudrat M. Digital Remote Sensing New Delhi: Concept Publishing.
10. Rafael C.G. and Woods R.E. (1992) Digital Image Processing.
11. Rencz, Andrew N. (Ed), Remote Sensing for the Earth Sciences: Manual of Remote Sensing, 3rd ed., John Wiley & Sons, Inc., New York.

12. Sabins, Floyd F., Remote Sensing: Principles and Interpretation, H. Freeman and C., New York.
13. Umbaugh S.E (2005) Computer Imaging: Digital Image Analysis and Processing.
14. William K.P. (1978) Digital Image Processing.

RSGC452X0: IMAGE ENHANCEMENT & TRANSFORMATION

TEXT BOOKS:

1. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
2. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
3. Gonzalez, R.C. and Woods, R.E. (2018) Digital Image Processing. 4th Edition, Pearson Education, New York, 1022 p.
4.
5. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
6. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
7. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India

REFERENCE BOOKS:

1. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
2. Campbell, James B., Introductory Remote Sensing: Principles and Concepts, Routledge.
3. Castleman, K.R. (1979) Digital Image Processing. Prentice Hall Inc, New Jersey.
4. Curran, P.J. (1980) Mulltispectral remote sensing of vegetation amount, Progress in Physical Geography, 4:315
5. Curran, P.J. (1988) Principles of Remote Sensing, ELBS Edn. Longman Group UK Ltd.
6. Gibson, P.J., Introduction to Remote Sensing, 2nd ed., Taylor & Francis, London.
7. John R.J. (2000). Introductory Digital Image Processing: Remote Sensing Perspective, New Jerysey, Prentice Hall.
8. Rafael C.G. and Woods R.E. (1992) Digital Image Processing.
9. Rencz, Andrew N. (Ed), Remote Sensing for the Earth Sciences: Manual of Remote Sensing, 3rd ed., John Wiley & Sons, Inc., New York.
10. Sabins, Floyd F., Remote Sensing: Principles and Interpretation, H. Freeman and C., New York.
11. Umbaugh S.E (2005) Computer Imaging: Digital Image Analysis and Processing.
12. William K.P. (1978) Digital Image Processing

RSGC453X0: INFORMATION EXTRACTION FROM SATELLITE IMAGES

TEXT BOOKS:

1. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
2. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
3. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
4. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
5. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India

REFERENCE BOOKS:

1. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
2. Cracknell A.P. (ed) Remote Sensing in Meteorology, Oceanography and Hydrology, Chichester, Ellis Horwood Limited.
3. Digital Elevation Model Technologies and Applications: The DEM Users Manual,
4. Ghassem A. Theory and Applications of Optical Remote Sensing, New York, John Wiley and Sons.
5. Imaging Radar (Manual of Remote Sensing, Volume 2) by Henderson F.M. and Lewis A.J. (3rd Ed.), Wiley, 1998.
6. Imaging with Synthetic Aperture Radar by Didier Massonnet, Jean-Claude Souyris, CRC Press, 2008.
7. Introduction to Microwave Remote Sensing by Iain H. Woodhouse, CRC, 2004.
8. Maune, D. F. and Bethesda, M.D. (2nd Ed.), American Society for Photogrammetry and Remote Sensing. 2007.
9. Microwave Remote Sensing: Active and Passive, from Theory Applications by Ulaby F.T., Moore R.K. and Fung A.K., Artech House Publishers, 1986.
10. Polarimetric Radar Imaging. From Basics to Applications by Lee, J.-S. andPottier, E., CRC Press, 2009.
11. Skolnik and Merrill I. Introduction to Radar Systems, McGraw-Hill (1st ed., 1962; 2nd ed., 1980; 3rd ed., 2001).
12. Topographic Laser Ranging and Scanning, Principles and Processing, Shan, J. and C. Toth, Taylor & Francis, 2008.
13. Understanding Synthetic Aperture Radar Images by Olivie, C. and Quegan, S. Scitech, 2004.

RSGC454X0: THERMAL AND MICROWAVE REMOTE SENSING

TEXT BOOKS:

1. Jensen, J.R., 2000. Remote sensing of the environment: An earth resource perspective, Prentice Hall, Upper saddle river, NJ,
2. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
3. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
4. Quantitative Remote Sensing in Thermal Infrared: Theory and Applications (2014) by Huajun Tang & Zhao-Liang Li
5. An Introduction to Contemporary Remote Sensing by Qihao Weng (2012)
6. Introduction to Microwave Remote Sensing (2017), Iain H. Woodhouse
7. Polarimetric Radar Imaging: From Basics to Applications by J.S. Lee & E. Pottier (2009)
8. Microwave Radar and Radiometric Remote Sensing: David Long & Fawwaz T. Ulaby

REFERENCE BOOKS:

1. Thermal Infrared Remote Sensing: Sensors, Methods, Applications (Claudia Kuenzer, Stefan Dech) (2013), Springer Books
2. Thermal Infrared Remote Sensing: Principles and Applications by Ruiliang Pu & Qiuyan Yu (Taylor & Francis)
3. Ground-Based Microwave Radiometry and Remote Sensing: Methods and Applications by Pranab K. Karmakar (2014)
4. Methods and Materials for Remote Sensing: Infrared Photo-Detectors, Radiometers and Arrays (2004) edited by Karen Kocharyan et al.
5. Practical Applications of Infrared Thermal Sensing and Imaging Equipment (3rd Ed., 2007): Herbert Kaplan
6. The SAGE Handbook of Remote Sensing (Includes Thermal IR sections), Editors: Warner, Nellis, & Foody

RSGC455X0: HYPERSPECTRAL REMOTE SENSING AND LIDAR

TEXT BOOKS:

1. Marcus Borengasser, William S. Hungate, and Russell Watkins, Hyperspectral Remote Sensing: Principles and Applications, CRC Press.
2. Pu, R. (2017). Hyperspectral remote sensing: Fundamentals and practices. CRC Press.
3. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
4. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York
5. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India
6. Pandey, P. C., Srivastava, P. K., Balzter, H., Bhattacharya, B., & Petropoulos, G. P. (2020). *Hyperspectral remote sensing: Theory and applications* (1st ed.). Elsevier
7. S. Rajendran, Hyperspectral Remote Sensing and Spectral Signature Applications, New India Publishing Agency (NIPA), 2009
8. https://www.wwf.org.uk/sites/default/files/2019-04/Lidar-WWF-guidelines.pdf
9. Dong, P., & Chen, Q. (2017). LiDAR Remote Sensing and Applications (1st ed.). CRC Press. https://doi.org/10.4324/9781351233354
10. Wang, C., Yang, X., Xi, X., Nie, S., & Dong, P. (2024). Introduction to LiDAR Remote Sensing (1st ed.). CRC Press. https://doi.org/10.1201/9781032671512

REFERENCE BOOKS:

1. Chein-I Chang, Hyperspectral Data Exploitation: Theory and Applications,Wiley & Sons Ltd.
2. Margaret Kalacska and G. Arturo Sanchez-Azofeifa, Hyperspectral Remote Sensing of Tropical and Subtropical Forests, CRC Press.
3. Hans F. Grahn and Paul Geladi, Techniques and Applications of Hyperspectral Image Analysis by, Wiley & Sons Ltd.
4. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
5. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
6. Paul F. McManamon, LiDAR Technologies and Systems, SPIE, Published: 2019 https://doi.org/10.1117/3.2518254

RSGC456X0: ADVANCED GIS

TEXT BOOKS:

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

2. C.P.Lo and Albert K.W.Yeung 2005 “Concepts and Techniques of Geographic Information Systems” Prentice Hall of India,New Delhi.
3. Chakraborty and Sahoo, 2008, Fundamentals of Geographic Information Systems, Viva Books Private Limited, India
4. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. Ed. 1991, ‘Geographical Information Systems: Principles and Applications', Longman Group, U.K.

REFERENCE BOOKS:

1. Bonham Carter G.F (1994) GIS for Geoscientists: Modeling with GIS Pergamon Publications.
2. Chaisman, N. 1992: Exploring Geographical Information Systems, John Wiley and Sons Inc., New York: 198p.
3. Chrisman, N.R. (1997) Exploring Geographic Information Systems. John Wiley and Sons.
4. David J Maguire, Michael F Goodchaild and David W Rahind., 1991, Geographical Information System, Ed.
5. DeMers, M.N.,Fundamentals of geographic information system, Wiley, New York, 1997
6. Foresman,T.W.(ed)History of GIS, Prentice-Hall, Upper saddle river, NJ,1998
7. Humhold.W.E., 1991. An introduction to urban geographic information system, Oxford University press, New York
8. Huxhold, W.E. (1991) An Introduction to Urban Information Systems. New York, OUP.
9. Ian Masser& Michael Blakemore., 1991, Handling Geographical Information: Methodology and Potential Applications, Ed.
10. Kang-tsung Chang 2002, ‘Introduction to Geographic Information Systems’ Tata McGraw Hill, New Delhi.
11. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (eds.) (1991) Geographical Information Systems: Principles and Applications. Avon, Longman Scientific and Technical.
12. Martin, D. (1991) Geographical Information Systems and their Socioeconomic Applications. London, Routledge.
13. Mary Summer, Computers: Concepts and Uses, Prentice Hall, Englewood Cliffs. New Jersey.
14. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.
15. Peuquet, D.J. and Marble, D.F. (eds.) (1990) Introductory Readings in Geographic Information Systems. London, Taylor and Francis.
16. Sanghavi, Hitesh (1998) Oracle Miracles, Express computers methods, 1998.

RSGC457X0: Modeling Spatial Database and Analysis

TEXT BOOKS:

1. Spatial Databases: With Application to GIS: Philippe Rigaux, Michel Scholl, Agnès Voisard (2001)
2. Spatial Database Systems: Design, Implementation and Project Management: Albert K. W. Yeung & G. Brent Hall (2007)
3. Spatial Data on the Web: Modeling and Management: Alberto Belussi, Barbara Catania, Eliseo Clementini, Elena Ferrari (2008)
4. Spatial Data Modeling: Mapping the World in Databases. Michael Kirshteyn (2024)
5. An Introduction to Spatial Data Analysis. Martin Wegmann, Jakob Schwalb-Willmann, Stefan Dech,, (2020), ISBN 9781784272135

REFERENCE BOOKS:

1. Spatial Databases: A Tour: Shashi Shekhar & Sanjay Chawla (2003)
2. Silberschats, Henry F. Korth “Database System Concepts”, 3rd Edition, TMH, 1998

3. DeMers, M.N.,Fundamentals of geographic information system, Wiley, New York, 1997
4. Goodchild, M.F. (1978) - Statistical Aspects of the Polygon Overlay Problems, in Harvard papers on GIS, Ed. G. Dulton, Vol. 6, Addison Wesley, Reading Press.
5. Laurini, R. and Thompson, D. (1992) Fundamentals of Spatial Information Systems. London, Academy Press.
6. Mac Donald, A. 1999, Building a Geodatabase, Redlands CA: ESRI Press.
7. Samet, H. 1990, The Design and Analysis of Spatial Data Structures, Addison–Wesley.

RSGO501X0: MASSIVE OPEN ONLINE COURSES (MOOC)/SWAYAM

The specific course must be selected from the available offerings on the SWAYAM platform for the current academic session.

RSGC502X0: APPLICATION OF GEOINFORMATICS

TEXT BOOKS:

1. An Introduction to Database Systems by C.J.Date, A. Kannan S. Swamynathan (8th Ed.), Pearson Education, 2009.
2. Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill, 2002.
3. Jenson J.R. 2000. Remote Sensing of the environment – An Earth Resource Perspective, Prentice Hall Inc.
4. Lillisand, T. M. and Keifer, R. W. 1994. Remote Sensing and Image interpretation', John Willey and Sons, New York, Third Edition
5. Malczewski, J. 1999 GIS and Multicriteria Decision Analysis, John Willey and Sons, New York

REFERENCE BOOKS:

1. An Introduction to Database Systems by C.J.Date, A. Kannan S. Swamynathan (8th Ed.), Pearson Education, 2009.
2. Bonczek, R.H., C.W. Holsapple, and A.B. Whinston, 1981. Foundations of Decision Support Systems, Academic Press, New York. Basic text on DSS.
3. Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill, 2002.
4. Fundamentals of Database Systems by Elmasri and Navathe, (6th Ed.), Addison-Wesley, 2011.
5. Geoffrion, A.M., 1983. "Can OR/MS evolve fast enough?" Interfaces 13:10. Source for six essential characteristics of DSS.
6. House, W.C. (ed.), 1983. Decision Support Systems, Petrocelli, New York. Basic DSS text.
7. P.S. Roy (2000) Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS)
8. Schultz, G. A. and Engman, E. T. 2000. Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
9. Spatial Technologies for Natural Hazard Management. Proceedings of ISRS National Symposium, Nov. 21-22, 2000, IIT, Kharagpur.
10. Sprague, R.H., 1980. "A framework for the development of decision support systems," Management Information Sciences Quarterly 4:1-26. Source for DSS development model.
11. Sprague, R.H., and Carlson, E.D., 1982. Building Effective Decision Support Systems, Prentice-Hall, Englewood Cliffs NJ. Basic DSS text.

RSGC503X0: SPATIAL DATA SCIENCE AND SDSS

TEXT BOOKS:

1. Database Management Systems by Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill, 2002.
2. Malczewski, J. 1999 GIS and Multicriteria Decision Analysis, John Willey and Sons, New York
3. Gao, S., Hu, Y., & Li, W. (Eds.). (2023). Handbook of Geospatial Artificial Intelligence (1st ed.). CRC Press. https://doi.org/10.1201/9781003308423
4. McClain, B. P. (2022). Python for geospatial data analysis. O'Reilly
5. Pebesma, E.; Bivand, R. (2023). Spatial Data Science: With Applications in R (1st ed.). 314 pages. Chapman and Hall/CRC, Boca Raton. https://doi.org/10.1201/9780429459016

6. Comber, L., & Brunsdon, C. (2021). Geographical data science and spatial data analysis. SAGE Publications Ltd. https://doi.org/10.4135/9781526485465
7. An Introduction to Database Systems by C.J.Date, A. Kannan S. Swamynathan (8th Ed.), Pearson Education, 2009.

REFERENCE BOOKS:

1. House, W.C. (ed.), 1983. Decision Support Systems, Petrocelli, New York. Basic DSS text.
2. Sprague, R.H., 1980. "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. Jordan, D. S. (2023). Applied geospatial data science with Python: Take control of implementing, analyzing, and visualizing geospatial and spatial data with GeoPandas and more. Packt Publishing Limited
5. Matthew Forrest. Spatial SQL: A Practical Approach to Modern GIS Using SQL. Autor/in Herausgeber, Tyler J Mitchell, Keith Mitchell,, Verlag, Locate Press, 2023.
6. Qiusheng Wu, Earth Engine and Geemap - Geospatial Data Science with Python, Locate Press. July 2023. https://book.geemap.org/index.html

RSGC504X0: FUNDAMENTAL OF RESEARCH AND GEOSPATIAL PROJECT MANAGEMENT

TEXT BOOKS:

1. An Introduction to Geographical Information Systems by Ian Heywood Sarah Cornelius Steve Carver, Fourth edition, Pearson Education Limited 1998, 2011.
2. GIS Research Methods: Incorporating Spatial Perspectives by Sheila Lakshmi Steinberg (Author), Steven J. Steinberg (Author)
3. GIS Research Methods – 1 January 2025 by Prakhar Mukherjee (Author)

REFERENCE BOOKS:

1. Introducing Research Methodology: a Beginner's Guide to Doing a Research Project by Uwe Flick
2. Research Methodology, Methods and Techniques – 1 January 2023 by C R Kothari (Author)

SPECIAL PAPER: The students have to select any one of the following subjects (A-J), as proposed by the department, likely to be offered as elective special papers.

RSGE505A0: THEORETICAL CONSIDERATIONS OF GEO-INFORMATICS IN COASTAL MANAGEMENT

1. Carter, R. W. G., 1989. Coastal Environments: An Introduction to Physical, Ecological and Cultural Systems of Coastlines, Academic Press Ltd.
2. Paul, A., 2002. Coastal Geomorphology and Environment, ACB Publications, Kolkata, 582p
3. Paul, A., 2005. Tsunami-an assessment of disasters, ACB Publications, Kolkata, 125p
4. Pethic, J., 1983. An Introduction to Coastal Geomorphology, Arnold Publishers
5. Woodrooffe, C., 2002. Coasts-form, process and evolution, Cambridge University Publications, 688p

RSGE510F0: APPLICATION OF GEOINFORMATICS IN EARTH SCIENCES

1. Drury, S.A. 1993. Image interpretation in geology, Chapman & Hall India.
2. Jenson, J.R. 2000. Remote Sensing of the environment – An Earth Resource Perspective, Prentice Hall Inc.

3. Lillisand, T. M. and Keifer, R. W. 1994. Remote Sensing and Image interpretation', John Willey and Sons, New York, Third Edition
4. Murk & Skinner. 1999. Geology Today- Understanding our planet, John Wiley and Sons Inc, New York
5. Pandey, S. N. 1987. Principal and applications of photogeology. New Delhi: Eastern Wiley.
6. Sabins, Floyd F. 1986. Remote Sensing: Principles and Interpretation, 2nd ed., Freeman, New York.
7. Thornbury, W. D. (I960): Principles of Geomorphology, John Wiley and Sons, New York

RSGE515K0: GEOINFORMATICS IN URBAN, RURAL DEVELOPMENT & REGIONAL PLANNING A THEORETICAL CONSIDERATION

1. Brench M.C., City Planning and Aerial Information, Harvard University, Cambridge, 1971

RSGE517M0: THEORETICAL CONSIDERATIONS IN EVIRONMENTAL SCIENCE AND MANAGEMENT

1. Baretl, E.C. and Culis I.F. Introduction to Environmental Remote Sensing, Second edition, Chapman and Hall, New York, 1993.
2. Simmons, T.G. The Ecology of Natural Resources, Edword Arnold, London, 1974.
3. Baretl, E.C. and Culis I.F. Introduction to Environmental Remote Sensing, Second edition, Chapman and Hall, New York, 1993.
4. Lintz, J.andSimonent,D.S. Remote Sensing of environment Addision Wesley, Rading mars, 1976.

RSGE521Q0: GEOINFORMATICS IN TRANSPORT NETWORK ANALYSIS

1. Network Analysis in Geography. St Martin's Press Haggett P, Chorley R J
2. Spatial Processes: Models and Applications. Pion Cliff A D, Ord J K

RSGE507C0: GEOINFORMATICS IN WATERSHED MANAGEMENT

1. Dutta, D., Sharma, J.R. and Adiga, S. (2002). Watershed characterization, development planning, and monitoring- Remote sensing approaches, Tech. Report, ISRO-NNRMS-TR- 103-2002.
2. Manual of Remote Sensing, vol-II, Chapter on "Water Resources Assesment". American Society of Photogrammtery.
3. Murthy, J. V. S. 1994. Watershed Management in India. Wiley Eastern Ltd., New Delhi.
4. Schultz, G. A. and Engman, E. T. 2000. Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
5. Schultz, G.A. &Engman, E.T., 2000. Remote Sensing in hydrology and water management, Springer-Verlang, Berlin, Germany.
6. Todd David Keith. 1980. Groundwater Hydrology, John Wiley & Sons, New York, Second Edition.

RSGE523S0: GEOINFORMATICS IN UTILITY MANAGEMENT

1. Escritt, L. B., Water Supply and Building Sanitation, 4th Ed., Mac Donald and Evans Limited, 1972
2. Hammer, Mark J., Water and wastewater Technology, 2nd Ed., John Willey and Sons Inc., 1986.
3. Harries K (1999) Mapping Crime: Principle and Practice. Washington, DC: Crime Mapping Research Center, Department of Justice
4. Hodder I, Orton C (1979) Spatial Analysis in Archaeology. Cambridge: Cambridge University Press

RSGE514J0: APPLICATION OF GEO-INFORMATICS IN SOIL AND AGRICULTURE

1. GhassemAsrar, Theory and application of optical remote sensing. John Wiley & Sons, New York, 1989.
2. 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.
3. Space Applications Centre –Status Report on Crop Acreage and Production Estimation, Report No. RSAM/SAC/CAPE/SR/ 25/90, October 1990, pp-253.

4. Steven, M.D. and Clark, J.A. Application of Remote Sensing in Agriculture, Butterworths, London, 1990.

RSGE519O0: GEOINFORMATICS IN RESOURCE MANAGEMENT

1. Lillisand, T. M. and Keifer, R. W. 1994. Remote Sensing and Image interpretation', John Willey and Sons, New York, Third Edition
2. Miller, R. W. and Donahue, R. L. (1990): Soils, Prentice-Hall of India
3. Robert G. Reeves: Manual of Remote Sensing Vol. II American Society of Photogrammetry and Remote Sensing, Falls Church.DonaldA Davidson: Soils and Land use Planning, Longman, London, 1998.
4. Robert W. Colwell. Monitoring of Earth Resources from Aircraft and Spacecraft, NASA, Washington DC.
5. Simmons, T.G. The Ecology of Natural Resources, Edword Arnold, London, 1974.