VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SCHEME OF TEACHING AND EXAMINATION

M.TECH--GEO-INFORMATICS

I SEMESTER **CREDIT BASED**

Subject Code	Name of the Subject	No. of Hrs/week		Duration of Exam in Hours	Marks for		Total Marks	Credits
		Lecture	Practical / Field Work		I.A.	Exam		
14CGI11	Fundamentals of Remote Sensing	4	2	3	50	100	150	4
14CGI12	Fundamentals of Photogrammetry	4	2	3	50	100	150	4
14CGI13	Fundamentals of Geographic Information Systems	4	2	3	50	100	150	4
14CGI14	Geospatial Database Management System	4	2	3	50	100	150	4
14CGI15X	Elective-I	4	2	3	50	100	150	4
14CGI16	Lab component		3	3	25	50	75	2
14CGI17	Seminar	--	3	--	25	--	25	1
		20	**16**	**18**	**300**	**550**	**850**	**23**

ELECTIVE – I	
14CGI151	Fundamentals of Geostatistics
14CGI152	Advanced Geographic Information Systems
14CGI153	Advanced Remote Sensing Techniques

I SEMESTER

FUNDAMENTALS OF REMOTE SENSING

Subject Code: **14 CGI -11**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objectives:
To understand the basic concepts of remote sensing, systems & techniques of data acquisition and to acquire skills in image processing techniques and interpretation of remote sensing data.

Introduction: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology, stages in remote sensing technology, spatial data acquisition, interdisciplinary nature and relation with other disciplines, applications of remote sensing, advantages of RS over conventional methods of survey and inventorying.

Basic Principles of Remote Sensing : Characteristics of electro-magnetic radiation; Interactions between matter and electro-magnetic radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; active and passive remote sensing, Definition of radiometry; Black body radiation; Reflectance; spectral reflectance of land covers; Spectral Signature; Spectral characteristics of solar radiation; Radiative transfer equation; energy interaction in the atmosphere; energy interactions with the earth's surface-spectral reflectance curves

Sensors: Types of sensors- passive sensors and active sensors; imaging systems, photographic sensors, characteristics of optical sensors; Sensor resolution- spectral, spatial, radiometric and temporal; Dispersing element; Spectroscopic filter; Spectrometer; Characteristic of optical detectors; Cameras for remote sensing; Film for remote sensing; non-imaging radiometers, imaging sensors, photograph v/s image, Panchromatic, Multispectral, hyperspectral, stereo images, Optical mechanical line scanner;Pushbroom scanner; Imaging spectrometer; spaceborne imaging sensors, active and passive microwave sensors; Thermal sensors; Atmospheric sensors; Sonar; Laser, radar, hyperspectral sensors. Products from scanner data, Image data characteristics, data selection criteria.

Platforms: Types of platforms- airborne remote sensing, space borne remote sensing; Atmospheric condition and altitude; Attitude of platform; Attitude sensors; Orbital elements of satellite; Orbit of satellite; Satellite positioning systems; satellites for Land, Ocean, and atmospheric studies.

Image Interpretation and Analysis: Fundamentals of aerial photos and satellite image interpretation; Types of imaging, elements of interpretation; Techniques of Visual interpretation; Generations of Thematic maps

Digital Image Processing: Digital data manipulation and analysis; image rectification – Radiometric correction, Atmospheric correction, Geometric correction; image enhancement – Spatial feature manipulation and multi-image manipulation; classification techniques – Supervised classification and unsupervised classification.

Advanced Remote Sensing Technologies: Synthetic Aperture Radar; Side Looking Airborne Radar; Hyper spectral Imaging Spectrometer; Lidar; Thermal Imaging System; Advanced Laser Terrain Mapping.

REFERENCE BOOKS:

1. **Fundamentals of Remote Sensing**: George Joseph
2. **Remote Sensing and Image Interpretation:** Lillesand & Keifer.
3. **Manual of Remote Sensing**: ASP Falls Church Virginia USA.
4. **Physical aspects of Remote Sensing:** PJ Curran.
5. **Remote Sensing Principles and Interpretation:** F.F. Sabins.
6. **Introduction to Remote Sensing**: J.B. Campbell.
7. **Introductory Digital Image Processing**: A Remote Sensing Perspective, John R Jensen.

8. **Remote sensing Models and methods for image processing** by Robert A. Schowengerdt, second edition, 1997, Academic Press

FUNDAMENTALS OF PHOTOGRAMMETRY

Subject Code: **14 CGI -12**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objective:
Understand the basic concepts of photogrammetry, systems and techniques of extraction and analysis of information from aerial/satellite stereo data.

Introduction: Definition and terms, history of photogrammetry, concepts, principles and types of photogrammetry, types of aerial photographs vertical photographs, tilted photographs, orthophotographs, aerial cameras, geometry and scale orientation and measurements, distortions, displacements and their corrections, rectification and orthophotographs, digital imaging devices and their characteristics and advantages over other analogue cameras, satellite stereo images.

Stereoscopy: Principles of stereoscopic vision, types of stereoscopes, stereoscopic viewing, stereoscopic parallax, stereoscopic plotting and mapping instruments, soft copy plotters.

Analytical Photogrammetry: image measurements, control points, colinearity, coplanarity, analytical interior orientation, analytical relative orientation, analytical absolute orientation, analytical self calibration.

Project Planning: flight planning, prepointing and post pointing, photographic end lap and side lap, purpose of photography, photo scale, flying height, ground coverage, weather conditions, season of the year, flight map, specifications, cost estimation and scheduling.

Ground Control for Aerial Photogrammetry: selecting photo control points number and location of photo control, planning the control survey, traditional field survey methods for horizontal control and vertical control, ground control surveys by GPS, artificial targets for photo identifiable control points, indexing ground control.

Aerotriangulation: GPS supported AT, geometric relationship between a camera and GPS antenna with respect to position, and attitude, synchronization of GPS coordinates with camera exposures, entering GPS coordinates, and INS parameters in bundle block adjustments for each exposure stations. Requirements with GPS and INS.

Orientation Procedures: Purpose of fiducial marks, image coordinate system and object space coordinate system, IO, EO procedures in digital photogrammetry, advantage of digital IO over analogue and analytical system, advantage of digital EO over analogue system.

Concept of Block/Bundle/Strip Adjustments: definition of block, types of block adjustments, planning of photo control, selecting photo control images, number and location of photo control, bundle block adjustment, (IO,EO) colinearity condition equations, epipolar geometry, space resection, space intersection, reasons for digital AT superior over analogue AT.

Digital Photogrammetry: Digital photogrammetric systems, Digital photogrammetric work station and its configuration, photogrammetric scanners, inputs to DPWS, Various formats of data, contrast enhancement, spectral transformation, multiscale representation, epipolar geometry, 3D visualization in digital environment, anaglyph, polarization, digital image matching, line interleaved, quad buffer, IO, RO automatic process, AO automatic, EO parameters, automatic production of digital elevation models, accuracy assessment of block, feature extraction by 2D, feature extraction by3D, data models, symbol library, feature classification, coding, feature collection, annotation, database attachments, interactive editing, and layer concepts. Advantages of digital photogrammetry, automatic tie point generation, digital photogrammetric softwares.

Introduction to DTM: digital surface modeling by DTM/DHM and DSM/DEM, Interpolation techniques, GRID and TIN, break lines, profiles, mass points, / random points, factors influencing choice of sampling patterns, DTM generation process, preprocessing, main processing, post processing, differential rectification, mosaicing, automatic production of digital orthophotos. Differential sampling techniques- manual, semiautomatic, automatic sampling techniques, storage of TIN Grid and its data base structure. Data sources, / input to DTM, Direct and indirect data collection method, field survey, photogrammetry and Remote sensing data, maps.

Photogrammetry and GIS: input of data from photogrammetry for GIS database, photogrammetric applications in GIS.

REFERENCE BOOKS:

1. **Elements of Photogrammetry with applications in GIS** by Paul R Wolf and Bon A. Dewitt, 3rd edition, 2004, ISBN 007-123689-9
2. **Aerial Photography and Image interpretation second edition** by David P paine, and James D Kiser, 2003, John Wiley and Sons Inc. ISBN 0-471-20489-7
3. **Interpretation of Aerial Photographs:** TE Avery
4. **Elementary Air Survey:** W. Kilford.
5. **Manual of Photogrammetry**: ASP Falls Church Virginia.
6. **Modern Photogrammetry** by Edward M Mikhail
7. **Photogrammetry** Vol. I- Kranss

FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEMS

Subject Code: **14 CGI -13**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objective:

To understand the basic principles of GIS, creation of GIS database and develop basic practical skills in the use of GIS software for data inputting and error correction.

Introduction to GIS: Definitions, Basic Concepts, history and evolution, Components, Need, Scope, interdisciplinary relations, applications areas, and overview of GIS.

Data- Types and Models: Spatial/Geometrical Data- Raster data, Vector data, Non-spatial / Attribute Data. Models of data- Basic Data Models –raster and vector, Spaghetti model and Topology model, Choice between data models; Advanced data models- Grid model, TIN model, network model, other models, combination of models. Data formats – Raster data formats, vector data formats, advantages and disadvantages of raster and vector data formats. Compression of vector and raster data

Data Sources: Data collection, modes of data acquisition- Primary and secondary methods of acquisition of spatial and non-spatial data-surveying, remote sensing, Photogrammetry, Database generation Data capturing, map scanning and digitizing, data conversion from other digital sources, data exchange standards, topology building, editing and cleaning, linking of spatial and non-spatial data.

Data Processing: Updation, corrections, modifications, scale changes, Coordinate thinning, geometric transformations and map projection transformations, conflation sliver removal, edge matching, interactive graphic editing, rubber sheeting.

Data Quality and Standards: Definition of data quality, components of geographic data quality – lineage, positional accuracy, attributes accuracy, temporal accuracy, logical consistency and completeness; assessment of data quality. Accuracy, precision, error and uncertainty. Sources and types of errors, error propagation and error management; Geographic data standards components and types of GIS standards, international GIS standards, interoperability of GIS, quality control.

Elementary Spatial Analysis and Modeling: Spatial Concepts : introduction to space, Spatial awareness, Euclidean space, Set based geometry of space, Topology of space, Network spaces, Metric spaces, Spatial elements - point, line, area, surface and network spatial patterns, spatial data relationships, topological relationships and geometrical relationships, proximal, directional relationships

Basic Spatial Analysis, Integration and Modelling: Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, complex operations of attribute data, classification reclassification, integrated geometry and attributes, overlay, buffer zones, raster data overlay, integrated data analysis.

Advanced Analysis and Modelling: Spatial reference systems, trend surface analysis, Network and Raster connectivity operations, Spatial interpolation and proximity operations, fuzzy analysis, GIS analytic models, Digital Terrain models, Hydrologic modeling, engineering GIS.

REFERENCE BOOKS:

1. **Concepts and Techniques of Geographic Information Systems,** CP Lo Albert K W Yeung, 2005 Prantice Hall of India.
2. **Principles of GIS for Land Resources Assessment** by P.A.Burrough, Oxford: Science publications, 1986.
3. **Geographic Information Systems** – **An introduction** by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
4. **GIS – A computing Perspective** by Micheal F. Worboys, Taylor & Francis, 1995.
5. **Remote Sensing and Image Interpretation** by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
6. **Geographical Information Systems** – Principles and Applications, Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
7. **Geographical Information Systems** – Principles and Applications, Volume II edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

GEOSPATIAL DATABASE MANAGEMENT SYSTEMS

Subject Code: **14 CGI -14**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objectives

On completion of this subject, students should have a sound knowledge about the database concepts, database management systems and their applications in GIS and modeling the real world.

Note: The subject will be taught as applied to Geospatial Database Management

Databases and Database Users: Introduction, characteristics of database approach, intended uses of a DBMS, implications of database approach.

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Database System Concepts and Architecture: Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems.

Data Modeling: High level conceptual data models for database design, ER model concepts, schema constructs and simple applications.

Record Storage and Primary File Organizations: Secondary storage devices, buffering of blocks, placing file records on disk, operations on files – heap files and sorted files – hashing techniques.

Index Structure of Files: Single-level and multilevel ordered indexes, dynamic multilevel indexes using B-trees and B+ trees.

Relational Data Model: Concepts and constraints, update operations on relations, relational algebra, simple examples

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Structured Query Language: Data definition in SQL, queries, update statements, views in SQL, simple examples. Introduction and basics of Relation Database Management System.

Database design: Functional dependencies and normalization for relational databases, Normal forms based on primary keys, gene general definition of second and third normal forms, Boyce-Codd normal form.
Query Processing: Basic algorithms for executing query operations.

Transaction Processing Concepts: Introduction, transaction and system concepts, properties, schedules and recoverability.

Concurrency and Recovery: Locking techniques for concurrency control, recovery concepts and techniques.
Design and implementation of Geospatial database: Spatial database system, Spatial Indexing, SDBMS or RDBMS models,

Spatial database management using POSTGIS: postGIS Geography type,SPATIAL_REF_SYS table and Spatial Reference System, Creating Spatial Table, Loading GIS data, Retrieving GIS data, Building indexes , Spatial SOL-Exercise.

Advanced database concepts: Object–relational database management system (ORDBMS), Distributed databases, web services and XML, OLAP (Online Analytical Processing), OLTP (Online transaction processing).

New Applications: Discussion on new applications like Decision Support System, Data Mining, Data Warehousing and Spatial Databases, Recent Developments.

REFERENCE BOOKS:

1. Elmasri R. and Navathe S.B., "**Fundamentals of Database Systems**", Benjamin/Cummings Publishing Co. Inc. (Addison- Wesley world student series), 2002

2. Trembley J.P. and Sirenson P.G., "**An Introduction to Data Structures with Applications**", Tata McGraw-Hill.

3. Date C.J., "**An Introduction to Database Systems**", Vol-I, Addison-Wesley.

4. A.Silberschatz, H.F.Korth and S.Sudarshan, "**Database System Concepts**", McGraw-Hill International Editions, Computer Science Series.

FUNDAMENTALS OF GEOSTATISTICS

Subject Code: **14 CGI -151**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objective:
To introduce and familiarize the students with the basic concepts and techniques of statistical analysis which serve as a prerequisite for understanding digital image processing and spatial analysis and modeling in GIS.

Basics and Fundamental Concepts: Histogram – univariate and bivariate, estimation of basic statistical parameters, viz., mean, standard deviation, variance, covariance.

Probability Theory: Introduction to probability theory, kinds of probability – classical or apriority probability, A posteriori or Frequency probability, probability models, an inside to set theory, sample space and events, conditional, joint probability and independence.

Random Variables, Distribution Functions and Expectation:
Introduction and summary, Cumulative distribution function, Density function, Expectations and moments.

Special Parametric Families of Univariate and Multivariate Distributions: Introduction and summary, Discrete and continuous distributions – binomial, poisson, exponential, Gaussian/Normal distribution functions, joint and continuous distributions, bivariate and multivariate normal distribution.

Estimation Theory: Introduction and summary, methods of finding estimators, properties of point estimators, unbiased estimation, location or scale invariance, Bayes estimators – posterior distribution, loss function approach, min-max estimators, maximum likelihood estimators.

Stratification and Sampling: Introduction, sampling, sample mean, sampling from normal distribution, stratification and sampling.

Testing of Hypothesis: Introduction and summary, simple hypothesis testing, composite hypothesis, tests of hypotheses – sampling from normal distribution, chi-square tests, tests of hypotheses and confidence intervals, sequential test of hypotheses.

Estimation and Quality Control: Introduction, point estimates and interval estimates: basic concepts, interval estimates and confidence intervals, calculating interval estimates of the mean from large samples, calculating interval estimates of the proportion from large samples.

Geo-statistics for Spatial Analysis and Modeling: Cluster analysis concepts and techniques, Spatial autocorrelation, Multivariate Correlation, Linear regression, Multiple regression. Statistical Surfaces- Interpolation, Variogram, Krieging. geostatistical models, stochastic models, probabilistic models, Deterministic models; enthalpy; Geo-statistics soft-wares- SpaceStat, S-Plus.

Time Series and Forecasting: Introduction, variation in time series, trend analysis, time series anlaysis in forecasting.

REFERENCE BOOKS:

1.Richard I.Levin, David S. Rubin, Sanjay Rastogi, Masood Hussain Siddiqui, **Statistics for Management,** 7th edition, Pearson Education Inc,2013
2.Alexander M Mood, Franklin A Graybill and DuaneC Boes**,Introduction to the Theory of Statistics**, 3rd Edition, McGraw-Hillseries in probability and statistics, (1974).
3 Fruend John E and Miller, Irwin, **Probability and Statistics for Engineering,** 5th Edition, Prentice Hall (1994)
4. Jay L Devore, **Probability and Statistics for Engineering and Sciences**, Brooks/Cole Publishing company Monterey, California (1982)
5. **Sampling theory**, Cochran WG
6. **Multivariate Statistical Inference**, W A Anderson
7. **Principles of Geographic Information System** by Peter ABurrough and Rachael A McDonnnel
8**. Introduction to Geostatistics. Applications in Hydrogeology, ISBN:** 9780521587471
9. **Spatial Statistics and Computational Methods**, ISBN:0387001360
10. GSLIB. Geostatistical Software Library and User's Guide. (2nd Ed), Clayton V. Deutsch, Andre G. Journal, Oxford University Press, ISBN: 0195100158

ADVANCED GEOGRAPHIC INFORMATION SYSTEMS

Subject Code: **14 CGI -152**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03

Total no. of Lecture Hrs: 52 Exam Marks: 100

Objective:
Upon completion of study of this subject the student would be able to model and analyse the spatial data, utilize GIS as navigation guide, decision support and expert tool. Understand how to use a wide range of vector-based GIS tools to address questions relevant to natural resource management. Analyse the requirements of a proposed application and synthesise an appropriate solution and customise a GIS.

Geodatabase: Types of geodatabase, Advantages of geodatabase, Basic geodatabase structure, Topology, relational classes, geometric networks, raster data - Creating geodatabase, organizing data, defining database structure - Understanding spatial reference in geodatabase – Modifying spatial domain, Simple feature creation in geodatabase, Creating and editing map topology, - Types of geodatabase annotation - Adding behavior to a geodatabase.

Surface Analysis: Slope and aspect - Hydrologic functions - Viewsheds - Shaded relief maps Spatial analysis - Surface analysis - 3-D analysis – Map algebra - Cell statistics DEM, DTM and TIN

Model Building and Spatial Modeling: Why build models - Anatomy of a model - Model elements - Introduction to scripting. The object model in GIS. Vector and raster data extraction for modeling, Land use classification, Temporal land use analysis, Spatial modeling procedure, Cellular automata modeling, Methods of spatial interpolation.

Data Accuracy, Error Assessment and Propagation: Spatial data standards, Positional accuracy, Methods of measuring data accuracy, Accuracy measurement, Error in linear and area feature, Land use classification accuracy, Attribute accuracy, Error propagation in spatial attribute

Advanced Cartography: Annotations, labels, and metadata; Map making with advance tricks Working with labels and annotations – Managing (organizing and modifying) labels and annotations - Metadata file creation and management with new tools.

Multi-Criteria Decision Analysis and SDSS : Elements of multi-criteria decision analysis, classification of decision problems, evaluation criteria, hierarchical decision alternatives and constraints, alternatives and decision variables, deterministic variables, criteria weighting , estimation weights, ranking methods, decision rules, multi-attribute decision rules, sensitivity analysis, multi-criteria spatial decision support systems (SDSS). SDSS for location planning, application-specific capabilities; requirements of a SDSS.

Expert GIS : Introduction to concepts of Expert GIS, Data formats, Proprietary file formats, translator and transfer formats, open formats, standards, metadata, standards gazetteer, XML and GML, Spatial databases,
relational databases, object databases, GIS and databases, advanced database technology, derived mapping – generalization, text placement, automated cartography, data from imagery, Web GIS, simple maps in web pages, internet mapping sites, internet softwares, Mobile GIS –positioning, location based services, personal and vehicle navigation, LBS for mass market, telematics. –Applications

Enterprise GIS : User need assessment; old and new spatial database models, SDE layers, Geo database, architecture design, capacity planning(Hardware), security planning, RDBMS software selection, GIS software selection, planning for migration. Enterprise GIS management.

Case Studies: GIS analysis in transportation, GIS analysis in water management, urban development, environmental analysis, hydrological modeling, Habitat suitability modeling, virtual cities 3D modeling and visual simulation, Automata based models of Urban system

REFERENCE BOOKS:
1. **GIS and Multi-criteria decision analysis** by Jacek Malczewski, John Wiley and sons.
2. **Expert Systems** by Peter Jackson, third edition, 1999, Pearson Education.
3. **Concepts and Techniques of Geographic Information Systems,** CP Lo, Albert K W Yeung, 2005 Prantice Hall of India

4. **Geographic Information Systems – An introduction** by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
5. **Remote sensing and Image interpretation** by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
6. **Geographical Information Systems** – Principles and Applications, Volume I & II, edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

ADVANCED REMOTE SENSING TECHNIQUES

Subject Code: **14 CGI -153**	IA Marks: 50
No. of Lecture Hrs/ Week: 04	Exams Hrs: 03
Total no. of Lecture Hrs: 52	Exam Marks: 100

Objective:
Upon completion of this subject students should have gained the knowledge of optical and microwave remote sensing and also they become familiar with the basic principles and advantages of thermal and Microwave RS.

Thermal Remote Sensing: Thermal radiation principles, processes and thermal properties of materials, thermal conductivity, thermal capacity, thermal inertia, thermal diffusivity, emissivity, sensing radiant temperatures, radiant versus kinetic temperatures, blackbody radiation, atmospheric effects, interaction of thermal radiation with terrain elements, IR detection and imaging technology, thermal sensors and scanners, airborne IR surveys, satellite thermal IR images, spatial resolution and ground coverage, thermal IR broad band scanner and multispectral scanner, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery, temperature mapping with thermal scanner data, thermal inertia mapping, apparent thermal inertia, applications of thermal remote sensing in geology, hydrogeology, urban heat budgeting.

Passive Microwave Remote Sensing: Basics –physics of RADAR waves, spectral characteristics of RADAR waves, microwave radiometers, passive microwave scanners and sensors, applications in atmosphere, ocean and land.

Precision Remote Sensing: Introduction, Spatial, Spectral, Temporal precision and their requirement.

Active Microwave Remote Sensing: RADAR- definition and development, Radar Systems –airborne and space borne SLRs and their components, imaging systems, typical images, radar wavelengths, scattering theory, RADAR equation, Depression angle, slant range and ground range images, spatial resolution and theoretical limits, azimuth resolution, real aperture and synthetic aperture RADAR systems, geometric characteristics of radar imagery and transmission characteristics of radar signals, SLR stereoscopy and RADARgrammetry, RADAR return and image significance, coherence, phase unwrapping, polarization, image registration, baseline determination, measurement of surface topography and deformation analysis, satellite radar systems and images, image processing, RADAR image interpretation. SAR interferometry- principle, image processing, differential SAR interferometry, factors affecting SAR interferometry, Applications of RADAR soil response, vegetation response, water and ice response, urban area response.

LIDAR Remote Sensing: Altimetric LiDAR: Physics of laser, spectral characteristics of laser, laser interaction with objects, Airborne Altimetric LiDAR: principle, Multiple return, Components of LiDAR system, INS technology, INS-GPS integration, measurement of laser range, calibration, flight planning, laser range to xyz coordinates, accuracy of various components of LiDAR, error analysis of data and error removal, raw data of DEM processing, filtering of data uses of return strength/waveform, data classification techniques, LiDAR data integration with spectral data, LiDAR Applications.

Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, N-dimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Mixture tuned matched filtering, Classification techniques,

airborne and space-borne hyperspectral sensors, applications. High resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications.

REFERENCE BOOKS:

1. Fawaz T Ulaby, Richard K Moore and Adrian K Fung, **Microwave Remote Sensing active and passive**, Vol. 1, 2 and 3 Addison – Wesly Publication company 1981, 1982, and 1986.
2. Philip N Slater, **Remote Sensing, optics and optical systems**. 1980
3. Robert M Haralick and Simmonet**, Image processing for remote sensing** 1983.
4. Robert N Colwell **Manual of Remote sensing** Volume1, American Society of Photogrammetry 1983.
5. Travett J W **Imaging Radar for Resources surveys**, Chapman andHall, London 1986.
6. **Remote sensing and Image Interpretation** by Thomas M Lillesand and Ralph W. Keifer fourth Edition, 2002, 2003, John Wiley and Sons Inc.
7. **Remote Sensing Geology** by Ravi P Gupta, Second edition, 2003, Springer
8. **Remote Sensing Principles and Interpretation** by Floyd F Sabins, 1997, W H Freeman And Company

GEOINFORMATICS LABORATORY-I

Subject Code: **14 CGI -16**	IA Marks: 25
No. of Lab Hrs/ Week: 03	Exams Hrs: 03
Total no. of Lecture Hrs: 39	Exam Marks: 50

Remote Sensing & Geographic Information System:

1. Familiarization with Maps of different scales (SOI Toposheets)
2. Familiarization with Monochromatic and Multispectral Satellite Imagery (Creation of FCC)
3. Downloading Satellite Images
4. Study of Spectral Signatures with Spectroradiometer
5. Geometric Correction of Satellite Data(Georeferencing, Mosaicing and Subsetting)
6. Import and Export of Satellite data to various formats using different softwares
7. Visual Interpretation of Aerial photographs & Satellite Imagery and area measurement (Dot grid, Planimetetrs etc.)
8. Spatial Data creation using field data in GIS Software environment
9. Feature extraction (Vectorization) using GIS Softwares

Photogrammetry:

10. Stereo Test
11. Familiarization with Mirror Stereoscope
12. Familiarization with the use of Parallax Bar
13. Determination of height of objects from stereo pairs
14. Feature extraction and tracing of details from stereo pairs
15. Demonstration on Digital Photogrammetric Station
16. Orthophoto generation

Geospatial Database Management System:

17. RDBMS - Familiarization with MS Access Software, SQL Querying, Post GRE, Post CRES

18. Practicals on Stratification and Sampling

19. Practicals on Correlation and Regression

REFERENCE BOOKS:

1. **ERDAS Field Guide,** 4th Edition, 1997, ERDAS Inc, Georgia
2. **Using ArcCatalog,** Aleta Vienneau, 2001, ESRI
3. **ArcGIS 9 – Using ArcGIS Desktop,** 2006, ESRI
4. **ArcGIS 9- Getting Started with ArcGIS,** 2004, ESRI
5. **Building a Geodatabase,** Andrew McDonald, 2001, ESRI
6. **ArcGIS 9 – Geodatabase Workbook,** 2004, ESRI
7. **Introducing Geographic Information Systems with ArcGIS,** Michael Kennedy, 2006, John Wiley &Sons Inc, New Jersey
8. **ERDAS Stereo Analyst User's Guide,** 2000, ERDAS Inc., Georgia
9. **IMAGINE OrthoBASE User's Guide,** 2001, ERDAS
10. Elmasri R. and Navathe S.B., "**Fundamentals of Database Systems**", Benjamin/Cummings Publishing Co. Inc. (Addison-Wesley world student series), 2002