Syllabus
for
M. Sc. Course in Remote Sensing & Geographic Information System

REVISED IN MARCH 2018: TO BE EFFECTIVE FROM THE ACADEMIC SESSION 2018-2019

Department of Remote Sensing & GIS

Vidyasagar University,

West Medinipur, West Bengal

PIN – 721 102

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Programmes Outcomes

The major objective of the course is to train the students on fundamental principles and components of remote sensing, platforms and sensors, data capturing, storing and transmission processes, advanced remote sensing techniques i.e., Hyperspectral, LiDAR, Thermal and Microwave data capturing, processing, analysis and their applications in various fields of earth science, environment and agriculture, forestry, water resource management, urban planning, climate change etc. This course also imparts knowledge on fundamentals and advanced GIS techniques, photogrammetry, geostatistics, digital surveying techniques and navigational systems. Furthermore, the students will learn the available tools, data accessing, processing, analysing and storing processes using the sophisticated commercial as well as open sources software or tools. The course contains compulsory field study with the objective to train the students on ground data collection, validation as well as outreach to the society and environment. Another major objective of this course is to provide the students hands on experience on executing research project, resource mapping and monitoring during their end semester.

DIVISION OF MARKS

Total Marks   :   1200
SEM I Marks   :   300
SEM II Marks   :   300
SEM III Marks   :   300
SEM IV Marks   :   300

Theoretical Marks :   600 (SEM I: 200, SEM II: 200, SEM III: 200)
Practical Marks   :   300(SEM I: 100, SEM II: 100, SEM III: 100)
Dissertation   :   200 marks (SEM IV)
Grand Viva   :   100 marks (SEM IV)

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M. Sc in RS&GIS

SEMESTER	COURSE NO.	COURSE TITLES		Full Marks	Credit
I	RSG 101	FUNDAMENTALS OF REMOTE SENSING		50	4
		RSG 101.1	FUNDAMENTALS & PHYSICS OF REMOTE SENSING		
		RSG 101.2	PLATFORMS AND SENSORS		
	RSG 102	FUNDAMENTALS OF GIS AND DIGITAL CARTOGRAPHY		50	4
		RSG 102.1	FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM		
		RSG 102.2	DIGITAL CARTOGRAPHY		
	RSG 103	PHOTOGRAMMETRY,SURVEYING AND NAVIGATIONAL SATELLITE SYSTEM		50	4
		RSG 103.1	PHOTOGRAMMETRY		
		RSG 103.2	SURVEYING AND NAVIGATIONAL SATELLITE SYSTEM		
	RSG 104	COMPUTER PROGRAMMING AND STATISTICS		50	4
		RSG 104.1	COMPUTER BASICS AND PROGRAMMING LANGUAGES		
		RSG 104.2	PROBABILITY AND STATISTICS		
	RSG 195	IMAGE INTERPRETATION(practical)		25	4
	RSG 196	FUNDAMENTALS OF GIS(practical)		25	4
	RSG 197	PHOTOGRAMMETRY,SURVEYING AND GNSS(practical)		25	4
	RSG 198	COMPUTER PROGRAMMING AND STATISTICS(practical)		25	4
		TOTAL		300	24
II	RSG 201	DIGITAL IMAGE PROCESSING AND INFORMATION EXTRACTION		50	4
		RSG 201.1	DIGITAL IMAGE PROCESSING		
		RSG 201.2	INFORMATION EXTRACTION FROM SATELLITE IMAGES		
	RSG 202	ADVANCED REMOTE SENSING		50	4
		RSG 202.1	THERMAL AND MICROWAVE REMOTE SENSING		
		RSG 202.2	HYPERSPECTRAL REMOTE SENSING AND LIDAR		
	RSG 203	ADVANCED GEOGRAPHIC INFORMATION SYSTEM		50	4
		RSG 203.1	GIS DATA ANALYSIS		
		RSG 203.2	GEODESY		
	C-RSG 204	*FUNDAMENTALS OF GEOSPATIAL TECHNOLOGY(CBCS)*		50	4
		C-RSG 204.1	FUNDAMENTALS OF REMOTE SENSING AND PHOTOGRAMMETRY		
		C-RSG 204.2	FUNDAMENTS OF GEOGRAPHIC INFORMATION SYSTEM AND NAVIGATIONAL SATELLITE SYSTEM		
	RSG 295	DIGITAL IMAGE PROCESSING(practical)			
	RSG 296	ADVANCED REMOTE SENSING: DATA PROCESSING AND APPLICATION (practical)			
	RSG 297	ADVANCED GEOGRAPHIC INFORMATION SYSTEM(practical)			
	RSG 298	GEODESY (practical)			
		TOTAL		300	24
III	RSG 301	APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISION SUPPORT SYSTEM		50	4
		RSG 301.1	APPLICATION OF GEO-INFORMATICS		
		RSG 301.2	SPATIAL DECISION SUPPORT SYSTEM		
	RSG 302	FUNDAMENTAL OF RESEARCH AND GEOSTATISTICS		50	4
		RSG 302.1	FUNDAMENTAL OF RESEARCH AND GEOSPATIAL PROJECT MANAGEMENT		
		RSG 302.2	GEOSTATICS		
		SPECIAL PAPER			

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SEMESTER	COURSE NO.			COURSE TITLES	Full Marks	Credit
				SPECIAL PAPER		
	RSG 303	RSG 303A		GEO-INFORMATICS IN COASTAL MANAGEMENT	50	4
			RSG 303A. 1	THEORETICAL CONSIDERATIONS		
			RSG 303A.2	POTENTIAL APPLICATION AREAS OF RS /GIS		
		RSG 303B		GEO-INFORMATICS IN WATERSHED MANAGEMENT		
			RSG 303B.1	WATER RESOURCES AND WATERSHED MANAGEMENT		
			RSG 303B.2	REMOTE SENSING IN WATER RESOURCE EVALUATION		
		RSG 303C		GEO-INFORMATICS IN EARTH SCIENCES		
			RSG 303C.1	FUNDAMENTALS OF EARTH SYSTEM		
			RSG 303C.2	APPLICATION OF GEO-INFORMATICS IN EARTH SCIENCE		
		RSG 303D		GEO-INFORMATICS IN DISASTER MANAGEMENT		
			RSG 303D.1	FUNDAMENTAL CONCEPTS OF HAZARDS AND DISASTERS		
			RSG 303D.2	APPLICATION OF GEO-INFORMATICS IN HAZARDS AND DISASTERS MANAGEMENT		
		RSG 303E		GEO-INFORMATICS IN SOIL AND AGRICULTURE		
			RSG 303E.1	FUNDAMENTAL CONCEPTS OF SOIL AND AGRICULTURAL SCIENCE		
			RSG 303E.2	APPLICATION OF GEO-INFORMATICS IN SOIL AND AGRICULTURE		
		RSG 303F		GEO-INFORMATICS IN URBAN,RURAL DEVELOPMENT & REGIONAL PLANNING		
			RSG 303F.1	THEORETICAL CONSIDERATIONS		
			RSG303F.2	POTENTIAL APPLICATION AREAS OF RS / GIS		
		RSG 303G		GEO-INFORMATICS IN EVIRONMENTAL SCIENCE AND MANAGEMENT		
			RSG 303G.1	THEORETICAL CONSIDERATIONS		
			RSG 303G.2	APPLICATION OF REMOTE SENSING AND GIS		
		RSG 303H		GEO-INFORMATICS IN RESOURCE MANAGEMENT		
			RSG 303H.1	CONCEPTS IN RESOURCES		
			RSG 303H.2	APPLICATION OF REMOTE SENSING AND GIS IN RESOURCE MANAGEMENT		
		RSG 303I		GEO-INFORMATICS IN TRANSPORT NETWORK ANALYSIS		
			RSG 303I.1	CONCEPTS IN TRANSPORTATION		
			RSG 303I.2	APPLICATION OF REMOTE SENSING AND GIS IN TRANSPORTATION		
		RSG 303J		GEO-INFORMATICS IN UTILITY MANAGEMENT		
			RSG 303J.1	CONCEPTS OF UTILITY MANAGEMENT		
			RSG 303J.2	APPLICATION OF REMOTE SENSING AND GIS IN UTILITY MANAGEMENT		
	C-RSG 304			*ADVANCED REMOTE SENSING AND AREAS OF APPLICATIONS(CBCS)*	50	4
		C-RSG 304.1		*ADVANCED REMOTE SENSING* TECHNIQUES		
		C-RSG 304.2		*APPLICATIONS* OF GEO-INFORMATICS		
	RSG 395			APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISSION SUPPORT SYSTEM	25	2
	RSG 396			GENERATION OF CASE STUDIES (COMPULSORY FIELD STUDY)	25	2
	RSG 397			GEOSTATISTICS	25	2

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					Marks	Credits	Exam Time
		RSG 398	PRACTICAL (based on Spl. Paper)(RSG 398A, RSG 398B, RSG 398C, RSG 398D, RSG 398E, RSG 398F, RSG 398G, RSG 398H, RSG 398I, RSG 398J)		25	2	
			TOTAL		300	24	
IV		RSG 401	DISSERTATION AND VIVA				
		RSG 401.1	DISSERTATION EXAMINATION		100	8	
		RSG 401.2	DISSERTATION-VIVA		100	8	
		RSG 402	GRAND -VIVA		100	8	
			TOTAL		300	24	
			GRAND TOTAL		1200	96	

STRUCTURE OF THE SYLLABUS (SEM-I)

Type	Name of Paper	Paper /Module No.		Subject	Marks	Credits	Exam Time
THEORETICAL	FUNDAMENTALS OF REMOTE SENSING	**RSG 101**	RSG 101.1	Fundamentals & Physics of Remote Sensing	20	4	2 hrs
			RSG 101.2	Platforms and Sensors	20		
				Internal Assessment	10		
	FUNDAMENTALS OF GIS & DIGITAL CARTOGRAPHY	**RSG 102**	RSG 102.1	Fundamentals of Geographic Information System	20	4	2 hrs
			RSG 102.2	Digital Cartography	20		
				Internal Assessment	10		
	PHOTOGRAMMETRY, SURVEYING AND NAVIGATIONAL SATELLITE SYSTEM	**RSG 103**	RSG 103.1	Photogrammetry	20	4	2 hrs
			RSG 103.2	Surveying and Navigational Satellite System	20		
				Internal Assessment	10		
	COMPUTER PROGRAMMING AND STATISTICS	**RSG 104**	RSG 104.1	Computer Basics and Programming languages	20	4	2 hrs
			RSG 104.2	Probability and Statistics	20		
				Internal Assessment	10		
PRACTICAL		**RSG 195**		Image Interpretation	25	2	4 hrs
		RSG 196		Fundamentals of GIS	25	2	4 hrs
		RSG 197		Photogrammetry, Surveying and GNSS	25	2	4 hrs
		RSG 198		Computer Programming and Statistics	25	2	4 hrs

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STRUCTURE OF THE SYLLABUS (SEM-II)

Type	Name of Paper	Paper /Module No.		Subject	Marks	Credits	Exam Time
THEORETICAL	DIGITAL IMAGE PROCESSING AND INFORMATION EXTRACTION	**RSG 201**	RSG 201.1	Digital Image Processing	20	4	2 hrs
			RSG 201.2	Information Extraction from Satellite Images	20		
				Internal Assessment	10		
	ADVANCED REMOTE SENSING	**RSG 202**	RSG 202.1	Thermal and Microwave Remote Sensing	20	4	2 hrs
			RSG 202.2	Hyperspectral Remote Sensing and LIDAR	20		
				Internal Assessment	10		
	ADVANCED GEOGRAPHIC INFORMATION SYSTEM	**RSG 203**	RSG 203.1	GIS Data Analysis	20	4	2hrs
			RSG 203.2	Geodesy	20		
				Internal Assessment	10		
	CBCS I: FUNDAMENTALS OF GEOSPATIAL TECHNOLOGY	**C-RSG 204**	C-RSG 204.1	Fundamentals of Remote Sensing & Photogrammetry	20	4	2 hrs
			C-RSG 204.2	Fundamentals of Geographic Information System &Navigational Satellite System	20		
				Internal Assessment	10		
PRACTICAL		**RSG 295**		Digital Image Processing	25	2	4 hrs
		RSG 296		Advanced Remote Sensing: Data Processing & Applications	25	2	4 hrs
		RSG 297		Advanced Geographic Information System	25	2	4 hrs
		RSG 298		Geodesy	25	2	4 hrs

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STRUCTURE OF THE SYLLABUS (SEM-III)

Type	Name of Paper	Paper /Module No.		Subject	Marks	Credits	Exam Time
THEORETICAL	APPLICATION OF GEOINFORMATICS & SPATIAL DECISION SUPPORT SYSTEM	RSG 301	RSG 301.1	Application of Geo-informatics	20	4	2 hrs
			RSG 301.2	Spatial Decision Support System	20		
				Internal Assessment	10		
	FUNDAMENTAL OF RESEARCH &GEOSTATISTICS	RSG 302	RSG 302.1	Fundamental of Research and Geospatial Project Management	20	4	2 hrs
			RSG 302.2	Geostatistics	20		
				Internal Assessment	10		
	ELECTIVE PAPER	RSG 303	RSG 303.1	*Elective Special paper*	20	4	2 hrs
			RSG 303.2	*Elective Special paper*	20		
				Internal Assessment	10		
	CBCS II: ADVANCED REMOTE SENSING AND AREAS OF APPLICATIONS	RSG 304	RSG 304.1	Advanced Remote Sensing Techniques	20	4	2 hrs
			RSG 304.2	Application of Geo-Informatics	20		
				Internal Assessment	10		
PRACTICAL		RSG 395		Application of Geo-Informatics and Spatial Decision Support System	25	2	4 hrs
		RSG 396		Generation of Case Studies (Compulsory Field study)	25	2	4 hrs
		RSG 397		Geostatistics	25	2	4 hrs
		RSG 398		*Elective Special paper*	25	2	4 hrs

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STRUCTURE OF THE SYLLABUS (SEM-IV)

Type	Name of Paper	Paper /Module No.		Subject	Marks	Credit	Exam Time
THEORETICAL	DISSERTATION	**RSG 401**	**RSG 401.1**	Dissertation (Examination)	100	8	
			RSG 401.2	Dissertation (Viva)	100	8	
		RSG 402		Grand Viva	100	8	

The students have to select any one of the following subjects, likely to be offered as elective special papers:

RSG 303A: Geoinformaticsin Coastal Management

RSG 303B: Geoinformatics in Watershed Management

RSG 303C: Geo-informatics in Earth Sciences

RSG 303D: Geo-informatics in Disaster Management

RSG 303E: Geoinformatics in Soil and Agriculture

RSG 303F: Geoinformatics in Urban, Rural Development & Regional Planning

RSG 303G: Geoinformatics in Environmental Science & Management

RSG 303H: Geoinformatics in Resource Management

RSG 303I: Geoinformatics in Transport Management

RSG 303J: Geoinformatics in Utility Management

Important Note:

∨ **Total intake capacity of the Department (SEM-I) every year is 45 candidates at present.**

∨ **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.**

∨ **Internal assessment will be based on class attendance and class performance.**

∨ **Field work is compulsory for Students of semester - III**

∨ **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.**

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SEM I PAPERS

SEM -I THEORY

/ **RSG 101:** (*Examination Time: 2 hours)*
FUNDAMENTALS OF REMOTE SENSING (50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will understand the various sources of energy, their properties, interaction mechanisms, and use in remote sensing studies. They will be able to discuss the broad application areas of remote sensing technology. They will understand the forces involved in maintaining the satellite orbits. They will able to solve related numeric problems. They will understand the differences in satellite types, payloads/ sensors, their working principles, data capturing, storing and transmission processes. They will understand the properties and use of different satellite data.

RSG 101.1:

Full Marks: 20. Number of lectures to be delivered for each module is 35

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-Boltzman 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

RSG 101.2:

Full Marks: 20. Number of lectures to be delivered for each module is 35

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

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synchronous, shuttle orbit. Semisynchronous 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 (10)

/ RSG 102: (*Examination Time: 2 hours*)
FUNDAMENTALS OF GIS &DIGITAL CARTOGRAPHY (50 marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be able to differentiate the spatial and non-spatial data, data format and types, data capturing, storing and processing steps, application, advantages and disadvantages of GIS. They will be able to explain the digital cartography system, application and components, projection systems, digital mapping units; and generate digital surface.

RSG 102.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30
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

iii. *Information Organization and Data Structures:* Raster and Vector data structures, advantages and disadvantages

iv. Nature and Source of data in GIS: Spatial and Attribute data capture

v. *Creating GIS Database:* GIS Software, file organization and formats, Rectification, Digitization and Map Composition

vi. *Methods of Data Input:* Keyboard entry, Manual digitizing, Semi-automatic digitizing, Automatic digitizing

vii. *Data Editing:* Detecting and correcting errors, Re-projection, Transformation andGeneralization, Edge matching and Rubber sheeting, Topology

RSG 102.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30
Digital Cartography:

i. *GIS and Digital Cartography*: Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography

ii. *Concept of Map Scales:* Defining Map, Projection Systems, Lambert Conformal Conic (LCC) and Universal Transverse Mercator (UTM) projection, Categories of maps, Map Scales

iii. *Measurement of Geographic Variables:* Nominal, Ordinal, Interval and Ratio Scales

iv. *Types of data*: Qualitative vs. Quantitative data, Discrete vs. Continuous 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 Isoplethic Mapping, Dasymetric

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Mapping, Multivariate and Dynamic Mapping

Internal Assessment (10)

/ **RSG 103:** (*Examination Time: 2 hours*)
PHOTOGRAMMETRY, SURVEYING AND GPS: (50marks)
Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will understand the basics of old and modern photographic systems, aerial photography, the principles and measurement procedures, 3-D mapping, height estimation, flight planning etc. They will be able to generate traditional, modern digital, and Satellite Navigational System surveying data using high end equipment and devices; and they will be able to analyse such data using powerful computer systems. They will also learn the uses and limitations of such systems.

RSG103.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30

Photogrammetry:
  i. *Introduction:* Historical Development and Fundamentals of aerial photography, Vertical and Oblique aerial photography, Classification of Aerial Film Cameras, Analog and Digital cameras, Components of Digital aerial Cameras, Charge-Coupled Device (CCD), digital cameras, spectral sensitivity of CCD sensor, geometric problems in CCD, Photogrammetric Applications and Products.
  ii. Scale, Geometry and Ground Coverage of Aerial Photographs, Area calculation & Flight Planning.
  iii. Binocular and Stereoscopic vision, Conditions for Stereovision, Photographic overlap Image Parallax, Height determination from stereo pairs - Parallax Equation, Ground Control.
  iv. Co-ordinate Systems used in Photogrammetry, Relief distortion and Tilt distortions, Rectification, Ortho Rectification, Height determination from single photograph, Planimetricmap compilation, Digital Elevation Model (DEM), Digital orthophotos.
  v. *Principles of digital photogrammetry:* Softcopy operations - Systems, Stereo: anaglyph, polarization, image matching, digital orthophoto generation, Determination of digital surfaces models. The geometric accuracy of ortho images, True ortho-photo, Airborne laser scanning, Unmanned aerial vehicles (UAV) photogrammetry.

RSG 103.2:

Full Marks: 20 Number of lectures to be delivered for each module is 30.

Surveying andNavigational Satellite System:
  i. *Validation of Data:* Importance of Field Survey, Collection of Ground Truth.
  ii. *Introduction to conventional field survey techniques:* Plane and Geodetic Surveying (Traversing, Triangulation and Levelling), Topographic, Cadastral, Engineering and Hydrographic surveys.
  iii. *Surveying Instruments:* Principles of using Plane Table, Principles of Prismatic Compass, Theodolite traversing, Utility of Total Station
  iv. *Global Navigational Satellite System:* Introduction, Satellite constellation, GPS signals and data, Geo-positioning – BasicConcepts. GPS, NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS),Control Segment, Space Segments, User Segment,

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GPS Positioning Types- Absolute Positioning, Differential positioning

v. *GPS Surveying Methods and Accuracy:* Methods-Static & Rapid Static, Kinematic-Real Time Kinematic Survey- DGPS-GPS Data Processing and Accuracy, Factors Affecting GPS Accuracy

vi. *Reference Station:* Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna

Internal Assessment (10)

/ RSG 104: (*Examination Time: 2 hours*)
COMPUTER PROGRAMMING AND STATISTICS (50marks)

Full Marks50. Number of lectures to be delivered for thispaper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will learn the basics traditional, modern digital surveying methods, and satellite navigational system using high end equipment, devices and powerful computer systems. They will also learn the uses and limitations of such systems.They will be able to analyse the data using basic and advanced statistical methods, distribution functions. They will be able to apply the mathematical functions in geospatial data, and to derive important information from it.

RSG 104.1:
Full Marks: 20. Number of lectures to be delivered for each module is 30

Computer Basics and Programming Languages:

i. Introduction to Computers, *Data Representation*: Representation of Characters in Computers, Representation of Integers, Representation of Fractions, Hexadecimal Representation of Numbers, Decimal to Binary Conversion, Error Detecting Codes.

ii. *C programming:* Preliminaries, Constants & Variables, Arithmetic Expressions, Input-Output statements, Control Statements, Do-Statements, C–Preprocessor, Do-While statement, if-else statement, Array, Pointer. Elementary Format Specifications, Logical Statements & Decision Tables, Function & Subroutines.

iii. *R programming:* Preliminaries, structure of basic image processing using R.

RSG 104.2:
Full Marks: 20. Number of lectures to be delivered for each module is 30.

Probability and Statistics:

i. Concept of set, Probability, Conditional Probability: Bayes' Theorem, Random Variables: discrete and continuous, simple examples.

ii. Measures of central tendency: mean, median, mode, quartiles; Moments, Skewness, Kurtosis; Variance-Covariance, Standard Deviation.

iii. Discrete Distribution: Bernoulli's, Poisson; Continuous Distribution: Exponential, Normal or Gaussian

iv. R programming: Basic image statistics derivation.

Internal Assessment (10)

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SEM -I PRACTICAL

Course Outcome: Students will be able to process satellite image, aerial photographs, basic GIS data, and digital survey data using multiple image processing and GIS software. They will be able to solve the problems applying statistics in advance statistical and programming platform in the modern computer systems.

⁄ RSG 195 (Practical)
IMAGE 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.

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. Determination of orbital period of a satellite, its velocity and distance from the earth's centre.

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)

⁄ RSG 196 (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.

Topic to be covered	Available Software's
Visualization Tools Blend, Swipe, Flicker, Conversion: Raster ↔ Vector ↔ ASCII and others	
Managing Geo-database, Geo-referencing & Changing Projection	
Digitization: Point, Line, Polygon	
Managing attribute table and thematic mapping	
Map composition and representation	

(20)

Practical Notebook and Viva Voce   (5)

⁄ RSG197 (Practical)
PHOTOGRAMMETRY,SURVEYING AND GNSS (25 marks)

Full Marks: 25. At least evennumber 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.

   i.   Scale measurement of aerial photographs, Distance and area measurement of themes, Aerial-photo Interpretation for Terrain Evaluation and thematic mapping, Object height measurements by Parallax bar, Aerial photo mosaicking.

   ii.   Ortho rectification of Air photos [Orthobase]; Softcopy operations -Stereo analysis & Anaglyph generation, polarization, image matching, digital orthophoto generation, Determination of digital surfaces models

(10)

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

   iv.   Plane table survey for cadastral and large-scale Mapping, Theodolite traverse and triangulation, Spirit Leveling, use of Dumpy level, Prismatic Compass, and preparation of a road map.

   v.   LAI Plant Canopy Analyser, GPR Survey

   vi.   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 pro software and Export functions, GPS and GIS integrations output preparation

(10)

Practical Notebook and Viva Voce   (5)

⁄ RSG 198 (Practical)
COMPUTER FUNDAMENTALS & 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.

   i.   C Programming Language: Basics, Statements, Loop, Array, String, Pointer

   ii.   R Programming: Basic Image Processing: Layer Stack, Subset, Mosaic.

   iii.   R Programming: Image Statistics Derivation, Scatter Plot, Variance-Covariance and Correlation Matrix.

(20)

Practical Notebook and Viva Voce   (5)

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SEM II PAPERS

SEM -II THEORY

/ **RSG201:** (*Examination Time: 2 hours*)
DIGITAL IMAGE PROCESSING & INFORMATION EXTRACTION (50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be able to access the satellite image data, can apply pre-processing tools. They will learn the background algorithms, applications of such algorithms in data processing, and image analysis. They will be able to access and analyse the satellite and ground data. They will be able to apply basic and advance image classification algorithm to generate various information from the satellite data.

RSG201.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30

Digital Image Processing:

  i. *Introduction:* Definition of digital image, Source of Data, Data loading, Image Restoration, Image Reduction and Magnification
 ii. *Image Pre-processing:* Sources of Error in image data, Image Rectification and Registration, Resampling Techniques, Radiometric corrections
iii. *Contrast Manipulation*: Gray Level Thresholding, Level Slicing; Contrast Stretching – Linear and Non-linear
 iv. *Spatial Texture Manipulation:* Spatial filtering – Linear, High Boost, Directional and Gradient Filters; Edge Enhancement and Fourier Analysis
  v. *Multi-image Manipulation:* Band Ratioing and Differencing, Principal and Canonical Components, Vegetation Components, Image Fusion; Initial Statistics Extraction:Univariate& Multivariate Image Statistics, Band Correlation, Statistical Evaluation of Image Quality Parameters

RSG 201.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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. *Unsupervised Classification:* Isodata, K-mean
 iv. *Supervised Classification System:* Minimum Distance to Mean, Parallelepiped, Maximum Likelihood, Mahalanobis Distance
  v. *Advanced Classification Techniques:* Hybrid Classification, ANN, Spectral Mixture Analysis,

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Fuzzy Classifiers, Spectral Angle Mapper, Decision Tree, Support Vector Machine, Object Based Classification.

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

Internal Assessment (10)

⁄ RSG 202: (*Examination Time: 2 hours*)
ADVANCED REMOTE SENSING(50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be able to explain the energy-matter interaction mechanisms in thermal and microwave region of the EM spectrum, the information acquires using such imaging systems, the properties of such image data, and their data processing methodology. They will be able to differentiate the multispectral from hyperspectral imaging systems, their advance capability of information generation, the methods and tools for analysing the hyperspectral data, their application areas and limitations.

RSG 202.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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 Imaginary, Geometric and Radiometric Calibration of Thermal data, 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

RSG 202.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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:* Atmospheric Corrections-Empirical and Physics based Approaches, Bad band and Bad line removal

iii. *Information extraction:* Endmember collection, Minimum Noise Fraction, Pixel Purity Index, N-D visualizer, ground truthing through Spectro-radiometer, Image Classification techniques

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

v. *LIDAR:* Basic Principles and advantages, Laser and Scanning System, Laser Location,

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LIDAR Antenna Attitude, Types of LIDAR returns, LIDAR post processing of multiple returns, Accuracy of LIDAR measurements, The Laser Vegetation Imaging Sensor

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

Internal Assessment (10)

✔ **RSG 203:** (*Examination Time: 2 hours*)
ADVANCEDGEOGRAPHIC INFORMATION SYSTEM(50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be familiar with advance GIS data analysis, identifying the sources of errors in such data, and various approaches to minimize the data short-coming. They will be able to understand the concept of projection system, datum, and interlinked gravitational forces. They will be confident is measuring height, distance and area at larger geographical scale using the satellite geodesy.

RSG 203.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30

GIS Data Analysis:

i. *Data Storage:* Spaghetti Model, Topological Model, Quadtree
ii. *Database Modelling:* Hierarchical Model, Network Model, Relational Model
iii. *Spatial Database Management:* Concept of Spatial Database, Database Management System, Basic Concepts of Entity, Relationship and Primary Key, Database Structure
iv. *Data Organization:* Chain Coding, Run-length Coding, Block Coding
v. *Spatial Analysis:* Types of Spatial Analysis, Measurement in GIS, Query – Query by Attributes, Spatial Queries, Attribute Based Operation, Neighbourhood Analysis, Connectivity Analysis, Overlay and Coverage Rebuilding,
vi. *Data Quality in GIS:* Uncertainty in GIS data, Positional and Attribute Accuracy, Logical consistency, Completeness Lineage,
vii. *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

RSG 203.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Geodesy:

i. 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
ii. Rectangular and Geographical Coordinate System; Spherical trigonometry – concept of great circle and spherical triangle, Conversion of latitudes and longitudes to linear distances, Co-ordinate Transformations, Geoidal parameters and their relationship
iii. Dimensions of some well-known Spheroids, Definition and Determination of Geoid Undulation, Coordinate System used in Geodesy, Indian Geodetic Datum; Coordinate System used by Survey of India (ϕ, λ, H), Redefinition of Horizontal and Vertical Datum in India, Indian Mean Sea Level Datum

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iv. *Satellite Geodesy:* Early satellites, Interferometry, Doppler, Point Positioning, Translocation, Observational systems, New Satellite gravity missions

v. Modern Views on determination of figure of the Earth: Gravimetric Methods, Astrogeodetic methods

Internal Assessment (10)

⁄ RSG204: (*Examination Time: 2 hours*)
CBCS- I: FUNDAMENTALS OF GEOSPATIAL TECHNOLOGY (50marks)

Full Marks: 50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B

Course Outcome: Students will have the concept of satellite data collection, use of such system in mapping and monitoring of various earth surface processes, uses in planning, management and policy making processes. They will be able to understand the variables used in GIS, their sources, their processing or analysing and representation methods. They will also learn the principles, uses, and limitations of satellite navigational system.

RSG204.1:
Full Marks: 20. Number of lectures to be delivered for each module is 30.
Fundamentals of Remote Sensing & Photogrammetry:
i. *Concept and Scope of Remote Sensing:* Definitions, Process and Characteristics of Remote Sensing System, Advantages and limitations. Concept of Electromagnetic Radiation (EMR)

ii. Sensor System - Framing and Scanning System, Whiskbroom scanners, Push-broom scanners, Platforms and Sensors, Concept of False Colour Composites. Orbits and Orbital Characteristics

iii. Fundamentals of aerial photography, Vertical and Oblique aerial photography, Classification of Aerial Cameras, Charge-Coupled Device (CCD), Applications and Products, Scale, Geometry and Ground Coverage of Aerial Photographs, Area calculation & Flight Planning.

iv. Binocular and Stereoscopic vision, Parallax Equation, Relief distortion, Ortho Rectification, Height determination from single photograph,

v. Principles of digital Photogrammetry, Airborne laser scanning, Unmanned aerial vehicles (UAV) photogrammetry

RSG 204.2:
Full Marks: 20. Number of lectures to be delivered for each module is 30.
Fundamentals of Geographic Information System &Navigational Satellite System:
i. *Basic Concepts:* Definition and Components of GIS, application, Advantages and Limitations of GIS

ii. *GIS Data:* Spatial and Attribute Data, Raster and Vector data structures

iii. *Creating GIS Database:* Sources of Data in GIS, GIS Data Input, Rectification, Methods of Digitization, Map Composition

iv. *Global Navigational Satellite System:* Introduction, Satellite constellation, GPS signals and data, Basic Concepts of NAVSTAR, GLONASS, IRNSS)

v. *Applications:* Mobile Mapping basic concepts and Applications, GNSS Application in Surveying and Mapping

Internal Assessment (10)

SEM -II PRACTICAL

Course Outcome: Students will be able to analyse the advanced satellite and other geospatial data. They will be also able to solve various problems in a geospatial environment using various data processing platforms in modern computer systems.

⁄ RSG295 (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	Available Software's
Geometric and Atmospheric Correction	
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)

⁄ RSG296 (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	Available Software's
Atmospheric and Radiometric Correction, Image enhancement and filtering of multispectral optical data	
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)

⁄ RSG 297 (Practical)
ADVANCE GIS (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 Editing, Data base creation, Managing Attribute Table, Thematic Maps	**Available Software's**
Charts and Diagrams generation Select and Query in vector layers, Use of SQL, GIS based models.	
Network, Neighbourhood, Buffer, Proximity [Thiessen polygon]	
Topographic & Morphometric analysis: TIN, DEM, Contour &Isopleth generation.	

(20)

Practical Notebook and Viva Voce   (5)

/ RSG 298 (Practical)
GEODESY (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.   Linear Transformation- Conversion of latitudes and longitudes to linear distances, Co-ordinate Transformations
   ii.   Measurements of area and distances on a plane surface, on a Sphere and on an ellipsoid
  iii.   Satellite laser ranging, very long base line interferometry, etc.
  iv.   Determination of figure of the Earth: Gravimetric Methods, Astrogeodetic methods

(20)

Practical Notebook and Viva-Voce   (5)

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SEM III PAPERS

SEM -III   THEORY

/ RSG 301: (*Examination Time: 2 hours* **)**
APPLICATION OF GEO-INFORMATICS AND SPATIAL DECISION SUPPORT SYSTEM (50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be able to access various geospatial data, and they will learn the integration of various data for their meaningful analysis to solve various spatial problems or to generate various information layers. They will be able to perform the data integration using various geospatial data. They will be able to analyse and interpret the obtained results and to prescribe important inputs in management and policy making processes.

RSG301.1:

Group A

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Application of Geo-Informatics:
  i.   *Introduction:* Emergence of Geoinformatics technology in different application areas, Indian satellite missions with focused applications,
  ii. Geo-technical Engineering & Environmental Management, Digital terrain models for selection of dam site, road, and canal construction
  iii. GNSS in plate tectonic studies in Himalayas, Predicting seismicity in peninsular region through lineament studies
  iv. *Areas of Applications:* Application in Disaster Management, Water, Soil, Urban Planning,Landuse/ Landcover, Environmental Management
  v.   Remote Sensing in Water resource evaluation and Watershed Management, Runoff & Soil Loss estimation based on empirical models, Remote Sensing in hydro-geomorphological studies for ground water targeting
  vi. E-Governance: Demographic and business Applications
  vii. Application of Geo-informatics in Tourism Management

RSG 301.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Spatial Decision Support System:
  i.   *GIS and Decision Support Systems:* Concept and characteristics of Decision Support Systems (DSS), Types of Decision Problems, Phases of Decision-Making Process, Spatial Decision Support Systems (SDSS) and GIS
  ii. *Multicriteria Decision Analysis (MCDA):* Elements and Structure of MCDA, Framework of Spatial Multicriteria Decision Analysis (SMDA)
  iii. *Evaluation Criteria and GIS:* Defining Set of Evaluation Criteria, Techniques for Selecting Criteria, Standardization of Criterion Maps, Decision Alternatives and Constraints
  iv. *Criterion Weighting and Decision Rules:* Estimation of Weights- Ranking, Rating, Pairwise

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Comparison and Trade-off analysis method; Decision Rules-Simple Additive Weighting method
  v. Analytic Hierarchy Process

Internal Assessment (10)

/ **RSG 302:** (*Examination Time: 2 hours*)
RESEARCH METHODOLOGY, PROJECT MANAGEMENT &GEOSTATISTICS (50marks)

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

Course Outcome: Students will be able to identify the research problems in the field of geo-informatics. They will learn to develop or prescribe a research approach or project management structure starting from input data, techniques, with expected outcome. They will be able to perform statistical analysis of the geospatial problems. They will be able demonstrate the working principles of various data interpolation methods.

RSG 302.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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

RSG 302.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Geostatistics
  i. Mean centre of population & settlement and their temporal shift, Neighbourhood Analysis, Z-Score
  ii. Scatter Diagram, Bi-variate& Multiple correlation, Linear regression & Residual mapping
  iii. Standard Error of Estimate, Significance Test, RMSE.
  iv. *Surface Modelling*: Spatial autocorrelation, Variogram and its use for Interpolation
  v. Role of Interpolation, Methods of Interpolation – Global and Local Deterministic Methods, Moving Averages, Inverse Distance Interpolation, Optimal Interpolation using Geostatistics
  vi. Interpolation by Kriging – different types of Kriging
  vii. R programming: regression analysis

Internal Assessment (10)

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⁄ RSG303: (*EXAMINATION TIME: 2 HOURS*)
ELECTIVE SPECIAL PAPER THEORY: (Any One)

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

RSG 303A: Geoinformaticsin Coastal Management

RSG 303B: Geoinformatics in Watershed Management

RSG 303C: Geo-informatics in Earth Sciences

RSG 303D: Geo-informatics in Disaster Management

RSG 303E: Geoinformatics in Soil and Agriculture

RSG 303F: Geoinformatics in Urban, Rural Development & Regional Planning

RSG 303G: Geoinformatics in Environmental Science & Management

RSG 303H: Geoinformatics in Resource Management

RSG 303I: Geoinformatics in Transport Management

RSG 303J: Geoinformatics in Utility Management

RSG 303A: GEOINFORMATICS IN COASTAL MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303A.1

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Theoretical Considerations

i. Coastal morphodynamics: 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.

RSG 303A.2

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Potential Application areas of RS /GIS

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)

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iv.   Study of Suspended mineral in water
v.   Study of Chlorophyll in water
vi.   Measurement of Sea Surface Temperature (SST)

Internal Assessment (10)

RSG 303B: GEOINFORMATICS IN WATERSHED MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303B.1

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Water Resources and 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.

RSG 303B.2

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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 (10)

RSG 303C: GEOINFORMATICS IN EARTH SCIENCES

Full Marks50. Number of lectures to be delivered for this paper is 70. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303C.1

Full Marks: 20. 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.

RSG 303C.2

Full Marks: 20. 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, mineral targeting. Rock Information System. GIS based multivariate analysis in mineral targeting.
  iv. *Case Studies:*GPS in plate tectonic studies in Himalayas, Predicting seismicity in peninsular region through lineament studies, Study of hydro-geomorphology in West Bengal

Internal Assessment (10)

RSG 303D: GEOINFORMATICS IN DISASTER MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303D.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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.

RSG 303D.2:

Full Marks: 20. 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 (10)

RSG 303E: GEOINFORMATICS IN SOIL AND AGRICULTURE

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303E.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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

RSG 303E.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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 (10)

RSG 303F: Option-6GEOINFORMATICS IN URBAN, RURAL DEVELOPMENT & REGIONAL PLANNING

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303F.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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.

RSG 303F.2

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Potential Application areas of RS / GIS:

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 (10)

RSG 303G: GEOINFORMATICS IN ENVIRONMENTAL SCIENCE & MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303G.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Theoretical Considerations:

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

RSG 303G.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Application of Remote Sensing and GIS:

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 (10)

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RSG 303H: GEOINFORMATICS IN RESOURCE MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303H.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Concepts in Resources:

   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,

RSG 303H.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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 (10)

RSG 303I: Option-9GEOINFORMATICS IN TRANSPORT NETWORK ANALYSIS

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303I.1

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Concepts in Transportation:

   i. Introduction to Transportation Planning, Behavioural 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

RSG 303I.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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. Applicationsand case studies

Internal Assessment (10)

RSG 303J: GEOINFORMATICS IN UTILITY MANAGEMENT

Full Marks50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B.

RSG 303J.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Concepts of 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 GISElectricity, Gas, Water supply, Sewerage system

RSG 303J.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

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 (10)

∕ RSG 304:(*EXAMINATION TIME: 2 HOURS*)

CBCS- II: ADVANCED REMOTE SENSING AND AREAS OF APPLICATIONS (50 Marks)

Full Marks: 50. Number of lectures to be delivered for this paper is 60. Pattern of setting questions: Four questions of 10 marks (Group A) and four questions of 10 marks (Group B) are to be set. Two questions of 10 marks and two questions of 10 marks from each of the module are to be answered. Each question is to have at least two parts in Group A& Group B

Course Outcome: Students will have the concept of advance satellite sensors, working principles, data acquisition and processing techniques. They will be able to demonstrate or develop research methodology in solving geospatial problems.

30

RSG 304.1:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Advanced Remote Sensing Techniques

i. *Introduction:* Definition of digital image, Source of Data, Data Formats, Ground Truthing: Ground Truth Collection for Image Classification, *Image Classification techniques,* Spectral Signature

ii. *Thermal Remote Sensing:* Basic Principles and Applications

iii. *Microwave Remote Sensing:* Basic Principles, Radar Operation, Polarization, Spatial Resolution, Radar Image Geometry, Relief Displacement, Shadows and Speckle effect, Side Looking Radar System (SLAR) Operation, Synthetic Aperture Radar (SAR), Radar Interferometry; *RADAR Environmental Considerations:*

iv. *Hyperspectral Remote Sensing:* Basic Concept, Advantages and Disadvantages, Multispectral vs. Hyperspectral Remote Sensing, Hyperspectral sensors and platforms, Hyperspectral Data Processing, Applications of Hyperspectral Data

v. *LIDAR:* Basic Principles, DSM and DTM, Areas of Applications

RSG 304.2:

Full Marks: 20. Number of lectures to be delivered for each module is 30.

Application of Geo-Informatics:

i. *The Earth System:* Concept of Earth System, lithosphere, biosphere, hydrosphere & atmosphere, Relationships in seismic wave, earthquakes and volcanic activity. Rock types and rock Structures

ii. *Geomorphology:* Fundamental concepts, geomorphic agents and processes, drainage patterns, classification of landforms

iii. *Visual/ Digital Satellite Image Interpretation:* Elements of image interpretation, Digital image enhancement techniques for different environmental modelling

iv. *Areas of Applications:* Application in Disaster Management, Water, Soil, Urban Planning,Landuse/ Landcover, Environmental Management, Remote Sensing in Watershed Management, ground water targeting, Runoff & Soil Loss estimation based on empirical models, Remote Sensing in different hydrological modelling.

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SEM -III PRACTICAL

Course Outcome: Students will be able perform integration of various data sources. They became capable to performing geostatistical analysis using various commercial or open source software or platform. The students will be able to solve numbers of problems in few particular domains. In addition, few live-projects are assigned to students to make them more research oriented. With the faculty advisors, they visit the field to study available natural resources, environmental issues, societal problems through collectingseveral datasets, calibration and validation of the models, and to compare with the satellite based observations.

⁄ RSG 395 (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. Application of Geo-informatics in Environmental issues, Measurement of Canopy Cover through Leaf Area Index (LAI) Meter
   ii. Morphometric analysis of terrain, satellite image-based hydro-geomorphological interpretation for ground water targeting.
  iii. Runoff & Soil Loss estimation based on empirical models.
   iv. Digital terrain models for selection of dam site, road, and canal construction, Cut & Fill analysis using DEM
   v. Generating Criterion Maps, Linear Transformation Methods for Standardization of Criterion Maps
   vi. Estimation of Weights: Ranking, Rating, Pairwise Comparison and Trade-off analysis method; Decision Rules-Simple Additive Weighting method
  vii. Application of Spatial Decision Support System in Site Suitability Analysis

(20)

     Practical Notebook Viva-voce   (5)

⁄ RSG 396 (Practical)
GENERATION OF CASE STUDIES (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)

⁄ RSG 397 (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, Bi-variate and Multiple Correlation, Significance test, Mean Centre of Population, Z-Score
iv. Principal Component analysis
v. IDW and Krigging through GIS software
vi. Extraction of image statisticsand regression analysis using R

(20)

Practical Notebook and Viva-Voce (5)

RSG 398 (Practical)
ELECTIVE SPECIAL PAPER THEORY: (Any One)

RSG 398A: Geoinformaticsin Coastal Management

RSG 398B: Geoinformatics in Watershed Management

RSG 398C: Geo-informatics in Earth Sciences

RSG 398D: Geo-informatics in Disaster Management

RSG 398E: Geoinformatics in Soil and Agriculture

RSG 398F: Geoinformatics in Urban, Rural Development & Regional Planning

RSG 398G: Geoinformatics in Environmental Science & Management

RSG 398H: Geoinformatics in Resource Management

RSG 398I: Geoinformatics in Transport Management

RSG 398J: Geoinformatics in Utility Management

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)

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SEM IV

⁄ RSG 401: RESEARCH DISSERTATION (200marks)

Course Outcome: The individual student will be able to identify a small research problem, and try to generate a geospatial solution of the problem.

RSG 401 (GROUP A & B)
RSG 401.1: *Dissertation Examination 100* + **RSG 401.2:** *Dissertation Viva-Voce 100*

· Dissertation consisting of relevance of the problem to be studied and its aims and objectives, Methodology adopted to study such problem
· Chapter Scheme
   Ø Problem Definition
   Ø Objective
   Ø Review of Literature
   Ø Database and Methodology
   Ø Result and Discussion

· 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.

Course Outcome: Students will be self-confident in facing the job interviews.

⁄ RSG402: GRAND VIVA (100marks)
Grand viva will be based on the overall understanding of the subject in front of external and internal examiner

LIST OF REFRENCES:

RSG 101: FUNDAMENTALS 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

REFERENCE BOOKS:

1. Avery,T.E.,andG.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. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
4. Canada Center for Remote Sensing, Remote Sensing Tutorial
5. Cracknelll, A.P., and L.W.B.Hayes, Introduction to remote sensing, Taylor and Francis, Washington, DC,1991
6. Curran, P.J. (1980) Mulltispectral remote sensing of vegetation amount, Progress in Physical Geography, 4:315
7. Curran, P.J. (1988) Principles of Remote Sensing, ELBS Edn. Longman Group UK Ltd.
8. Guha, P.K. (2003) Remote Sensing for the Beginner, Affiliated East-West Press Pvt. Ltd., New Delhi
9. Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
10. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
11. John, R. J., Introductory Digital Image Processing – A Remote Sensing Perspective, Prentice Hall Series
12. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.
13. Nag P. and Kudrat M., Digital Remote Sensing, New Delhi, Concept Publishing.
14. Reeves, Robert G., "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA
15. Richards J.A. and Jia X. (2006) Remote Sensing Digital Image Analysis: An Introduction, 4th ed., Springer

RSG 102: FUNDAMENTALS OF GIS &DIGITAL CARTOGRAPHY

TEXT BOOKS:

1. Anson, R.W. &Ormeling, F.J. (1993), Basic Cartography, Vol. 1, 2nd ed., Elsevier Applied Science Publishers, London.

2. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.
3. C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.
4. Chakraborty and Sahoo, 2008, Fundamentals of Geographic Information Systems, Viva Books Private Limited, India
5. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. Ed. 1991, 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.
6. Robinson A.H. & Morrison J.L, (1995) Elements of Cartography, John Wiley & Sons

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. Harvey, F. 2008, A Primer of GIS: Fundamental Geographic and Cartographic Concepts, The Guilford Press, New York.
7. Humhold.W.E., 1991. An introduction to urban geographic information system, Oxford University press, New York
8. Ian Masser& Michael Blakemore., 1991, Handling Geographical Information: Methodology and Potential Applications, Ed.
9. Imus D. and Dunlavey P. (2002) Back to the Drawing Board: Cartography vs the Digital Workflow, MT, Hood, Oregon.
10. Kang-tsung Chang 2002, 'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
11. Keates, J.S. (1973): Cartographic Design and production, London, Longman
12. MacEachren A.M. (1994) Some Truth with Maps: A Primer on Symbolization and Design, University Park: The Pennsylvania State University.
13. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (eds.) (1991) Geographical Information Systems: Principles and Applications. Avon, Longman Scientific and Technical.
14. Martin, D. (1991) Geographical Information Systems and their Socioeconomic Applications. London, Routledge.
15. Menno-Jan Kraak&FerojanOrmeling, 2003, Cartography – Visualisation of Geospatial data, 2ndEdn, , Pearson Education Ltd.
16. Mishra, R.P. and. A. Ramesh, Fundamentals of Cartography , Concept Publishing House, New Delhi – 110059
17. Monkhouse F.J. and Wilkinson, H.R. 1971. : Maps and Diagrams: Their Compilation and Construction, B.I. Publications Private Limited, New Delhi: 527p.
18. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.
19. Peterson, M.P. (1995) "Interactive and Animated Cartography" Upper Sadde River, NJ: Prentice Hall.
20. Peuquet, D.J. and Marble, D.F. (eds.) (1990) Introductory Readings in Geographic Information Systems. London, Taylor and Francis.
21. Ramesh, P. A. (2000): Fundamentals of Cartography, Concept Publishing Co., New Delhi.

22. Rampal, K.K. (1993): Mapping and Compilation, Concept Publishing Co.,New Delhi.
23. Slocum T. (2003) Thematic Cartography and Geographic Visualization, Upper Saddle River, New Jersey: Prentice Hall.
24. Wilford J.N. (2000) The Mapmakers, Vintage Books.

RSG 103: PHOTOGRAMMETRY, SURVEYING AND GPS

TEXT BOOKS:

1. Hussain, S.K. and Nagaraj, M.S. 1992 :Text Book of Surveying, S. Chand & Co. Ltd., New Delhi:
2. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
3. Kanetkar, T.P. and Kulkatni, S. V. 1.988: Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan, Pune: 608p.
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. Terry-Karen Steede, 2002, Integrating GIS and the Global Positioning System, ESRI Press
7. Wolf P.R. (1983) Elements of Photgrammetry, McGraw-Hill, NY.

REFERENCE BOOKS:

1. Alvi, Z. 1995: Statistical Geography: Methods and Applications, Rawat Pub. New Delhi: 194p.
2. American society of photogrammetry (ASP), Manual of remote sensing, second edition, ASP, Falls church,VA,1983
3. Burnside C.D. (1985) Mapping from Aerial Photography, 2nd Ed, Collins.
4. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
5. Digital Photogrammetry, Michel Kasse and Yves Egles, Taylor & Francis, 2001.
6. Digital Photogrammetry, Theory and Application, Eilifried Linder, Springer, 2003.
7. Elements of Photogrammetry with Applications in GIS (3rd Ed.) by Wolf P. and DeWitt B., McGraw-Hill, 2000.
8. Elfic, M.H., Fryer, J.G. Brinkner, R.C. and Wolf, P.R. 1994: Elementary Surveying, 8th edition, Harper Collins Publishers, London: 510 p.
9. Floyd F.S. ( ) Remote Sensing: Principles and Interpretation New York, WH Freeman and Company.
10. Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others by BasudebBhatta, CRC Press.
11. GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and more by Hofmann-Wellenhof, Bernhard, Lichtenegger, Herbert, Wasle, Elmar, SPRINGER.
12. GPS: Theory, Algorithms and Applications by GuochangXu, Artech House, 2009.
13. Introduction to GPS: The Global Positioning System, by Ahmed El-Rabbany, ARTECH House.
14. Introduction to Modern Photogrammetry by Edward M.Mikhail, JananS.Bethel& Chris McGlone, Wiley & Sons Inc,2000.
15. Kellaway, G.P. 1979: Map Projections, 1st Indian edition, B.I. Publication, Delhi.
16. Kochher, C.L. 1993 : A Text Book of Surveying, S.K. Katariya& Sons, Delhi:
17. Leicka. A.: GPS Satellite Surveying, John Wiley & Sons, use. New York

18. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York

19. Menno-Jan Kraak&FerojanOrmeling, 2003, Cartography – Visualisation of Geospatial data, 2ndEdn, , Pearson Education Ltd.

20. Mishra, R.P. and. A. Ramesh, Fundamentals of Cartography , Concept Publishing House, New Delhi – 110059

21. Moffitt F.H. (1980) Photogrammetry, 3rd Ed, Harper & Row, NY.

22. N.K.Agrawal Essentials of GPS, Spatial Network Pvt Ltd 2004

23. Paul J.C. ( ) Principles of Remote Sensing UK, ELBS.

24. Photogrammetry: Geometry from Images and Laser Scans by Kraus, Karl, de Gruyter Publishers.

25. Principles of GNSS, Inertial, and Multi-sensor Integrated Navigation Systems by Paul D. Groves, ARTECH House.

26. Punmia, B.C, Surveying (vol I, and II), Standard book House, Nayasarak, New Delhi

27. Robinson, A.H., Sale, R.D., Morrison, J. 1984 : Elements of Cartography, Wiley, New York:

28. Roy, P. 1988 : An Analytical Study of Map Projections, Volume 1, Kolkata:

29. Saha, Pijushkanti& P. Basu, 2004, Advanced Practical Geography – A Laboratory Manual Books & Allied (P) Ltd.

30. Sarkar, A. 1997 : Practical Geography: A Systematic Approach, Orient Longman Ltd., Hyderabad:

31. Sheffield, C. (1983) Man on Earth, Sidgwick and Jackson, London

32. Shepherd, F.A. 1983 : Engineering Surveying, Edward Arnold, London:

33. Singh, N. Surveying, Tata McGraw-Hill Publishing Company Ltd., New Delhi:

34. Singh, R.L &Dutt. P.K, "Elements of Practical geography", Students Friends Allahabad

35. Singh, R.L. and Singh, R.P.B. 1991: Elements of Practical Geography, Kalyani Pub. New Delhi: 421p.

36. Steers, J.A. 1965 : An Introduction to Map Projections, 14th ion, University of London Press, London:

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

38. Understanding GPS: Principles and Applications by Elliott D.Kaplan, Artech House, 2005.

39. Venkatramaiah, C. 1996: A Textbook of Surveying, Universities Press / Orient Longman Ltd., Hyderabad: 76p.

40. Walford, P., 1995: Geographical Data Analysis, John Wiley and Sons Inc., New York: 446p.

41. www.trimble.com/index.htm

42. Zorn H.C. (1980) Introductory Course in Photogrammetry, 6th Ed. ITC, Netherlands.

RSG 104: COMPUTER FUNDAMENTALS & PROGRAMMING

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

38

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

RSG 201: DIGITAL IMAGE PROCESSING AND INFORMATION EXTRACTION

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. 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.

RSG 202: ADVANCED REMOTE SENSING

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. Hyperspectral Data Exploitation: Theory and Applications by Chein-I Chang,Wiley& Sons Ltd.
6. Hyperspectral Remote Sensing of Tropical and Subtropical Forests by Margaret Kalacska and G. Arturo Sanchez‑Azofeifa., CRC Press.
7. Hyperspectral Remote Sensing: Principles and Applications by Marcus Borengasser, William S. Hungate, and Russell Watkins, CRC Press.
8. Imaging Radar (Manual of Remote Sensing, Volume 2) by Henderson F.M. and Lewis A.J. (3rd Ed.), Wiley, 1998.
9. Imaging with Synthetic Aperture Radar by Didier Massonnet, Jean-Claude Souyris, CRC Press, 2008.
10. Introduction to Microwave Remote Sensing by Iain H. Woodhouse, CRC, 2004.
11. Maune, D. F. and Bethesda, M.D. (2nd Ed.), American Society for Photogrammetry and Remote Sensing. 2007.
12. Microwave Remote Sensing: Active and Passive, from Theory Applications by Ulaby F.T., Moore R.K. and Fung A.K., Artech House Publishers, 1986.
13. Polarimetric Radar Imaging. From Basics to Applications by Lee, J.-S. andPottier, E., CRC Press, 2009.
14. Skolnik and Merrill I. Introduction to Radar Systems, McGraw-Hill (1st ed., 1962; 2nd ed., 1980; 3rd ed., 2001).
15. Techniques and Applications of Hyperspectral Image Analysis by Hans F. Grahn and Paul Geladi, Wiley & Sons Ltd.
16. Topographic Laser Ranging and Scanning, Principles and Processing, Shan, J. and C. Toth, Taylor & Francis, 2008.
17. Understanding Synthetic Aperture Radar Images by Olivie, C. and Quegan, S. Scitech, 2004.

RSG-203: ADVANCED 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

40

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. A. Silberschats, Henry F. Korth "Database System Concepts", 3rd Edition, TMH, 1998

2. Bonham Carter G.F (1994) GIS for Geoscientists: Modeling with GIS Pergamon Publications.

3. Chaisman, N. 1992: Exploring Geographical Information Systems, John Wiley and Sons Inc., New York: 198p.

4. Chrisman, N.R. (1997) Exploring Geographic Information Systems. John Wiley and Sons.

5. David J Maguire, Michael F Goodchaild and David W Rahind., 1991, Geographical Information System, Ed.

6. DeMers, M.N.,Fundamentals of geographic information system, Wiley, New York, 1997

7. Foresman,T.W.(ed)History of GIS, Prentice-Hall, Upper saddle river, NJ,1998

8. 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.

9. Humhold.W.E., 1991. An introduction to urban geographic information system, Oxford University press, New York

10. Huxhold, W.E. (1991) An Introduction to Urban Information Systems. New York, OUP.

11. Ian Masser& Michael Blakemore., 1991, Handling Geographical Information: Methodology and Potential Applications, Ed.

12. Kang-tsung Chang 2002, 'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.

13. Laurini, R. and Thompson, D. (1992) Fundamentals of Spatial Information Systems. London, Academy Press.

14. Mac Donald, A. 1999, Building a Geodatabase, Redlands CA: ESRI Press.

15. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (eds.) (1991) Geographical Information Systems: Principles and Applications. Avon, Longman Scientific and Technical.

16. Martin, D. (1991) Geographical Information Systems and their Socioeconomic Applications. London, Routledge.

17. Mary Summer, Computers: Concepts and Uses, Prentice Hall, Englewood Cliffs. New Jersey.

18. Muralikrishna V., Geographical Information Systems and Remote Sensing Applications, Allied Publishers Private Limited.

19. Peuquet, D.J. and Marble, D.F. (eds.) (1990) Introductory Readings in Geographic Information Systems. London, Taylor and Francis.

20. Samet, H. 1990, The Design and Analysis of Spatial Data Structures, Addison–Wesley.

21. Sanghavi, Hitesh (1998) Oracle Miracles, Express computers methods, 1998.

RSG-204: CBCS I: FUNDAMENTALS OF GEOSPATIAL TECHNOLOGY

TEXT BOOKS:

1. Jensen, J.R., 2000. Remote sensing of the environment: An earth resource perspective, Prentice Hall, Upper saddle river, NJ,

2. Lillesand, T.M. and Kieffer, R.W., 2003. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York

41

3. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.
4. C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.
5. Wolf P.R. (1983) Elements of Photgrammetry, McGraw-Hill, NY.
6. Hussain, S.K. and Nagaraj, M.S. 1992 :Text Book of Surveying, S. Chand & Co. Ltd., New Delhi:

REFERENCE BOOKS:

1. Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India
2. Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
3. Chakraborty and Sahoo, 2008, Fundamentals of Geographic Information Systems, Viva Books Private Limited, India

RSG 301: APPLICATION OF GEOINFORMATICS & SPATIAL DECISION SUPPORT SYSTEMa

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), 2000.

42

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.

RSG 302: FUNDAMENTAL OF RESEARCH & GEOSTATISTICS

TEXT BOOKS:

1. Kothari, C. R., 1985. Research Methodology: Methods and Techniques, New Age International Pvt. Ltd.
2. Mishra, R. C. and Soota, T., 2005, Modern Project Management, New Age International Ltd.
3. Murthy, C., 2009, Research Methodology, Vrinda Publications Ltd.
4. W.E. Huxold& A.G. LerinsonsAronoft.S.(1989) Managing Geographic Information Projects.
5. Alvi, Z. 1995: Statistical Geography: Methods and Applications, Rawat Pub. New Delhi
6. Burrough, P.A. and McDonnel, R.A., 2007, Principles of Geographical Information Systems, 3e, Oxford University Press, New York.
7. Chiles, J.P. (1999). Geo-statistics: Modelling spatial uncertainty, Wiley Interscience Publ.
8. Isaaks, E.H. and Srivastava, R.M., 1989, Applied Geostatistics, Oxford University Press, New York, 561pp.
9. Longley, P. and Batty, M. (eds.), 1996, Spatial Analysis: Modelling in a GIS Environment, Geoinformation International, Cambridge, 392pp.
10. Pal, S.K. 1999 : Statistics for Geoscientists, Concept publishing Company, New Delhi
11. Sharma, D.D. (2002). Geo-statistics with application in Earth Sciences, Capital Publ.
12. Silk, J. 1979 : Statistical techniques in Geography, George Allen and Unwin, London
13. Walford, P.,1995: Geographical Data Analysis, John Wiley and Sons Inc., New York

REFERENCE BOOKS:

1. Ahuja, R., 2010. Research Methods, Rawat Publication.
2. Beer D. (1991) Writing and Speaking in the Technology Professions: A Practical Guide, Wiley-IEEE Press.
3. Bennet P. Lientz& Kathryn P. (1995) Project Management for the 21st Century, Academic Press, California
4. Berkun, Scott (2005). Art of Project Management. Cambridge, MA: O'Reilly Media.
5. Earickson, R,. and Harlin, J. (1994) Geographic Measurement & Quantitative Analysis, Macmillan, N.York
6. Kerzner, Harold (2003). Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 8th Ed., Wiley.
7. Lewis, James (2002). Fundamentals of Project Management, 2nd ed., American Management Association.
8. Markel M. (1994) Writing in the Technical Fields: A Step-by-Step Guide for Engineers, Scientists and Technicians, publisher.
9. Markel M. (2009) Technical Communications, 9th Edition, Bedford/St Martin's.

43

10. Meredith, Jack R. and Mantel, Samuel J. (2002). Project Management: A Managerial Approach, 5th ed., Wiley. ISBN 0-471-07323-7.
11. Rossiter, D. G. 2003. *Introduction to the R Project for Statistical Computing for use at ITC*. Enschede (NL): International Institute for Geo-information Science & Earth Observation (ITC). URL: http://www.itc.nl/personal/rossiter/teach/R/RIntro_ITC.pdf
12. Rossiter, D. G. 2004. *Statistical methods for accuracy assesment of classified thematic maps*. Technical note, International Institute for Geo-information Science and Earth Observation (ITC). URL: http://www.itc.nl/personal/rossiter/teach/R/R_ac.pdf 158

http://courses.washington.edu/hcde231/Readings.html

http://www.writing.engr.psu.edu/

http://owl.english.purdue.edu/owl/resource/629/01/

http://www.writing.engr.psu.edu/exercises/

13. Das, N.G., 1997, Statistical Methods: Part I, M. Das and Company, Calcutta.
14. Das, N.G., 1997, Statistical Methods: Part II, M. Das and Company, Calcutta.
15. Geostatistics for Environmental Scientists by R. Webster and M.A. Oliver, (2nd Ed.) Wiley, 2007.
16. Gregory, S. (1978): Statistical Methods for Geographers, Longman
17. Hierarchical Modeling and Analysis for Spatial Data by Banerjee, Carlin and Gelfand, Chapman and Hall, 2004.
18. Interpolation of Spatial Data by Stein, Springer, 1999.
19. Khan, N., 2002, Quantitative Methods in Geographical Research, Concept Publishing Company, New Delhi.
20. Mehmood, A., 2002, Statistical Methods in Geographical Studies, Rajesh Publication, New Delhi.
21. Multivariate Geostatistics: An introduction with Applications by Hans Wakernagel, Springer, (3rd Ed.), 2003.
22. Murray R. Spiegel, (1981), Theory and Problems of Statistics , Schaum's Outline Series
23. Paul L. Meyer: Introductory Probability and Statistical Applications, Addison Wesley
24. Peterson, M.P. (1995) "Interactive and Animated Cartography" Upper Sadde River, NJ: Prentice Hall.
25. Saha, Pijushkanti& P. Basu, 2004, Advanced Practical Geography – A Laboratory Manual Books & Allied (P) Ltd.
26. Sarkar, A. 1997 : Practical Geography: A Systematic Approach, Orient Longman Ltd., Hyderabad:
27. Singh, R.L. and Singh, R.P.B. 1991: Elements of Practical Geography, Kalyani Pub. New Delhi: 421p.
28. Spatial statistics: geospatial Information Modeling and Thematic Mapping by Mohammed A Kalkhan, CRC Press, 2011.
29. Statistics for Spatial Data by Cressie, Wiley, 1993.
30. Walford N. (2011) Practical Statistics for Geographers and Earth Scientists, John Wiley & Sons, New Jersey, USA.
31. Williams R.B.G. (1984) Introduction to Statistics for Geographers and Earth Scientists, Macmillan, London.
32. Wrigley N. (1985) Categorical Data Analysis for Geographers and Environmental Scientists, Longman, Harlow.
33. Zhang C. (2007) Fundamentals of Environmental Sampling and Data Analysis, John Wiley & Sons, NJ, USA.

RSG 303 ELECTIVE PAPERS

GEOINFORMATICS 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

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

GEOINFORMATICS IN URBAN, RURAL DEVELOPMENT & REGIONAL PLANNING

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

GEOINFORMATICS IN FOREST MANAGEMENT

2. Baretl, E.C. and Culis I.F. Introduction to Environmental Remote Sensing, Second edition, Chapman and Hall, New York, 1993.
3. Simmons, T.G. The Ecology of Natural Resources, Edword Arnold, London, 1974.

GEOINFORMATICS IN ENVIRONMENTAL SCIENCE & MANAGEMENT

1. Baretl, E.C. and Culis I.F. Introduction to Environmental Remote Sensing, Second edition, Chapman and Hall, New York, 1993.
2. Lintz, J.andSimonent,D.S. Remote Sensing of environment Addision Wesley, Rading mars, 1976.

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

GEOINFORMATICS IN WATER RESOURCES 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.

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

GEOINFORMATICS IN 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.

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.

RSG304: CBCS II: ADVANCED REMOTE SENSING AND AREAS OF APPLICATIONS

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. Hyperspectral Data Exploitation: Theory and Applications by Chein-I Chang,Wiley& Sons Ltd.
6. Hyperspectral Remote Sensing of Tropical and Subtropical Forests by Margaret Kalacska and G. Arturo Sanchez‑Azofeifa., CRC Press.
7. Hyperspectral Remote Sensing: Principles and Applications by Marcus Borengasser, William S. Hungate, and Russell Watkins, CRC Press.
8. Imaging Radar (Manual of Remote Sensing, Volume 2) by Henderson F.M. and Lewis A.J. (3rd Ed.), Wiley, 1998.
9. Imaging with Synthetic Aperture Radar by Didier Massonnet, Jean-Claude Souyris, CRC Press, 2008.
10. Introduction to Microwave Remote Sensing by Iain H. Woodhouse, CRC, 2004.