



Maharshi Dayanand Saraswati University

Ajmer

SYLLABUS

MSc Remote Sensing and Geo-Informatics

(SEMESTER SCHEME)

Semester I & II Examination 2026-2027

Semester III & IV Examination 2027-2028

MSc Remote Sensing and Geo-Informatics

Scheme of Evaluation

(A) Internal Evaluation – 30 Marks

(i) For Affiliated Colleges

The internal assessment shall consist of the following components:-

- First Internal Test – 10 Marks
- Second Internal Test – 10 Marks
- Hand written Assignment – 05 Marks
(to be written in approximately 500 words)
- Attendance – 05 Marks
- Total – 30 Marks**

(ii) For University Departments

The concerned Department shall devise its own scheme for Internal Assessment and intimate the same to the University Examination Section.

Both the University Department and the Affiliated Colleges shall submit the consolidated Internal Assessment marks (out of 30 marks) to the Examination Section within the prescribed time.

The detailed records and supporting documents relating to Internal Assessment shall be maintained by the respective Departments/Colleges in accordance with the Standard Operating Procedure issued by the University Examination Section.

(B) End Semester Examination – 70 Marks

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A: Section of 20 marks and consist of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are be compulsory.

Section B: Section of 30 marks and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of 20 marks, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each.

Distribution of Marks Component:-

- **Internal Evaluation** – **30 marks**
- **End-Semester Examination** – **70 marks**

Note : –

- (i) For Non- Collegiate Students, there shall be only One Terminal Examination of 100 containing the Section A, B and C. (Theory Paper will be of 70 Marks, the marks obtained from 70 Marks will be proportionately upgraded to as marks obtained from 100 Marks and will be awarded in Mark sheet.
- (ii) The examiner shall ensure adequate coverage of the prescribed syllabus while setting the question paper and, maintain a balanced representation of all Units.

The Teacher concerned, shall upload the marks online and submit awards in **3 Copies**, One will be retained by the Head / Principal and Two Copies of awards

- (i) Duly signed both by the Head/ Principal and the Teacher concerned shall be sent to the University Examination Section.
A Copy of the Performa shall be sent every college/ department by the University Examination Section.
- (ii) The student has to qualify both the Internal Assessment and External Assessment separately. The minimum qualifying marks in both shall be 40 percent.
- (iii) The scheme will be applicable only to Major/ Multidisciplinary Subject (Not to AEC, SEC and VAC) opted by the student.

MASTER'S PROGRAMME IN M.Sc. REMOTE SENSING & GEOINFORMATICS

Credit Score and Scheme

**TABLE 1: STRUCTURAL FRAMEWORK OF THE TWO YEARS M.SC. PROGRAM
UNDER NEP-2020**

SEMESTER	SEM-I	SEM-II	SEM-III	SEM-IV
Core Courses	DCC-01-Th (4 Cr) DCC-02 Th (4 Cr) DCC-03 Th (4 Cr) DCC-04 Th (4 Cr) DCC-05 P (4 Cr)	DCC-06-Th (4 Cr) DCC-07 Th (4 Cr) DCC-08 Th (4 Cr) DCC-09 P (4 Cr)	DCC-10-Th (4 Cr) DCC-11Th (4 Cr) DCC-(12 P (4 Cr)	DCC-13-Th (4 Cr) DCC-(14) Th (4 Cr) DCC-(15) P (4 Cr)
Discipline Specific Elective (DSE) / Generic Elective Courses (GEC)		DSE- 01 A Th (4 Cr) DSE- 01 BTh (4 Cr)	DSE-(02) A Th (4 Cr) DSE-(02) B Th (4 Cr) DSE-(03) ATh (4 Cr) DSE-(03)BTh (4 Cr)	DSE-(04 A) Th (4 Cr) DSE-(04 B) Th (4 Cr) DSE-(05 A) Th (4 Cr) DSE-(05 B) Th (4 Cr) OR <u>DSE OR DISSERTATION</u>
Total No. of Credits	20 + 0 = 20	16 + 4 = 20	12 + 8 = 20	12 + 8 = 20
	60 (DCC) + 20 (DSE) = 80			

- Duration of examination of each course shall be 3 hours (for Theory courses) and 4 hours (for Practical courses).
- Each Core and Elective course will be of 100 marks (70+ 30).
- It is mandatory to clear Theory and Internal Assessment courses separately. The minimum qualifying marks in both shall be 40 percent.

2.0 SCHEME OF TWO YEARS POST GRADUATE DEGREE M.Sc. REMOTE SENSING & GEOINFORMATICS ProgrammeCode:

ProgrammeFaculty: _____

ProgrammeName: TWO YEAR POST-GRADUATE DEGREE PROGRAM IN REMOTE SENSING & GEOINFORMATICS

SCHEMEANDWEIGHTAGEOFCOURSES

S. No.	Course Category	Title of the Course	Credits			Credits earned	Evaluation			Remarks
			L	T	P		IA	ESA	Total	
SEMESTER – I										
1	RSGI DCC – 01	FUNDAMENTALS OF REMOTE SENSING	4	0	0	4	30	70	100	All Courses are compulsory Courses
2	RSGI DCC – 02	FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM	4	0	0	4	30	70	100	
3	RSGI DCC – 03	GEODESY AND GNSS	4	0	0	4	30	70	100	
4	RSGI DCC – 04	DIGITAL CARTOGRAPHY AND TOPOGRAPHICAL MAPS	4	0	0	4	30	70	100	
5	RSGI DCC – 05	PRACTICAL	4	0	0	4			100	
			Total Credits in Semester I			20	Total Marks in Semester I		500	
SEMESTER – II										
6	RSGI DCC – 06	THERMAL, MICROWAVE AND HYPERSPECTRAL REMOTE SENSING	4	0	0	4	30	70	100	

7	RSGI DCC – 07	AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY	4	0	0	4	30	70	100	
8	RSGI DCC – 08	DIGITAL IMAGE PROCESSING	4	0	0	4	30	70	100	
9	RSGI DSE– 01A	FORESTRY MONITORING & GEOSPATIAL APPLICATION	4	0	0	4	30	70	100	Student may opt any one
	RSGI DSE– 01B	FUNDAMENTALS OF LIDAR TECHNOLOGY AND DATA ACQUISITION								
10	RSGI DCC – 09	PRACTICAL	4	0	0	4			100	
			Total Credits in Semester II			20	Total Marks in Semester II		500	
SEMESTER – III										
11	RSGI DCC – 10	APPLIED STATISTICS AND RESEARCH METHODOLOGY	4	0	0	4	30	70	100	
12	RSGI DCC – 11	COMPUTING AND AI FOR GEOSPATIAL APPLICATIONS	4	0	0	4	30	70	100	
13	RSGI DSE – 02A	HYDROLOGY AND WATER RESOURCES ENGINEERING	4	0	0	4	30	70	100	Student may opt any one
	RSGI DSE – 02B	ADVANCED EARTH OBSERVATION AND CLIMATE ANALYSIS								
14	RSGI DSE – 03A	GEOSPATIAL FOR RESOURCE MANAGEMENT	4	0	0	4	30	70	100	Student may opt any one
	RSGI DSE – 03B	APPLIED GEO-INFORMATION IN GEOLOGY								
15	RSGI DCC – 12	PRACTICAL	4	0	0	4			100	
			Total Credits in Semester III			20	Total Marks in Semester III		500	
SEMESTER – IV										
16	RSGI DCC- 13	ENVIRONMENTAL PLANNING & IMPACT	4	0	0	4	30	70	100	

		ASSESSMENT								
17	RSGI DCC- 14	URBAN AND REGIONAL PLANNING	4	0	0	4	30	70	100	
18	RSGI DSE –4A*	GEOSPATIAL IN SOIL AND AGRICULTURE	4	0	0	4	30	70	100	*Students may opt any one
	RSGI DSE –4B*	FUNDAMENTALS OF UAV REMOTE SENSING AND AERIAL DATA ACQUISITION								
19	RSGI DSE –5A*	GEOSPATIAL FOR DISASTER RISK MANAGEMENT	4	0	0	4	30	70	100	*Students may opt any one
	RSGI DSE –5B*	SPATIAL ANALYSIS AND MODELLING IN GIS								
20	RSGI DSE –6*	DISSERTATION	8	0	0	8			200	
21	RSGI DCC –15	PRACTICAL	4	0	0	4			100	
			Total Credits in Semester IV			20	Total Marks in Semester IV		500	
		Total Credits in all semester (20+20+20+20)				80	Total Marks in all semesters		2000	

Note:

- * STUDENTS have the Option to OPT For Discipline Specific RSGI DSE – 4/ RSGI DSE– 5 OR RSGIDSE–6 DISSERTATION (INTERNSHIP OF 3 MONTHS)**
- Course Categories :** DCC–Discipline Core Course ;DSE–Discipline Specific Elective
- Contact Hours:** Lecture-1 Credit=1Hour/ Week

SEMESTER – I

1	RSGI DCC – 01	FUNDAMENTALS OF REMOTE SENSING	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit: I

Basic of Remote Sensing: evolution, principles, and components of Remote Sensing. Advantages, limitations, Development of Remote Sensing in India and the role of ISRO in Earth observation. Fundamentals of Electromagnetic Radiation (EMR): nature and properties of EMR, electromagnetic spectrum, blackbody radiation and laws , Interaction of EMR with the atmosphere and earth surface spectral signatures of water, soil, vegetation, snow, ice, and urban features. Concept of spectral response curves and resolutions.

Unit: II

Platforms and Satellite Systems: principles, classification, and characteristics. Passive and active sensors; imaging and non-imaging sensors. Scanning systems, Optical, thermal infrared, microwave, SAR, and LiDAR sensors. Instantaneous Field of View (IFOV), swath width, revisit period, signal-to-noise ratio, and radiometric sensitivity. Satellite orbits characteristics and major Earth observation satellite missions including IRS, Resourcesat, Cartosat, Oceansat, RISAT, INSAT, Landsat, Sentinel, SPOT, WorldView, QuickBird, IKONOS, NOAA, GOES, MODIS, Terra, Aqua, and NIMBUS. Satellite data products, metadata, data formats, and data acquisition from national and international repositories.

Unit: III

Image Interpretation: Basic principles, Types, Steps and elements, Techniques of visual interpretation and interpretation key, Multidate, Multispectral and multidisciplinary concepts,

Ground truth instruments and spectral signature, Requirements of ground truth, Remote Sensing data products and their procurements, Application of Remote Sensing, Real and Ideal Remote Sensing system.

Suggested Reading

1. Lillesand, T.M., Kiefer, R.W. & Chipman, J.W. (2015). *Remote Sensing and Image Interpretation*. Wiley.
2. Campbell, J.B. & Wynne, R.H. (2011). *Introduction to Remote Sensing*. Guilford Press.
3. Jensen, J.R. (2016). *Introductory Digital Image Processing*. Pearson.
4. Jensen, J.R. (2015). *Remote Sensing of the Environment*. Pearson.
5. Sabins, F.F. & Ellis, J.M. (2020). *Remote Sensing: Principles, Interpretation and Applications*. Waveland Press.
6. Richards, J.A. (2013). *Remote Sensing Digital Image Analysis*. Springer.
7. Joseph, G. (2018). *Fundamentals of Remote Sensing*. Universities Press.
8. ISRO–IIRS. *Remote Sensing Course Material*.
9. NRSC/ISRO Earth Observation Data User Guides.

2	RSGI DCC – 02	FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit: I

Definition of GIS, Historical development, Terminology, GIS components, Hardware and software requirements for GIS, Concept of data, Geographic data sources (Remote Sensing, GPS, Maps and Field observations), Data structure in GIS, Type of data (Point, Line and Polygons), Data acquisition procedure, GIS data formats (Raster and Vector), GIS software, GIS workflow, Theoretical framework for GIS, Recent trends in GIS.

Unit: II

Data input methods, Source of errors, Data quality, Different types of geospatial data, Object-Based vector data model, Types of spatial data structure, Advantage and Disadvantage of various data structure. Raster and Vector data analysis: Raster Data analysis: Local, Neighborhood and Regional Operations – Map Algebra; Vector Data Analysis: Topological Analysis, point-in-polygon, Line-in-polygon, Polygon-in-Polygon – Proximity Analysis: buffering.

Unit: III

Database concepts, Development, Implementation and design, database management system (DBMS), Relational database management system (RDBMS), and Object Oriented database (OODS). GIS and Remote data integration, concept and need of integration, Image storage formats, Data quality, Concepts and Models of Network analysis, Digital Elevation Model (DEM), Methods of development and application of DEM, Triangulated Irregular Network (TIN), Geo-visualization, Application of Remote Sensing and Geographic Information System.

Suggested Reading:

1. Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. *Principles of Geographical Information Systems*.
2. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. *Geographic Information Science and Systems*.
3. Chang, K. T. *Introduction to Geographic Information Systems*.
4. DeMers, M. N. *Fundamentals of Geographic Information Systems*.
5. Heywood, I., Cornelius, S., & Carver, S. *An Introduction to Geographical Information Systems*.
6. Law, M., & Collins, A. *Getting to Know ArcGIS Pro*.
7. QGIS Development Team. *QGIS User Guide*.
8. ESRI. *ArcGIS Pro Documentation*.
9. ISRO–IIRS. *GIS and Geospatial Technologies Course Material*.

3	RSGI DCC – 03	GEODESY AND GNSS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit: I

Brief history of Geodesy, Geoid, Datum and Ellipsoid or Spheroid, Mean sea level, Indian Geodetic system, Coordinate systems, Map type, Symbols and Scales, Indian grid system and Map numbering, Earth fixed X, Y and Z, Historical evaluation and spatial information system.

Unit: II

Fundamentals of Reference Systems and Frames: Geodetic and Cartesian coordinate system; principles of coordinate transformation; Datums: Horizontal and vertical datums – national, regional and local datums; Major datums and Indian datum; World Geodetic System (WGS) WGS84; tidal datums. Satellite observational systems: Doppler; laser; Basic concepts- IRNSS, NAVSTAR, GLONASS, GALILEO, MTSAT, Beidou and GAGAN.

Unit: III

Global Positioning System (GPS): Elements – space segment, user segment and control segment; Observation principles; phase measurement techniques; GPS Error Sources and Error Handling Procedures; interference and jamming; Accuracy issues, GPS satellite navigation message, Multi-Channel, sequential and multiplexing receivers; Positioning methods: Differential, RTK, and Field data collection, DGPS, Mobile mapping, Applications of GPS.

Suggested Reading

1. Hofmann-Wellenhof, B., Lichtenegger, H., & Wasle, E. (2008). *GNSS – Global Navigation Satellite Systems*. Springer.
2. Leick, A., Rapoport, L., & Tatarnikov, D. (2015). *GPS Satellite Surveying* (4th ed.). Wiley.
3. Van Sickle, J. (2015). *GPS for Land Surveyors*. CRC Press.
4. Seeber, G. (2003). *Satellite Geodesy* (2nd ed.). Walter de Gruyter.
5. Torge, W., & Müller, J. (2012). *Geodesy* (4th ed.). Walter de Gruyter.
6. Misra, P., & Enge, P. (2012). *Global Positioning System: Signals, Measurements and Performance*. Ganga-Jamuna Press.
7. ISRO. *NavIC User Handbook*.
8. IIRS. *GNSS and GPS Course Material*.
9. NOAA. *National Geodetic Survey Publications*.

4	RSGI DCC – 04	DIGITAL CARTOGRAPHY AND TOPOGRAPHICAL MAPS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit: I

Introduction to Cartography, Map Design Principles: Hierarchy of map elements, Typography and font selection, Color theory in cartography, Labeling and annotation guidelines. Evolution of Cartographic Tools: From hand-drawn maps to digital cartography, Historical maps and their significance, Purpose and Classification of map- according to scale, according to amount of topographic details, according to purpose, according to style of construction (Qualitative and Quantitative).

Unit: II

Map Elements and Layout. Advanced Map Projections: Conic, cylindrical, and azimuthal projections, Equal-area vs. conformal projections, specialized projections for thematic mapping (Albers Equal Area, Lambert Conformal Conic). Layout Design: Grids and graticules for map organization, Legends for complex datasets, Design principles for multi-map layouts (Atlas design).

Unit: III

Introduction of topographical maps, Survey of India maps, Classification of Toposheet, Conventional Sign and Symbol, Interpretation of physical and culture features from topographical map, Triangulated height, Spot height, Bench marks, Relative height, Measurement of distances, directions, Gradients and area, Locating places in topographical maps: Latitudes and Longitudes, Universal Transverse Mercator zones, Four and Six- Figure grid references

Suggested Reading:

1. Dent, B. D., Torguson, J., &Hodler, T. (2009). *Cartography: Thematic Map Design*. McGraw-

Hill.

2. Slocum, T. A. et al. (2022). *Thematic Cartography and Geovisualization*. CRC Press.
3. Robinson, A. H. et al. (1995). *Elements of Cartography*. Wiley.
4. Tyner, J. A. (2014). *Principles of Map Design*. Guilford Press.
5. Kraak, M. J., & Ormeling, F. (2020). *Cartography: Visualization of Geospatial Data*. CRC Press.
6. Survey of India. *Topographical Map Reading Manual*.
7. ESRI. *Mapping and Visualization Guide*.
8. ICA. *Cartographic Standards and Guidelines*.
9. QGIS Documentation Team. *Print Layout Manual*.

5	RSGI DCC – 05	Practical	4 Credit
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Duration: 4hrs

Maximum Marks: 100

1. Visual Image Interpretation

- a. Interpretation of satellite images derived from Landsat, Spot, Quick Bird, PAN, LISS, Wifs etc. and visualizations of satellite image for physical features: Urban, Forest, Agriculture land use, Scrub land, Network patterns etc.
- b. Visual analysis of satellite data and their area calculation using dot grid and planimeters.

2. Geographic Information System (GIS) using open source GIS software QGIS:

Spatial data creation (Point, Line and Polygon), Digitization, Editing, Clip, Buffer, Merge, DEM, Topology building, Spatial and Non-spatial data integration (Linking of tables and joining tables).

3. Mapping and Surveying report using GPS

- a. Track analysis
- b. Route Survey
- c. Field data collection and import into GIS

4. Topographical

- a. Introduction of topographical maps.
- b. Identification to SOI topographical maps- Numbering, Scale, Grid reference, Sign and Symbol, Color System.
- c. Profile and Identification and representation of Land forms.
- d. Interpretation of physical and culture features from topographical map.
- e. Identification of location through four grid and six grid system

SEMESTER – II

6	RSGI DCC – 06	THERMAL, MICROWAVE AND HYPERSPECTRAL REMOTE SENSING	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit: I

Introduction to thermal IR radiation properties and law, Thermal radiation principle, Thermal properties of materials, Characteristics of thermal IR images and Factors affecting thermal imagery- atmospheric and other factors, Thermal Remote Sensing sensors, Thermal data sets: Landsat and ASTER, Application of thermal remote sensing, Qualitative and Quantitative analysis.

Unit: II

Concepts of microwave remote sensing and its components, Active and Passive microwave system, Backscattering, Cross-Section, Wavelength, Incidence angle, aspect angle, Polarization, Complex dielectric properties, Surface roughness, Surface geometry, Volume scattering,. LiDAR components, Types and system, Basics concepts of LiDAR, RADAR, SONAR, SAR , Side looking airborne radar (SLAR), geometric characteristics, components, wavelengths range and azimuth resolution, Transmission characteristics of radar signals and other radar image characteristics, Radar image interpretation

Unit: III

History of Hyperspectral imaging, Spectral radiometry difference between remote sensing, Comparison of Multispectral and Hyperspectral image data, Spectral signature, Hyperspectral types and characterization, Hyperspectral remote sensing atmosphere, Data format and system, Hyperspectral data processing techniques software, Hyperspectral data classification, Techniques for analysis of Hyperspectral data, Hyperspectral remote sensing imaging spectrometers,

Suggested Reading:

1. Lillesand, T., Kiefer, R., & Chipman, J. *Remote Sensing and Image Interpretation*. Wiley.
2. Jensen, J. R. *Remote Sensing of the Environment*. Pearson.
3. Richards, J. A. *Remote Sensing Digital Image Analysis*. Springer.
4. Schowengerdt, R. A. *Remote Sensing: Models and Methods*. Academic Press.
5. Rees, W. G. *Physical Principles of Remote Sensing*. Cambridge University Press.
6. Joseph, G. *Fundamentals of Remote Sensing*. Universities Press.
7. ISRO–NRSC. *Microwave & Thermal Remote Sensing Manual*.
8. ESA. *Sentinel SAR User Guide*.
9. NASA Earthdata. *Hyperspectral Remote Sensing Resources*

7	RSGI DCC – 07	AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit: I

Aerial photography: Scope, Advantages and Limitation; Flight planning, Aerial cameras types and their characteristics, Including digital mapping camera, Geometry of aerial photographs, Season and time, Photo Index, Scale of aerial photographs and its determination, Comparison of aerial photographs and Map.

Unit: II

Basics concepts of photogrammetry terms, photogrammetric Stereovision: Overlap required for stereovision, Binocular vision, Accommodation and Convergence, Stereoscopic viewing,

Principle of stereoscope, Pocket and Mirror stereoscopes; Digital Photogrammetry: methods and principles, Comparison of aerial photo and terrestrial photographs.

Unit: III

Measurement of absolute and differential parallax, Parallax bar and wedge, Measurement of height, principle of floating marks, contouring from stereometric height, Measurement of slope Stereoscopic exaggeration; model deformation, Elements of exterior and interior orientation; Aero-Triangulation: Radial line method, graphical mechanical and analytical methods, scaling, GCP and rectification, plotting; Aerial Mosaic: Uncontrolled, Semi-controlled and controlled mosaics, Ortho-photographs,

Suggested Reading

1. Wolf, P. R., Dewitt, B. A., & Wilkinson, B. *Elements of Photogrammetry*. McGraw-Hill.
2. Moffitt, F., & Mikhail, E. *Photogrammetry*. Harper & Row.
3. Lillesand, T., Kiefer, R., & Chipman, J. *Remote Sensing and Image Interpretation*. Wiley.
4. Kraus, K. *Photogrammetry: Geometry from Images and Laser Scans*. Walter de Gruyter.
5. McGlone, C. *Manual of Photogrammetry*. ASPRS.
6. ISRO-IIRS. *Photogrammetry Course Material*.
7. ASPRS. *Digital Photogrammetry Guidelines*.
8. Survey of India. *Aerial Survey Manual*.
9. Esri. *Drone2Map Documentation*.

8	RSGI DCC – 08	DIGITAL IMAGE PROCESSING	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit-I

Data Products, Image Formation and Pre-processing: satellite data products and their characteristics, digital image formation, image display mechanisms, image histograms, and look-up tables (LUTs). It covers the principles and techniques of image pre-processing, including

atmospheric, radiometric, and geometric corrections, orthorectification, and ground truth collection. The unit also emphasizes the basic principles of visual image interpretation and the importance of pre-processing in improving image quality for analysis.

Unit-II

Image Enhancement and Classification Techniques: This unit focuses on digital image enhancement techniques, including linear and non-linear contrast enhancement, density slicing, pseudo-colour generation, spatial enhancement using convolution filtering, spectral enhancement, image algebra, Principal Component Analysis (PCA), and data fusion. It further introduces image classification concepts, covering supervised, unsupervised, and hybrid classification approaches, training sample selection, feature space analysis, signature generation and separability, Bayes decision rule, parametric and non-parametric classifiers, minimum distance, parallelepiped, and maximum likelihood methods. The unit also includes classification accuracy assessment using confusion matrices, error analysis, kappa coefficient, and multi-temporal image analysis for change detection.

Unit-III

Advanced Image Analysis and Geospatial Applications: This unit covers advanced image analysis techniques, including machine learning approaches, object-based image analysis (OBIA), texture analysis, fuzzy classification, Artificial Neural Networks (ANN), Support Vector Machines (SVM), sub-pixel mixture analysis, and object-oriented image classification. It also introduces image segmentation methods such as watershed, mean-shift, minimum description length (MDL), and edge detection.

Suggested Reading

1. Jensen, J. R. *Introductory Digital Image Processing*. Pearson.
2. Richards, J. A., & Jia, X. *Remote Sensing Digital Image Analysis*. Springer.
3. Gonzalez, R. C., & Woods, R. E. *Digital Image Processing*. Pearson.
4. Schowengerdt, R. A. *Remote Sensing Models and Methods*. Academic Press.
5. Campbell, J. B., & Wynne, R. H. *Introduction to Remote Sensing*. Guilford Press.
6. ERDAS Imagine User Guide.
7. ENVI User Guide.
8. ISRO-IIRS. *Digital Image Processing Manual*.
9. QGIS Documentation Team.

9	RSGI DSE – 01A	FOREST MONITORING AND GEOSPATIAL APPLICATIONS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit I

Forest Resources, Mapping and Inventory: geographical distribution, forest types, extent, and status of vegetation; Global Forest Resource Assessment (FRA), forest cover classification systems; Principles of vegetation mapping using Vegetation phenology and vegetation indices for forest monitoring; Forest degradation mapping and monitoring.; Forest inventory: concepts, objectives, sampling design, sampling methods, statistical analysis, growing stock estimation, and biomass assessment.

Unit II

Forest Informatics and Ecosystem Analysis: Ecological niche concept and Species Distribution Modelling, Wildlife habitat suitability analysis, protected area management, and satellite telemetry for wildlife movement studies. Forest ecosystem; Landscape ecology; Biodiversity assessment, conservation prioritization, ecosystem services, and ecosystem valuation.

Unit III

Forest Disturbance and Environmental Assessment: climate change, interactions, impacts, and adaptation strategies. ; Forest fire ecology and fire regimes. ; Earth Observation (EO)-based active fire detection, burnt area mapping, fire severity assessment, and post-fire recovery monitoring. ; Forest fire risk zonation, and geospatial technologies in sustainable forest management and climate resilience.

Suggested Reading

1. FAO. (2020). Global Forest Resources Assessment 2020: *Main Report. Food and*

Agriculture Organization of the United Nations.

2. Nagendra, H., & Gadgil, M. (1999). *Satellite imagery as a tool for monitoring species diversity: An overview. International Journal of Remote Sensing*, 20(14), 2821–2830.
3. Franklin, J. (2010). *Mapping Species Distributions: Spatial Inference and Prediction*. Cambridge University Press.
4. McGarigal, K., Cushman, S. A., & Ene, E. (2012). *FRAGSTATS v4: Spatial Pattern Analysis Program for Categorical and Continuous Maps*. University of Massachusetts.
5. Roy, D. P., Boschetti, L., & Trigg, S. N. (2006). *Remote sensing of fire severity: Assessing the performance of the normalized burn ratio. IEEE Geoscience and Remote Sensing Magazine*, 44(10), 315–321.
6. IPCC. (2023). *Climate Change 2023: Synthesis Report. Intergovernmental Panel on Climate Change*.

9	RSGI DSE – 01B	FUNDAMENTALS OF LIDAR TECHNOLOGY AND DATA ACQUISITION	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit I

Introduction to LiDAR: principles and evolution of LiDAR technology. Types of LiDAR; Advantages and limitations. Components of a LiDAR system; LiDAR data acquisition, flight planning, pulse emission, time-of-flight principle, accuracy, precision, survey parameters, and sources of error.

Unit II

LiDAR Data Processing and 3D Terrain Modelling, LiDAR data processing; LiDAR returns and point cloud processing, classification, filtering, noise removal, and feature extraction. Generation and LiDAR intensity data, normalization, and applications in land cover mapping and surface characterization.

Unit III

Applications of LiDAR in topographic mapping, terrain analysis, forestry (canopy height, biomass, forest inventory, carbon estimation), and urban mapping. Bathymetric LiDAR for coastal and inland water mapping. Emerging applications in agriculture, mining, archaeology, disaster management, environmental monitoring, change detection, and digital twin modelling.

Books Recommended:

1. Wehr, A., & Lohr, U. (1999). *Airborne laser scanning—An introduction and overview*. *ISPRS Journal of Photogrammetry and Remote Sensing*, 54(2–3), 68–82.
2. Vosselman, G., & Maas, H.-G. (Eds.). (2010). *Airborne and Terrestrial Laser Scanning*. Whittles Publishing.
3. Liu, X. (2008). *Airborne LiDAR for DEM generation: Some critical issues*. *Progress in Physical Geography*, 32(1), 31–49.
4. Shan, J., & Toth, C. K. (Eds.). (2018). *Topographic Laser Ranging and Scanning: Principles and Processing (2nd ed.)*. CRC Press.
5. NOAA. (n.d.). *Digital Coast: LiDAR Data and Information*. National Oceanic and Atmospheric Administration.
6. USGS. (n.d.). *3D Elevation Program (3DEP) Products and Services*. U.S. Geological Survey.

10	RSGI DCC – 09	Practical	4 Credit
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Duration: 4hrs

Maximum Marks: 100

1. Aerial Photograph and Photogrammetry

- a. Study of Aerial stereo photo.
- b. Determination of photo scale and relief displacement mirror stereoscope and parallax bar.
- c. Annotation of aerial photographs, drawing of flight line, Height measurement of an object using stereo model.
- d. Determination of height of object and slope.
- e. Interpretation of single aerial photograph and comparison with a stereo pair,
- f. Interpretations of aerial photographs for the mapping of geomorphology, land use/ land cover and transport network.

2. **Digital Image Processing (ERDAS):-**Digital conversion- Scanning method, Image rectification; Define projection, Reprojection and mosaicking,; Digital database creation- Point, Line and Polygon, Editing, topology building, area and perimeter estimation; Radiometric enhancement- Linear and Nonlinear stretching, Histogram equalization, LUT stretch and Noise reduction; Image enhancement technique- Low pass filtering and High pass filtering; Data compression techniques- PCA; Resolution merging; NDVI, Supervised classification; Unsupervised classification; Object-oriented classification; Accuracy Assessment; Change detection; Map composition; Output preparation, Land use/ Land cover mapping.
3. **Forest Monitoring & Geospatial Applications Practical (QGIS/ERDAS):-**Study of forest types, forest cover mapping, forest boundary delineation, NDVI analysis, forest density mapping, LULC mapping, forest inventory database, biomass estimation, canopy cover mapping, habitat suitability analysis, biodiversity mapping, forest fragmentation analysis, forest fire risk mapping, burnt area mapping, sustainable forest management plan.
4. **Lidar practical (QGIS/ERDAS):-**Lidar data visualization, digital elevation model (DEM), Point Cloud Classification, canopy height analysis, 3D terrain mapping.

SEMESTER – III

11	RSGI DCC – 10	APPLIED STATISTICS AND RESEARCH METHODOLOGY	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

UNIT I

Introduces the principles and importance of applied statistics in geoinformatics and Earth system research, the concepts of population, sample, variables, data types, scales of measurement, data collection methods, descriptive statistics, frequency distribution, tabulation, graphical representation of data, measures of central tendency (mean, median, mode), measures of dispersion (range, variance, standard deviation, coefficient of variation), skewness, kurtosis, probability distributions, normal distribution, sampling distribution, probability theory, correlation analysis, covariance, simple and multiple regression, hypothesis testing, confidence intervals, t-test, chi-square test, ANOVA, non-parametric statistics, multivariate statistical analysis, principal component analysis (PCA), cluster analysis, spatial statistics

Unit II

Principles of scientific research methodology and the systematic process of conducting research in geospatial sciences. meaning, objectives, types, and approaches of research, including basic, applied, exploratory, descriptive, analytical, qualitative, quantitative, and mixed-method research. identification of research problems, formulation of research objectives, research questions, hypotheses, conceptual frameworks, literature review, research gap identification, sampling techniques, primary and secondary data collection, questionnaire design, field surveys, experimental design, geospatial data acquisition, Remote Sensing and GIS-based research methods, data validation, reliability, accuracy assessment, uncertainty analysis, research ethics, plagiarism, intellectual property rights, reproducibility of research

Unit III

Application of statistical analysis and research methodology in scientific investigation and professional research. Structure and preparation of research proposals, dissertations, theses, technical reports, project reports, conference papers, review articles, and research manuscripts. statistical interpretation of research findings, graphical and tabular presentation of results, and the application of statistics and research methodology.

Suggested Reading:

1. Montgomery, D. C., &Runger, G. C. *Applied Statistics and Probability for Engineers*. Wiley.
2. Walpole, R. E. et al. *Probability and Statistics for Engineers and Scientists*. Pearson.
3. Creswell, J. W. *Research Design*. Sage.
4. Kothari, C. R., & Garg, G. *Research Methodology*. New Age International.
5. Field, A. *Discovering Statistics Using SPSS*. Sage.
6. Hair, J. F. et al. *Multivariate Data Analysis*. Pearson.
7. ISRO–IIRS. *Research Methods in Geospatial Science*.
8. APA. *Publication Manual* (7th ed.).
9. UGC. *Research and Publication Ethics Manual*.

12	RSGI DCC – 11	COMPUTING AND AI FOR GEOSPATIAL APPLICATIONS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

UNIT I

Fundamentals of computer systems, computer architecture, CPU, memory, storage devices, operating systems, computer networks, Internet, cloud computing, cybersecurity, data security, number systems and data representation. Introduction to algorithms, flowcharts and computational problem solving. Introduction to Python and MATLAB programming, variables, data types, operators, conditional statements, loops, functions, arrays, matrices and basic data visualization.

UNIT II

Python and MATLAB programming for Remote Sensing and GIS applications. Lists, tuples, dictionaries, strings, file handling, exception handling, modules, packages and object-oriented programming. Introduction to NumPy, Pandas and Matplotlib, MATLAB matrix operations, scripts and functions. Digital image fundamentals, image enhancement, filtering, thresholding and edge detection. Introduction to DBMS, database architecture, ER model, keys, relationships and SQL queries for Remote Sensing and satellite data management.

UNIT III

Introduction to Artificial Intelligence, Machine Learning and Deep Learning. Supervised, unsupervised, semi-supervised and reinforcement learning, data preprocessing, feature engineering, training, validation, overfitting and model evaluation. Machine Learning algorithms including Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machine and K-Means clustering. Introduction to Neural Networks and CNN for image analysis. Applications of AI/ML in Remote Sensing and GIS including LULC classification, object detection, change detection, crop monitoring, disaster mapping, urban growth and environmental monitoring. Introduction to Google Earth Engine, cloud-based geospatial computing and GeoAI applications.

Suggested Reading

1. Goodfellow, I., Bengio, Y., & Courville, A. *Deep Learning*. MIT Press.
2. Géron, A. *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*. O'Reilly.
3. Longley, P. et al. *Geographic Information Science and Systems*. Wiley.
4. Chang, K. T. *Introduction to GIS*. McGraw-Hill.
5. ESRI. *ArcGIS Pro Python Reference*.
6. QGIS Documentation Team.
7. Google Earth Engine Documentation.
8. ISRO–IIRS. *GeoAI and Machine Learning Course Material*.
9. Tensor Flow Documentation.

13	RSGI DSE – 02A	HYDROLOGY AND WATER RESOURCES ENGINEERING	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit–I

Introduction to hydrology, hydrological cycle, water budgeting, water demand estimation, surface and groundwater resources, water resource scenario in India, meteorological parameters, rainfall mapping, evapotranspiration, atmospheric water content, cloud mapping, rain and cyclone forecasting, water quality parameters, glaciology including snow monitoring, snowmelt runoff estimation, river diversion studies, site suitability analysis for reservoirs and hydroelectric projects, and reservoir storage yield analysis.

Unit–II

Hydrograph Analysis, Flood and Drought Studies: Infiltration, effective rainfall, design storm, direct runoff hydrograph, unit hydrograph theory, runoff analysis, rational and NRCS methods, synthetic and ungauged catchment unit hydrographs, flood frequency analysis, floodplain zoning, flood estimation and forecasting, drought assessment, monitoring, and management.

Unit–III

Irrigation and Watershed Management: Mapping and monitoring of catchment and command areas, land irrigability mapping, crop water demand estimation, tank information systems, wetland and siltation mapping, watershed delineation, morphometric analysis, rainfall–runoff modelling, reservoir sedimentation, water harvesting structures, watershed development planning, and mapping of drought-prone areas.

Suggested Reading:

1. Chow, V. T., Maidment, D. R., & Mays, L. W. (1988). Applied Hydrology. McGraw-Hill.
2. Subramanya, K. (2013). Engineering Hydrology (4th ed.). McGraw-Hill Education.
3. Maidment, D. R. (Ed.). (1993). Handbook of Hydrology. McGraw-Hill.
4. USDA Natural Resources Conservation Service. (2004). National Engineering Handbook, Part 630: Hydrology.
5. WMO. (2012). Management of Water Resources. World Meteorological Organization.
6. Central Water Commission. (n.d.). Flood Forecasting and Hydrological Data Resources, Government of India.

13	RSGI DSE – 02B	ADVANCED EARTH OBSERVATION AND CLIMATE ANALYTICS	4 Credit
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Duration: 3hrs**Maximum Marks: 70**

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

UNIT-I

Earth Observation Systems and Climate Dynamics: Concepts and Components of Earth's Climate System, Atmosphere, Hydrosphere, Cryosphere, Biosphere and Lithosphere, Climate Variables and Essential Climate Indicators: Soil Moisture and Vegetation Indices., Earth Observation Data Sources, Climate Data Portals and Geospatial Databases., Principles of Climate Monitoring using Remote Sensing Techniques.

UNIT-II

Climate Change Assessment and Environmental Monitoring: Detection and Analysis of Climate Change using Geospatial Technologies., Monitoring of Land Surface Temperature (LST) and Urban Heat Island Effect., Drought Assessment, Vegetation Health Monitoring and Agricultural Applications., Glacier Retreat, Snow Cover Mapping and Cryosphere Studies., Ocean Observation: Sea Surface Temperature, Ocean Colour and Sea Level Rise., Greenhouse Gas Monitoring, Carbon Cycle Assessment and Environmental Sustainability.

UNIT–III

Climate Analytics, Modelling and Applications: Climate Data Analytics and Statistical Techniques for Environmental Studies., Trend Analysis and Climate Variability Assessment., Global Climate Models and Regional Climate Models; Geospatial Modelling for Climate Risk, Vulnerability and Adaptation Assessment., Water Resources, Agriculture and Ecosystem Management., Artificial Intelligence, Big Earth Data and Future Trends in Climate Analytics.

Suggested Readings :

1. IPCC. (2021). Climate Change 2021: The Physical Science Basis. Cambridge University Press.
2. IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge University Press.
3. Jensen, J. R. (2015). Introductory Digital Image Processing: A Remote Sensing Perspective. Pearson.
4. Justice, C. O., et al. (2002). The Moderate Resolution Imaging Spectroradiometer (MODIS): Instrument and mission. IEEE Transactions on Geoscience and Remote Sensing, 36(4), 1228–1240.
5. Copernicus Programme. (n.d.). Climate Data Store and Earth Observation Resources.
6. NASA Earthdata. (n.d.). Earth Observation and Climate Data Resources.

14	RSGI DSE – 03A	GEOSPATIAL RESOURCE ASSESSMENT AND MANAGEMENT	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

UNIT–I

Fundamentals of Natural Resources and Geospatial Assessment: characteristics of natural and cultural resources; renewable and non-renewable resources; resource availability and utilization. Principles of resource conservation and sustainable development. Role of Remote Sensing in

natural resource management, resource inventory, spatial databases, and geospatial decision support systems. Introduction to Environmental Impact Assessment (EIA) and geospatial monitoring of natural resources.

UNIT-II

Land, Water, Bio-Resources and Energy: management of land resources, including soils, land degradation, desertification, wasteland mapping, mineral resources, and the environmental impacts of mining using geospatial techniques. Surface and groundwater resource mapping, watershed management, groundwater potential zonation, Assessment and management of conventional and renewable energy resources, including solar, wind, hydro, biomass, coal, oil, and nuclear energy using GIS and remote sensing.

UNIT-III

Geospatial modelling concepts and spatial decision support systems for sustainable resource management. Multi-Criteria Decision Analysis, suitability analysis; Modelling applications including forest fire risk assessment, wildlife habitat suitability, soil erosion; watershed prioritization, groundwater potential mapping, land resource development prioritization, and climate resilience assessment. Geospatial monitoring using multi-temporal satellite data and emerging for natural resource assessment and management.

Essential Readings

1. Jensen, J. R. (2015). Introductory Digital Image Processing: A Remote Sensing Perspective. Pearson.
2. Malczewski, J. (1999). GIS and Multicriteria Decision Analysis. Wiley.
3. Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). Principles of Geographical Information Systems. Oxford University Press.
4. FAO. (2022). The State of the World's Land and Water Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations.
5. UNEP. (2019). Global Environment Outlook 6: Healthy Planet, Healthy People. United Nations Environment Programme.
6. USGS. (n.d.). Earth Resources Observation and Science (EROS) Center Data Resources.

14	RSGI DSE – 03B	APPLIED GEO-INFORMATICS IN GEOLOGY	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

UNIT-I

Geological Foundations and Geospatial Mapping: geology, Earth materials, rock cycle, and geomorphological processes. Geological maps and map interpretation. Principles of Remote Sensing and GIS in geological studies. Satellite image interpretation for lithological and geomorphological mapping. Spectral characteristics of igneous, sedimentary, and metamorphic rocks. Terrain analysis, slope, aspect, drainage, and lineament mapping. multispectral and hyperspectral data in geological investigations.

UNIT-II

Structural Geology, Geohazards and Engineering: Geospatial mapping of geological structures including bedding, folds, faults, joints, fractures, dykes, lineaments, and unconformities. Structural interpretation using satellite imagery and GIS. Engineering geological investigations using geospatial techniques. Landslide inventory, susceptibility mapping, hazard zonation, monitoring, and mitigation. Geological suitability analysis for dams, reservoirs, roads, tunnels, and urban infrastructure using GIS-based Multi-Criteria Decision Analysis

UNIT-III

Mineral, Emerging Geospatial: mineral exploration, alteration mapping, lithological discrimination, and mineral targeting. Geophysical methods including electrical resistivity, seismic, magnetic, and gravity surveys. Applications of LiDAR, InSAR, hyperspectral remote sensing, Artificial Intelligence in geological mapping, mineral exploration.

Suggested Readings :

1. Sabins, F. F. (1997). Remote Sensing: Principles and Interpretation (3rd ed.). W.H. Freeman.
2. Gupta, R. P. (2018). Remote Sensing Geology (3rd ed.). Springer.
3. Drury, S. A. (2001). Image Interpretation in Geology (3rd ed.). Butterworth-Heinemann.
4. Bonham-Carter, G. F. (1994). Geographic Information Systems for Geoscientists: Modelling with GIS. Pergamon.

5. Groshong, R. H. (2006). 3-D Structural Geology: A Practical Guide to Quantitative Surface and Subsurface Map Interpretation (2nd ed.). Springer.
6. USGS. (n.d.). Mineral Resources and Geospatial Data.

15	RSGI DCC – 12	Practical	4 Credit
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Duration: 4hrs

Maximum Marks: 100

1. **Climate analysis (ARCGIS):-**Temperature data analysis, rainfall distribution mapping, land surface temperature (LST) mapping, NDVI based vegetation analysis, drought assessment, snow cover mapping
2. **Hydrology (ARCGIS):-**Hydrological cycle study, rainfall distribution, mapping, watershed delineation, drainage network analysis, slope and aspect mapping, flood hazard mapping, groundwater potential mapping, water quality mapping, reservoir and wetland mapping, rainfall-runoff analysis.
3. **Geology (ARCGIS/QGIS/ERDAS):-**Geological map interpretation, lithology mapping, lineament mapping, slope and terrain analysis, drainage pattern analysis, mineral potential mapping, minning potential mapping groundwater potential zonation, landform mapping, fault and fracture mapping,
4. **Resource management (ARCGIS/QGIS/ERDAS):-**Natural resource inventory, wasteland mapping, resource management plan, change detection analysis.
5. **Computer:**
 - a. Perform binary number system conversion and binary addition and subtraction using Python/MATLAB.
 - b. Write Python and MATLAB programs to demonstrate variables, data types, operators, conditional statements and loops.
 - c. Write programs using functions, lists, tuples and dictionaries to calculate and analyze Remote Sensing-related data.
 - d. Perform array and matrix operations, data analysis and visualization using NumPy, Pandas and MATLAB.
 - e. Read, write and manipulate text/CSV files and demonstrate exception handling using Python.
 - f. Perform basic digital image processing operations including image display, enhancement, filtering, thresholding and edge detection using MATLAB/Python.
 - g. Design an ER diagram and create a database for satellite/Remote Sensing data; perform basic SQL queries and table operations.
 - h. Implement Machine Learning algorithms such as Linear Regression, Logistic Regression, Decision Tree and K-Means for sample geospatial data and evaluate their performance.

- i. Perform land use/land cover classification or image classification using Machine Learning/CNN and assess the classification accuracy.
- j. Use Google Earth Engine for satellite image visualization, preprocessing, spectral-index calculation and basic change detection/classification.

SEMESTER – IV

16	RSGI DCC – 13	COMPUTING AND AI FOR GEOSPATIAL APPLICATIONS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit–I

Environmental Planning and Policy: evolution of environmental policies, international environmental agreements and treaties, Sustainable Development Goals (SDGs), environmental governance, role of government agencies and NGOs in environmental management, environmental policy formulation and implementation, stakeholder engagement and public participation, regulatory frameworks, environmental legislation, compliance mechanisms, and policy instruments for sustainable resource management.

Unit–II

Environmental satellite missions; monitoring of land, water, atmosphere and oceans using remote sensing, GIS database development, integration of environmental planning, geospatial data analysis, data fusion techniques, interoperability of geospatial data, spatial analysis; spatial interpolation, and Multi-Criteria Decision Analysis for environmental assessment and planning.

Unit–III

Environmental Impact Assessment and Decision Support: Concept, need and objectives of

Environmental Impact Assessment (EIA), environmental impact identification and prediction, types of environmental impacts, stages and methodology of EIA studies, environmental monitoring and management plans, EIA techniques and system diagram methods, comparative evaluation of EIA techniques, merits and limitations of EIA studies, and GIS-based environmental decision support for sustainable planning and resource management.

Suggested Readings :

1. Glasson, J., Therivel, R., & Chadwick, A. (2012). Introduction to Environmental Impact Assessment (4th ed.). Routledge.
2. Canter, L. W. (1996). Environmental Impact Assessment (2nd ed.). McGraw-Hill.
3. Jay, S., Jones, C., Slinn, P., & Wood, C. (2007). Environmental impact assessment: Retrospect and prospect. *Environmental Impact Assessment Review*, 27(4), 287–300.
4. UNEP. (2018). Assessing Environmental Impacts: A Global Review of EIA Practice.
5. Ministry of Environment, Forest and Climate Change, Government of India. (2006). EIA Notification and Amendments.
6. UN. (2015). Transforming Our World: The 2030 Agenda for Sustainable Development.

17	RSGI DCC – 14	URBAN & REGIONAL STUDIES	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Unit I

Fundamentals of Urban and Regional Planning: Concepts and principles of urban and regional planning, urban planning terminology, master and zonal plans, regional planning, resource regions, decentralized planning, and smart cities. Preparation and assessment of base maps, cadastral maps, and building footprint maps. Urban land use/land cover classification, mapping techniques, and accuracy assessment using geospatial technologies.

Unit II

Urban Growth and Population Analysis: Urban area analysis, urban sprawl, built-up area extraction, spatial metrics, urban development indicators, and urban growth models. Census operations, population estimation and projection, and applications of remote sensing in demographic studies. Urban resources, green spaces, tourism, renewable energy potential, municipal GIS, urban heritage mapping, disaster risk assessment, urban hydrology, and flood modelling.

Unit III

Urban Infrastructure, Environment and Geospatial Techniques in urban utility mapping, infrastructure suitability analysis, service area analysis, location-allocation, and urban information systems. Urban micro-climate, heat island studies, pollution, public health, and solid waste management. Hyperspectral, microwave, and thermal remote sensing for urban mapping, environmental monitoring, and material characterization.

Suggested Readings:

1. Hall, P. *Cities of Tomorrow*. Wiley.
2. Cullingworth, J. B. *Town and Country Planning*. Routledge.
3. Chorley, R. J., & Haggett, P. *Models in Geography*. Routledge.
4. Pacione, M. *Urban Geography*. Routledge.
5. UN-Habitat. *Planning Sustainable Cities*.
6. MoHUA. *Urban Planning Manual*.
7. ISRO–NRSC. *Urban Remote Sensing Applications*.
8. ESRI. *GIS for Urban Planning*.
9. National Institute of Urban Affairs (NIUA). *Urban Planning Resources*.

18	RSGI DSE – 04A	GEOSPATIAL IN SOIL AND AGRICULTURE	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately 20 words each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately 250 words each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in 500 words each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit-I

Land Use, Crop Inventory and Crop Assessment: multi-temporal remote sensing for LULC mapping, optical and microwave remote sensing of crops, spectral vegetation indices, crop inventory and mapping, crop discrimination, crop growth monitoring, crop condition and stress assessment, hyperspectral remote sensing, crop yield modelling, integration of remote sensing with crop growth models, agriculture information systems, wireless sensors, decision support systems, and ICT in agriculture including crop insurance.

Unit-II

Soil Resources, Land Evaluation: Physico-chemical properties of soils, soil-forming factors, soil spectral characteristics, soil survey and mapping, soil resource mapping, soil taxonomy and classification, land evaluation, land use planning, land degradation assessment, hyperspectral remote sensing, watershed delineation, terrain analysis, soil erosion modelling, digital soil mapping, and soil carbon and soil quality assessment.

Unit-III

Agro meteorology and Agricultural Water Management: observations and advanced instrumentation, satellite sensors for agrometeorological studies, retrieval of agrometeorological parameters; crop water requirement estimation, irrigation scheduling, and agricultural drought monitoring, prediction and vulnerability analysis.

Suggested Readings:

1. Brady, N. C., & Weil, R. R. (2016). *The Nature and Properties of Soils (15th ed.)*. Pearson.
2. McBratney, A. B., Mendonça Santos, M. L., & Minasny, B. (2003). *On digital soil mapping*. *Geoderma*, 117(1–2), 3–52.
3. Thenkabail, P. S. (Ed.). (2016). *Remote Sensing of Croplands*. CRC Press.
4. Campbell, J. B., & Wynne, R. H. (2011). *Introduction to Remote Sensing (5th ed.)*. Guilford Press.
5. Allen, R. G., Pereira, L. S., Raes, D., & Smith, M. (1998). *Crop Evapotranspiration: FAO Irrigation and Drainage Paper 56*. FAO.
6. FAO. (n.d.). *FAOSTAT and Land & Water Resources Information*.

18	RSGI DSE – 04B	Fundamentals of UAV Remote Sensing And Aerial Data Acquisition	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit I

Fundamentals of UAVs and Remote Sensing: Introduction to Unmanned Aerial Vehicles (UAVs) and remote sensing, history and evolution of UAVs, classification and components of UAVs, airframe design and payloads, design standards, regulatory aspects, safety and operational considerations, and applications of UAVs in remote sensing.

Unit II

Mission Planning and Aerial Data Acquisition: Flight planning principles and considerations, manual and autonomous mission planning, software tools for flight planning and simulation, ground control points (GCPs), aerial data acquisition, image mosaicing, feature detection and mapping, point cloud generation, 3D models, and orthophoto generation.

Unit III

UAV Applications: Drone remote sensing in utilities, construction and infrastructure management, oil and gas industry, precision agriculture, marine projects, surveying and 3D city modelling, surveillance, search and rescue operations, humanitarian applications, archaeological applications, environmental monitoring, and emerging trends in UAV remote sensing.

Suggested Readings:

1. Colomina, I., & Molina, P. (2014). Unmanned aerial systems for photogrammetry and remote sensing: A review. *ISPRS Journal of Photogrammetry and Remote Sensing*, 92, 79–97.
2. Nex, F., & Remondino, F. (2014). UAV for 3D mapping applications: A review. *Applied Geomatics*, 6, 1–15.
3. Westoby, M. J., Brasington, J., Glasser, N. F., Hambrey, M. J., & Reynolds, J. M. (2012). Structure-from-Motion photogrammetry: A low-cost, effective tool for geoscience applications. *Geomorphology*, 179, 300–314.
4. Turner, D., Lucieer, A., & Watson, C. (2012). An automated technique for generating georectified mosaics from ultra-high resolution UAV imagery. *ISPRS Journal of Photogrammetry and Remote Sensing*, 68, 60–67.
5. ASPRS. (2014). Positional Accuracy Standards for Digital Geospatial Data.

6. Directorate General of Civil Aviation, Government of India. (n.d.). Drone Rules and Digital Sky regulatory resources.

19	RSGI DSE – 05A	Geospatial Applications for Disaster Risk Management	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

UNIT – I

Fundamentals of Disaster Risk Management: Concepts of Hazard, Vulnerability, Exposure and Risk; Types of Natural and Anthropogenic Disasters, Disaster Management Cycle, Role of Remote Sensing and GIS in Disaster Studies., National and International Frameworks for Disaster Risk Reduction., Spatial Data Requirements for Disaster Management.

UNIT – II

Geospatial Technologies in Disaster Assessment: Satellite Data for Disaster Monitoring and Damage Assessment., Flood Hazard Mapping and Flood Risk Analysis., Drought Monitoring using Remote Sensing Indicators., Landslide Susceptibility and Seismic Hazard Mapping., Forest Fire Detection and Monitoring.

UNIT – III

Advanced Applications and Decision Support Systems: Early Warning Systems and Real-Time Monitoring., Climate Change and Disaster Risk Interactions., Geospatial Modelling for Disaster Prediction., Case Studies of Disaster Management in India and Global Best Practices

Suggested Readings:

1. UNDRR. (2015). Sendai Framework for Disaster Risk Reduction 2015–2030. United Nations Office for Disaster Risk Reduction.

2. Smith, K. (2013). Environmental Hazards: Assessing Risk and Reducing Disaster (6th ed.). Routledge.
3. Jha, A. K., Bloch, R., & Lamond, J. (2012). Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century. World Bank.
4. Joyce, K. E., Belliss, S. E., Samsonov, S. V., McNeill, S. J., & Glassey, P. J. (2009). A review of the use of remote sensing and GIS for natural hazards. Geomatics, Natural Hazards and Risk, 1(3), 183–207.
5. UN-SPIDER. (n.d.). Knowledge Portal: Space-based Information for Disaster Management.
6. National Disaster Management Authority, Government of India. (n.d.). Disaster Management Guidelines and Resources.

19	RSGI DSE – 05B	Spatial Analysis and Modeling in GIS	4 Credit
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Duration: 3hrs

Maximum Marks: 70

Section A: Section of **20 marks** and consists of 10 questions carrying 2 marks each to be answered in approximately *20 words* each. All questions are compulsory.

Section B: Section of **30 marks** and consist of 9 questions (3 from each unit) carrying 5 marks each to be answered in approximately *250 words* each. A Candidate has to attempt six questions choosing at least one question from each unit.

Section C: Section of **20 marks**, consist of three questions (1 from each unit) carrying 10 marks each. Candidate has to attempt two questions to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit

Unit–I

Concepts and principles of spatial analysis and GIS modelling, spatial data models, spatial relationships and topology, spatial data structures, GIS database design and management, spatial queries, map algebra, overlay analysis, buffering, proximity analysis, interpolation techniques, terrain analysis, surface analysis, geostatistics, spatial autocorrelation, and spatial decision support systems.

Unit–II

Spatial Modelling Techniques: Principles and approaches of spatial modelling, Multi-Criteria Decision Analysis, suitability and capability modelling, weighted overlay analysis, Analytical Hierarchy Process (AHP), fuzzy logic, network analysis, cost-distance and least-cost path

modelling, hydrological and surface modelling, spatial statistical modelling, predictive modelling, geostatistical modelling, cellular automata, agent-based modelling, and model development and validation using GIS and Remote Sensing.

Unit-III

Spatial modelling for land use/land cover change analysis, urban growth and urban expansion modelling, watershed and hydrological modelling, groundwater potential modelling, environmental and ecological modelling, habitat suitability analysis, disaster risk and hazard zonation modelling, agricultural land suitability modelling, climate change impact assessment, natural resource management, and spatial decision support systems for planning and sustainable development.

Suggested Readings :

1. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Science and Systems (4th ed.)*. Wiley.
2. Mitchell, A. (2005). *The ESRI Guide to GIS Analysis, Volume 2: Spatial Measurements & Statistics*. ESRI Press.
3. Malczewski, J. (1999). *GIS and Multicriteria Decision Analysis*. Wiley.
4. Anselin, L. (1995). *Local indicators of spatial association—LISA*. *Geographical Analysis*, 27(2), 93–115.
5. Goodchild, M. F. (1986). *Spatial Autocorrelation*. CATMOG 47, Geo Books.
6. ESRI. (n.d.). *ArcGIS Pro Spatial Analyst and Geoprocessing Documentation*.

20	RSGI DSE – 06	Spatial Analysis and Modeling in GIS	8Credit
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STUDENTS have the Option to OPT For Discipline Specific RSGI DSE – 4/ RSGI DSE– 5 OR RSGIDSE–6 DISSERTATION (INTERNSHIP OF 3 MONTHS)

21	RSGI DCC – 15	Practical	4 Credit
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Duration: 4hrs

Maximum Marks: 100

EIA (ARCGIS PRO):-Air Pollution Mapping, Environmental Impact Identification, Environmental Sensitivity Mapping, Environmental Impact Assessment Report, Environmental

Management Plan (EMP).

Urban planning and smart city (ARCGIS PRO):-Urban Land Use/Land Cover Mapping, Building Footprint Mapping, Urban Growth Analysis, Population Density Mapping, Road Network Analysis, Service Area Analysis, Urban Green Space Mapping, Urban Heat Island Mapping, Flood Risk Mapping in Urban Areas, Site Suitability Analysis for Smart City Infrastructure, Utility Mapping.

Geospatial In Soil And Agriculture(ARCGIS PRO/ARCGIS/QGIS/ERDAS): Soil Map Preparation; Soil Texture Mapping; Soil Fertility/Soil Quality Mapping; NDVI-based Crop/Vegetation Analysis; Agricultural Land Suitability Analysis; Crop Classification Mapping; Agricultural Land Use/Land Cover Mapping; Soil Erosion Risk Mapping; Crop Health/Vegetation Stress Assessment; Site Suitability Analysis for Agriculture.

Geospatial For Disaster Risk Management(ARCGIS PRO/ARCGIS/QGIS/ERDAS): Flood Hazard Map, Flood Risk Analysis, Drought Monitoring Map, Landslide Susceptibility Map, Seismic Hazard/Zonation Map, Disaster Damage Assessment, Disaster Risk Map
