

Choice Based Credit System (CBCS) Syllabus
for
Post Graduate Course
on
Geospatial Science
With effective from the Academic Session – 2015-17



The University of Burdwan
Golapbag,
Burdwan
West Bengal - 713104

Syllabus for Post Graduate Course on Geospatial Science

Summary of the Course and Credits



Division of Course and Credits

Semester	Core Course					Major Elective Course		Minor Elective Course	Project /Dissertation		Community Outreach Program	Total
	Theory	Practical	Field Work	Seminar	Grand Viva	Theory	Practical		Report	Viva		
	Semester - I	16	8	0	0	0	0	0	0	0	0	0
Semester - II	16	6	1	1	0	0	0	0	0	0	0	24
Semester - III	8	4	0	1	0	4	4	2	0	0		23
Semester - IV	0	0	0	4	4	0	0	0	10	6	1	25
Total	40	18	1	6	4	4	4	2	10	6	1	96

Core Course:	Have to take by the students as offered by the Department of Geospatial Science. It may have Theory, Practical, Seminar, Field Work and Grand Viva
Field Work:	Students would have to take "Field Work" for real life experience to identify different geospatial features. Field Experiences are to be presented by the students using audio visual methods. Examiner: All Internal Examiners and External Examiners
Seminar:	To enhance the presentation and communication skills of a student, each of the students has to present one seminar lecture over the topic(s) as decided by the Geospatial Science Department using audio visual aids. It will be a 20 minutes presentation, followed by 5 minutes interaction session Examiner: All Teachers of the Geospatial Science Department
Grand Viva:	A comprehensive oral examination at the end of the Course to judge the expertise/knowledge acquire by a student. Examiner: All Internal Examiners and One External Examiners for each board of Examination
Project /Dissertation:	Project work/Dissertation is of Six Months duration i.e. entire IV Semester. The Project work may be assigned at different Institutions/laboratories of repute of the country including the University of Burdwan. At the Semester - IV Examination, a student has to submit a final dissertation based on the Project work performed along with a presentation and viva-voce examination on the Project work. Out of 125 marks, 75 is allotted for the Report and rest 50 marks on the seminar presentation, Viva-Voce on project report Examiner: All Teachers of the Geospatial Science Department and One/Two External Examiners for each board of Examinations

Syllabus for Post Graduate Course on Geospatial Science

Summary of the Course and Credits

Division of Course and Credits

SEMESTER - I

Course	Code	Course Title	T	P	Credit	Marks	Examination Time (Hrs.)
GST	101	Principles of Earth System and Geospatial Science	√	×	4	50	2
GST	102	Cartography and Surveying Technology	√	×	4	50	2
GST	103	Geodesy and GPS	√	×	4	50	2
GST	104	Fundamentals of Remote Sensing and GIS	×	×	4	50	2
GSP	105	Computer Programming, Remote Sensing and GIS Practical	×	√	4	50	4
GSP	106	Surveying and Thematic Mapping	×	√	4	50	4
		Total			24	300	

SEMESTER - II

Course	Code	Course Title	T	P	Credit	Marks	
GST	201	Principles of Photogrammetry	√	×	4	50	2
GST	202	Digital Image Processing (DIP)	√	×	4	50	2
GST	203	Microwave, Thermal and Hyper Spectral Remote Sensing and Applications	√	×	4	50	2
GST	204	Geographical Information System (GIS)	√	×	4	50	2
GSP	205	Digital Image Processing	×	√	4	50	4
GSP	206	Statistical Methods	×	√	4	50	4
GSP	207	Field Work and Seminar	×	√	2	25	
		Total			26	325	

SEMESTER - III

Course	Code	Course Title	T	P	Credit	Marks	
GST	301	Spatial Data Analysis and Modelling	√	×	4	50	2
GST	302	Digital Photogrammetry, LIDAR, SONAR	√	×	4	50	2
GST	303	Database Management System	√	×	4	50	2
GST	304	Major Elective	√	×	4	50	2
GSMT	304A	Earth System Science	√	×			
GSMT	304B	Forestry and Ecology	√	×			
GSMT	304C	Urban Development and Planning	√	×			
GSMT	304D	Environment and Public Health	√	×			

GSMP	305	Major Elective	×	√	4	50	3
GSMP	305A	Earth System Science	×	√			
GSMP	305B	Forestry and Ecology	×	√			
GSMP	305C	Urban Development and Planning	×	√			
GSMP	305D	Environment and Public Health	×	√			
GSMIE	306	Minor Elective: Geospatial Science and Applications	√	×	2	25	2
GSSOP	307	Community Outreach Programme	×	√	2	25	2
Total					24	300	

SEMESTER - IV

Course	Code	Course Title	T	P	Credit	Marks	
GSGV	401	Grand Viva	√	×	4	50	3
GSSM	402	Seminar	√	×	2	25	3
GSDS	403	Dissertation	√	×	10	125	3
GSVI	404	Viva- Voce on Project	√	×	6	75	3
Total					22	275	
Grand Total					96	1200	

SEMESTER I
GST 101: Core Course, Theoretical
PRINCIPLES OF EARTH SYSTEM AND GEO-SPECIAL SCIENCE

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

➤ **PRINCIPLES OF EARTH SYSTEM:**

Introduction, types, components and optical aspects of aerial cameras, Lens formula, Understanding Earth, its Bio-physical components, Energy systems, Geo-Bio-chemical systems, Earth process; energy types; transform and interactions; the atmosphere and hydrosphere.

➤ **EARTH SIZE, MEASUREMENTS AND CHARACTERISTIC:**

Earth size, shape, rotational and orbital characteristic, gravity and magnetic fields, space and time concepts, measurement of physical properties, energy interactions and measurements, bio-physical-chemical measurements.

➤ **COORDINATE SYSTEMS, DATUMS AND GEODETIC SYSTEMS**

Concept of Geo-informatics and Geospatial Science. Concepts of measurements by triangles traversing; planer polar, and spherical coordinate systems; concept of Datum and its parameters; Horizontal and vertical Datums, Geodetic reference system.

➤ **GEOSPATIAL DATA, MEASUREMENTS AND ANALYSIS**

Geospatial data: data types and models; database concepts relational and object oriented data base; data coding and storing; data analysis and geo-statistical concepts.

➤ **SPATIAL INFORMATION AND MAPPING TECHNOLOGY**

Spatial information technology; historical overview of survey methods, Introduction to Satellite Navigation systems and its application in surveying; digital analysis and mapping techniques; Internet and web in geospatial delivery.

➤ **PHOTOGRAMMETRY , REMOTE SENSING AND GIS**

Definition and goal, History and evolution of Photogrammetry and Remote Sensing techniques, application and product. Fundamentals of Geographic Information Systems (GIS), Data Input, Processing and Presentation.

➤ **GIS DATA ANALYTICAL METHODS**

Data base Management System (DBMS). Data organization, spatial information technology and modeling, integration of Spatial & Non spatial data. Limitations of GIS.

➤ **OVERVIEW OF GEOSPATIAL SCIENCE AND GEOINFORMATICS APPLICATIONS**

Geospatial technology for Environmental survey and analysis; cartography and mapping Services; management system; ocean and atmospheric studies; Socio-economic and development studies; E-governance; Business and infrastructural management; facilities planning and management; emergency and disaster management.

Examination and Question Pattern

Continue Assessment – 10 Marks (5+5)

End Semester Examination – 40 marks (Four questions to be answered)

SEMESTER I
GST 102: Core Course, Theoretical
CARTOGRAPHY & SURVEYING TECHNOLOGY

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **INTRODUCTION TO CARTOGRAPHY AND SURVEYING TECHNOLOGY**
Scope and content of cartography, concepts of cartography and surveying. Trends in Cartography
- **PRINCIPLES AND METHODS OF CARTOGRAPHY**
Characteristics and classification of maps, methods of mapping, principles of map design, symbols, colors and layout, map numbering system. Thematic mapping: Concept, Classification
- **MAP PROJECTIONS**
Development of projection surfaces, Characteristics of map projections.
Gnomonic, Stereographic and Orthographic Projection, Mercator, and UTM Projection
- **PROBLEMS RELATED TO MAP PROJECTIONS**
Conversion of Latitude and Longitude to Meters; Numerical problems of projections: Co-ordinate, Distance, Bearing, Azimuth and Scale Variation on Conical, Cylindrical and others projections
- **PRINCIPLES AND METHODS OF SURVEYS**
Principles, methods and types of surveys, Accuracy assessment
- **DIFFERENT CONVENTIONAL SURVEY TECHNIQUES AND ITS APPLICATION**
Survey by conventional methods, methodology, survey and depiction of details planimetry and height control by triangulation, traverse and tachometric Survey
- **ADVANCE SURVEY TECHNIQUES AND ITS APPLICATION**
- **Utility and mechanism of Electronics Distance Measurer (EDM). Surveying methods and mathematical implication of Total station, (Triangulation and Traversing method) surveying**
- **MODERN TRENDS IN SURVEYING AND MAPPING: GLOBAL POSITIONING SYSTEM (GPS)**
- **GPS Survey and Location Mapping; Global Positioning System (GPS) for ground control and extension, Application of DGPS survey**

Examination and Question Pattern

Continue Assessment – 10 Marks (5+5)

End Semester Examination – 40 marks (Four questions to be answered)

SEMESTER I
GST 103: Core Course, Theoretical
GEODESY AND GPS

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **INTRODUCTION TO GEODESY**
History, principles of geodesy, geometric geodesy, physical geodesy, geodetic system and geodetic datum.
- **ELLIPSOID OF REVOLUTION**
The ellipse, basic and mathematical properties of ellipse, flattening, eccentricity, use of ellipsoid as regional datum
- **COMPUTATION OF THE ELLIPSOID**
Need for mathematical surface, Reduction of baseline to mathematical surface, Reduction of baseline to reference ellipsoid, Effect or height of a point observed on the azimuth of a line, Convergence of meridians, Forward and backward Azimuths, Plane curves and geodesic line, Calculation of coordinates
- **GRAVIMETRY**
Gravity field of the Earth, expressions for gravity and potential, geoid undulations and deflections of vertical measurement of gravity on earth, reduction of gravity values
- **SATELLITE GEODESY AND PROJECTION**
Satellite orbit, Celestial coordinate system, Geodetic position from known orbit, Coordinate transformation in equatorial plane, Range observation from three satellite positions, WGS 84 and GPS, Conversion of Projection system
- **GLOBAL NETWORK SATELLITE SYSTEM (GNSS)**
Navigation system, brief history and background of GPS, different segment of GPS, GPS receivers, the performance of GPS, satellite geometry and GPS positioning
- **GPS SIGNAL AND CODE**
GPS signal characteristics, signal structure, signal coverage, signal propagation, GPS code structure and types. Factors influencing GPS accuracy, errors and accuracy's in the GPS system, DGPS
- **GPS MATHEMATICAL MODEL AND GPS APPLICATION**
GPS mathematical model, Pseudo range mathematical model, preparation for data processing, baseline data computation coordinate change and satellite positions, fundamentals of GPS application for various fields, possible applications for future developments

Examination and Question Pattern

Continue Assessment – 10 Marks (5+5)

End Semester Examination – 40 marks (Four questions to be answered)

SEMESTER I
GST 104: Core Course, Theoretical
FUNDAMENTALS OF REMOTE SENSING & GIS

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **PHYSICS OF REMOTE SENSING AND ENERGY INTERACTIONS**
Electromagnetic spectrum, energy source and its characteristics, nature of EMR, laws governing energy interactions, blackbody radiation principles, radiation quantities and terminology; atmospheric windows
- **COMPONENTS OF REMOTE SENSING**
Platforms types and characteristics, Satellite orbits, motion Laws and launching system, scanning system, sensor parameters, concept of resolution and FCC, digital data format, optical, Vader, Sonar, LIDAR and interferometry concepts in data collection
- **ATMOSPHERIC INTERACTIONS WITH ELECTRO MEGNATIC RADIATION (EMR)**
Atmospheric properties and scattering, particulate scattering & absorption, Rayleigh's and Mie's theories
- **EMR INTERACTION WITH EARTH SURFACE MATERIALS**
Concepts of spectral signature; spectral reflectance & emittance ; EMR Interaction with water, vegetation, soil, minerals/rock and man-made structures
- **OVERVIEW ON IMAGE ANALYSIS**
Aerial photos and image interpretation strategy, basic elements of image and photo interpretation, differentiate between map, photography and satellite data
- **FUNDAMENTALS OF GIS**
Brief history of GIS; definitions of GIS and related terminology, components of a GIS; input data for GIS, display, data structure- spatial, non-spatial and metadata

Examination and Question Pattern

Continue Assessment – 10 Marks (5+5)

End Semester Examination – 40 marks (Four questions to be answered)

SEMESTER I
GSP 105: Core Course, Theoretical
COMPUTER PROGRAMMING & PROCUREMENT OF SATELLITE DATA

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **PROGRAMMING IN COMPUTERS/ INTRODUCTION TO DIFFERENT LANGUAGES**
Program writing and use of high level computer language and programming (c++, java, python and Java scripts) ; language for Data handling and processing of Remote Sensing data
- **INTERPRETATION OF LAND USE DETAIL FROM CONVENTIONAL MAPS**
Conventional symbols, topographical map interpretation, reference system of topographical maps, map scale and border information
- **AIR PHOTO INTERPRETATION**
Orientation of aerial photograph, stereo test and determination of photo scale, feature extraction from stereo pairs, locating nadir point, principal point and conjugate principal point on stereo pairs and determination of height from aerial photograph
- **PROCUREMENT OF SATELLITE DATA AND DATA INTERPRITATION**
Procurement of satellite data, loading image data and display, study of satellite image annotation (information) LANDSAT, SPOT and IRS and Referencing Scheme (Analog and Digital). The role of proprietary and open source software systems; desktop systems to mobile systems
- **INTERPRETATION OF LAND USE DETAIL FROM SATELLITE IMAGERY**
Preparation of image standard false color composition (FCC), ground truth verification, visual interpretation using image interpretation keys and delineation of land use land cover of a satellite image and separation of physical and cultural features
- **GEOREFERENCING**
- **Editing of spatial features and topology creation, addition of tabular data to feature class & their editing, linking spatial and non-spatial data, creation, validation and modification of topology**
- **PREPARATION OF THEMATIC LAYER USING GIS SOFTWARE**
Layer creation, tabular data design and joining, functions, pitfall and reprocessing, thematic mapping
- **GIS ANALYSIS**
Buffer creation and analysis, overlay and dissolve analysis, labeling, symbolization, creation of cartograms and graph, output map generation

Evaluation of Practical Note Book and Viva-Voce Examination and Question Pattern

End Semester Examination – 40 marks (30+10). Three questions to be set – All to be answered

Practical Note Book and Viva-Voce – 10 marks

Continue Assessment – 10 Marks (5+5)

SEMESTER I
GSP 106: Core Course, Theoretical
SURVEYING & THEMATIC MAPPING

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **CONVENTIONAL SURVEY**
Demonstration of conventional survey Instruments for field work, generation of survey plots
- **SURVEYING BY OTHER METHODS**
Abney Level survey; use of Sextant, Clinometers and Burton compass
- **MEASUREMENT OF HEIGHT**
Height control by Theodolite leveling, Chain and Plane Tabling methods, Contour survey
- **TOTAL STATION SURVEY**
Total Station Survey in field, downloading, processing and generation of survey plots using software
- **GPS SURVEY**
Handheld GPS, feature collection, transfer of way points in computer, area calculation, processing of GPS survey data and generation of survey plots using software
- **DGPS SURVEY**
DGPS instrument and its accessories, surveying and data capture by using DGPS, data downloading and processing using software

Evaluation of Practical Note Book and Viva-Voce

Examination and Question Pattern

End Semester Examination – 40 marks (30+10). Three questions to be set – All to be answered

Practical Note Book and Viva-Voce – 10 marks

Continue Assessment – 10 Marks (5+5)

SEMESTER II
GST 201 : Core Course, Theoretical
PRINCIPLES OF PHOTOGRAMMETRY
Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **GEOMETRY AND FLIGHT PLANNING OF AERIAL PHOTOGRAPHS**
Principle and disciplines of photogrammetry, Geometry and scale of aerial photograph, Planning and execution of photographic flights and Flight planning.
- **AERIAL CAMERAS**
Introduction, types, components and optical aspects of aerial cameras, Lens formula, camera mounts, controls and calibration, Aerial film, Automatic data recording.
- **STEREO PHOTOGRAMMETRY AND PARALLAX**
Introduction and principles of Stereo Photogrammetry, Ortho rectification, parallax equations and measurement of parallax differences, parallax corrections, Error evaluation.
- **AERIAL TRIANGULATION**
Principle and purpose of aerial triangulation, Classification of aerial triangulation based on methods, Preparation of aerial triangulation, Independent Model Triangulation (IMT), Blocks of photos, Bundles adjustment.
- **APPLICATION OF GPS IN PHOTOGRAMMETRY**
Integrated GPS flight management system, the navigation, determination prospective centers for aerial triangulation, Airplane altitude measurement, aerial triangulation using GPS data.
- **NON-TOPOGRAPHIC PHOTOGRAMMETRY**
Definition, potential of close range photogrammetry, instrumentation for data acquisition and data analysis, under water and X-ray photogrammetry.

Continuous Assessment

GST 202: Core Course, Theoretical
DIGITAL IMAGE PROCESSING (DIP)

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **INFORMATION SYSTEMS**
Satellite data encoding and decoding, modulation, acquisition, storage and retrieval, generation of digital data formats.
- **PRE-PROCESSING OF DIGITAL IMAGE**
Cosmetic Operations, noise removal, Atmospheric correction methods, illuminations and view angle effects, sensor calibration and terrain effects.
- **RADIOMETRIC CORRECTIONS OF DIGITAL IMAGE**
Missing scan line, Destripping, line dropout, Gain bias error, Methods of radiometric corrections- nearest neighbor, bilinear, cubic.
- **IMAGE ENHANCEMENT TECHNIQUES**
Different types of Enhancement techniques- linear, non linear, contrast, density slicing, Band ratio, RGB transformations, image filtering types and methods.
- **GEOMETRIC CORRECTIONS OF DIGITAL IMAGE**
Importance and need of Geometric Corrections, Polynomial math models, Resampling methods- cubic convolution, Bilinear and nearest neighbour.
- **IMAGE CLASSIFICATION**
Unsupervised, supervised classification, Training sites selection, Statistical parameters, Accuracy assessment, Signature statistics, mathematic algorithm.
- **DIP & GIS INTEGRATION**
Image classification and GIS integration and linkage, various band data for landuse, landcover classification system with case studies.

Continuous Assessment.

GST 203: Core Course, Theoretical

MICROWAVE, THERMAL AND HYPER SPECTRAL REMOTE SENSING AND APPLICATIONS

Credit: 4

Full Marks 50; (University Examination: 40 + Internal Assessment: 10)

Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

➤ **BASIC CONCEPTS**

Microwave, Thermal and Hyperspectral Remote sensing- Definitions, comparison and review of previously acquired knowledge.

➤ **RADAR**

Working principle of Radar, measurement and discrimination, System parameters- Wave length, Polarization, Resolution, Look Angle, Target parameters- back scattering, Point target, Volume scattering, Penetration, Reflection, Physics of RADAR remote sensing, factors affecting microwave measurement.

➤ **REAL AND SYNTHETIC APERTURE RADARS (SAR)**

Principles, platforms and sensors, airborne data products and selection procedures, Different passive microwave radiometers.

➤ **RADAR INTERFEROMETRY**

Radiometers and radar-grametry – fundamentals and data processing techniques.

➤ **THERMAL REMOTE SENSING**

Thermal imaging techniques, thermal properties of terrain, thermal inertia of earth surface features, IR- radiometers, Airborne and Satellite TTR scanner systems, thermal scanners, radiometric calibrations, interpretation of thermal images.

➤ **HYPER SPECTRAL REMOTE SENSING TECHNIQUES AND ANALYSIS**

Multispectral and hyperspectral remote sensing, comparison of multispectral and hyperspectral image data, Hyperspectral sensors, Design trade-offs, hyperspectral satellite systems, Hyperspectral Data Analysis techniques, spectral reflectance, libraries, absorption process, Theoretical basis and relevance.

➤ **APPLICATIONS OF MICROWAVE, THERMAL AND HYPER SPECTRAL REMOTE SENSING**

Agriculture, forestry, hydrology, ice studies, land use mapping, ocean and glacier related studies, case studies.

Continuous Assessment.

GST 204: Core Course, Theoretical
GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **GIS DATA ACQUISITION**
Existing GIS data, metadata, conversion of existing data, creating new data
- **SPATIAL DATA EDITING**
Location errors, spatial data accuracy standards, topological errors, topological editing, non topological editing, other editing operations
- **ATTRIBUTE DATA MANAGEMENT AND EXPLORATION OF DATA**
Attribute data in GIS, relational model, attribute data entry, manipulation of fields and attribute data, map-based data manipulation, attribute data query, spatial data query and raster data query
- **VECTOR AND RASTER DATA ANALYSIS**
Buffering, overlay, distance measurement, pattern analysis and features manipulation. Local operations, neighbourhood operations, zonal operations, physical distance measure operations, comparison of vector and raster based data analysis
- **SPATIAL ANALYSIS**
Terrain mapping and analysis, viewshed and watershed analysis, path analysis and network application
- **SPATIAL INTERPOLATION**
Elements of spatial interpolation, global methods, local methods, krigging, comparison of spatial interpolation methods
- **GIS MODELS AND MODELLING**
Basic elements of modeling, binary models, index models, regression models and process models
- **MODERN TRENDS IN GIS**
3D GIS, integration of 3D and web GIS, 4D GIS and real time GIS, mobile GIS.

- **Continuous Assessment**

GSP 205: Core Course, Practical
DIGITAL IMAGE PROCESSING (DIP)

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **IMAGE VISUALIZATION**
Import and export of digital data to working environment, preparation of FCC, generation of spectral signature library and analysis of spectral reflectance curves
- **IMAGE ENHANCEMENT**
Techniques, resolution merge, contrast, enhancement, band rationing (NDVI, TVI) density slicing, spatial filtering, DOS correction
- **GEOREFERENCING**
Satellite and other raster data- using available coordinates, map to image, image to image, reprojection, creating subset/clip and mosaic of digital data
- **IMAGE CLASSIFICATION**
Supervised, unsupervised and hybrid; Accuracy assessment, creation of look-up table, classification report generation, class editing and merge classes, mask creation, signature separability, change detection study
- **INTERPRETATION OF MICROWAVE AND THERMAL IMAGE**
Collection of radiant temperatures and plotting of diurnal values
- **PREPARATION OF THEMATIC MAPS**
Selection of features and calculation of area/perimeter, legend creation and editing, creation of layout

Evaluation of Practical Note Book and Viva-Voce Examination and Question Pattern

End Semester Examination – 40 marks (30+10). Three questions to be set – All to be answered

Practical Note Book and Viva-Voce – 10 marks

Continue Assessment – 10 Marks (5+5)

GSP 206: Core Course, Practical

STATISTICAL METHODS

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 60.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **COLLECTION OF DATA**
Primary and Secondary data, collection of data and frequency distribution. Relative and percent relative frequencies, discrete and cumulative frequency distribution frequency diagrams. Graphical representation of data.
- **DESCRIPTIVE STATISTICS**
Measures of central tendency, measure of dispersion, skewness and kurtosis.
- **PROBABILITY**
Probability scales, types and rules of probability, theoretical probability distribution: binomial, poisson and normal.
- **SAMPLING**
Introduction, distributions used in Sampling Theory, Confidence Interval for the Mean, Sampling, its uses, some sampling distributions, Analysis of variance.
- **HYPOTHESIS TESTING**
Chi-square and Z-test, Analysis of variance.
- **CORRELATION**
Multiple and partial correlations, Linear regression, Multiple regression, regression modelling. Analysis of Time series.
- **DATA ANALYSIS**
Principal Component Analysis (PCA), Factor analysis, Cluster analysis.

Evaluation of Practical Note Book and Viva-Voce

Examination and Question Pattern

End Semester Examination – 40 marks (30+10). Three questions to be set – All to be answered

Practical Note Book and Viva-Voce – 10 marks

Continue Assessment – 10 Marks (5+5)

GSP 207: Core Course, Practical
FIELD WORK AND SEMINAR
Credit: 2
FULL MARKS:25

FIELD WORK

Full Marks 15

Field Report: 10

Presentation and Viva-voce: 5

Students shall be taken to the "Field Work" for real life experience to identify different geospatial features.

Duration of Field Work: Not More than 7 Working Days.

Area of Field Work: As decided by the Department of Geospatial Science with prior approval of the appropriate authority of the University of Burdwan.

Students shall be accompanied with teacher(s) of the Geospatial Department as per the rules and regulations of the University of Burdwan.

Field Report: It should be certified by the HoD and concerned teacher(s) and should be less than 50 pages including maps and diagrams.

Pattern of Evaluation of the Field Report: Field Experiences are to be presented by the students using audio visual methods and all the Internal Examiners and External Examiners jointly evaluate the Presentation and the Field Report.

Evaluation of Practical Note Book and Viva-Voce

SEMINAR

Full Marks 10

Presentation and Interaction: 10 (5+5)

Each of the students has to present one seminar lecture over the topic(s) as decided by the Geospatial Science Department using audio visual aids. It will be a 20 minutes presentation followed by 5 minutes interaction session.

Pattern of Evaluation of the Seminar:

All teachers of the Geospatial Science Department.

SEMESTER III
GST 301: Core Course, Theoretical
SPATIAL DATA ANALYSIS & MODELING

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **GIS ANALYSIS: PROXIMITY AND EXTRACTION**
Proximity analysis, buffer, near and Thiessen polygon , GIS layer extraction, comparison of vector- and raster-based data analysis
- **VECTOR OVERLAY PROCESSING**
Boolean algebra, introduction to overlay in GIS, topological and graphical overlay, dissolve analysis
- **SPATIAL DECISION SUPPORT SYSTEM (SDSS)**
Basic Elements of SDSS, decision support, spatial modeling in GIS environment: modeling, binary models, index models, regression, models, process models
- **SPATIAL MULTI-CRITERIA DECISION ANALYSIS**
Introduction to Boolean and Fuzzy logic, analytic hierarchy process, compromise programming, cellular automata modeling
- **TERRAIN MAPPING AND VIEWSHEDS ANALYSIS**
Data for terrain mapping and analysis, terrain mapping, slope and aspect, surface, curvature, raster versus TIN, DEM, DTM, view shed analysis, parameters of view shed analysis, and application of view shed analysis, raster interpolation
- **HYDROLOGICAL ANALYSIS**
Surface water analysis: watershed analysis, factors influencing watershed analysis, basin demarcation, flow analysis and stream ordering, ground water analysis: darcy law, hydraulic conductivity and porosity and permeability
- **GEOCODING AND DYNAMIC SEGMENTATION**
Geocoding, Application of Geocoding, Dynamic Segmentation, Application of Dynamic Segmentation
- **PATH ANALYSIS AND APPLICATIONS OF NETWORK**
Path Analysis, Application of path Analysis, Network, Putting Together a Network, Network Application

Continuous Assessment

SEMESTER III
GST 302: Core Course, Theoretical
DIGITAL PHOTOGRAMMETRY, LIDAR & SONAR SYSTEM

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

➤ **IMAGE ACQUISITION**

Evolution of digital photogrammetry - analog, analytical, digital-advantages- auto - imation - accuracy - representation of digital images geometry of aerial and spatial pictures, digital image acquisition with airborne ccd cameras. storage and data compression of digital images

➤ **DIGITAL CAMERAS, ITS COMPONENTS AND SCANNERS**

Digital Cameras – systems of CCD Camera - Time delay integration, Spectral Sensitivity of CCD sensor, Scanners for digitization of aerial pictures, Scanner resolutions and calibration, line scanners. Geometric problems and precision in digital imagery, Image improvements

➤ **IMAGE TRANSFORMATIONS & MEASUREMENTS**

The technology and Equipment, Data input, Stereoscopic Visualization- Merits, demerits, Image measurement- Spatial, spectral and temporal methods, Image transformation, Concepts of Interior, Relative and Absolute orientation

➤ **LIDAR SYSTEM DESIGN AND CALIBRATION OF LIDAR DATA**

Introduction to lasers and LIDAR – definition - history of LIDAR Development - LIDAR System Components - Laser scanning, orbits, platform, sensors, Lidar data preprocessing and quality control procedures. - data errors and rectifications, error budget.- processes calibration of lidar data - artifacts and anomalies

➤ **DIGITAL SURFACE MODELS**

Manual editing and product generation, data format, surface editing — lidargrammetry - digital terrain models representation, DEM, DSM

➤ **LIDAR APPLICATIONS**

LIDAR – working principle, scope and applications Characteristics of Lidar Data -interaction of laser energy with earth surface features - Bathymetric Mapping Topographic Mapping, , flood inundation analysis, line-of-sight analysis – Forestry, vegetation metric calculations -specific application software - corridor mapping system, Link between GIS and Digital Photogrammetry

➤ **SONAR SYSTEM DESIGN AND CALIBRATION OF SONAR DATA**

➤ **SONAR APPLICATIONS**

Continuous Assessment

SEMESTER III
GST 303: Core Course, Theoretical
DATABASE MANAGEMENT SYSTEM (DBMS)

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **INTRODUCTORY CONCEPTS OF DBMS**
Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- levels, Mappings, Database, users and DBA
- **ENTITY-RELATIONSHIP MODEL**
Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets, extended E-R features – generalization, specialization, aggregation, reduction to E-R database schema
- **RELATIONAL MODEL**
Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus
- **SQL CONCEPTS**
Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All, view and its types. transaction control commands – Commit, Rollback, Savepoint
- **RELATIONAL DATABASE DESIGN**
Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1NF, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multivalued dependency, 4NF, Join dependency and 5NF
- **TRANSACTION MANAGEMENT**
Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking

Continuous Assessment

SEMESTER III
GSMT 304B: Major elective Course, Theoretical
FORESTRY AND ECOLOGY

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

- **Fundamental of forest resource:** Types and distribution of forests in India. Introduction and concept of forestry.
- **Forest Mapping:** Spectral properties of vegetation indices. Forest mapping using Aerial photographs and high resolution data-forest density, change detection, mapping of stressed vegetation, association between rock and forest types.
- **Forest inventory:** Principles and planning of forest inventory, forest sampling techniques, growing stock estimation, Biomass estimation using microwave assessment.
- **Forest management and wildlife ecology:** Deforestation/ afforestation/ encroachment mapping, forest information system, forest management plans, joint forest management, forest fire surveillance and forecasting, forest burnt area mapping and spread modeling, impact assessment of mining in forest. Habitat management, wildlife habitat selection, habitat fragmentation, protected areas, inputs for perception of working plan/management plan.

SEMESTER III
GSMT 304C: Major elective Course, Theoretical
URBAN DEVELOPMENT AND PLANNING
Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Eight questions of 10 marks are to be set and Students are required to answer four questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

Concept of Urbanization, Urban Growth Model, Urban Morphology, Urbanisation and its impact
Need and Objectives of Planning: Regional plan, Perspective plan, Master plan, Development plan,
Project (scheme) plan; Town Planning in India: past, present and future; Geospatial technique in Urban
Planning

Urban Land use/Land cover, Land Suitability Analysis and land Use Planning.

Urban Housing Demand; Slums and Squatters; Housing problem in India; National Housing policy;
Urban Renewal Projects; Urban Infrastructure Planning

Classification of Urban Roads; Traffic Surveys: speed, time, delay surveys; Use of speed, journey time
and delay studies; Traffic volume; Origin Destination surveys; Parking surveys; Utility of geospatial
technique in traffic and transportation studies

Urban Information System : Land; Housing; Transportation; Infrastructure

Urban hazards and risk management; Application of Database creation and management for
Infrastructure Development Decision Support System for Urban and Regional Management

Continued Assessment

SEMESTER III
GSMT 305B: Major elective Course, Practical
FORESTRY AND ECOLOGY

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

Measurement and interception of spectral signatures of vegetation cover.

Visual and digital information of satellite image for forest mapping and density assessment.

Forest change detection, insect pest damage detection.

Measurement of tree height, crown density on aerial photograph, sampling and analysis of field data, growing stock estimation, forest biomass assessment.

Site suitability analysis for forestry, revision and updating of stock maps, GIS database creation for forest management.

SEMESTER III
GSMT 305C: Major elective Course, Practical
URBAN DEVELOPMENT AND PLANNING

Credit: 4

Full Marks 50. Minimum number of lectures to be delivered for this paper is 35.

Pattern of setting questions: Three questions of 10 marks are to be set and Students are required to answer all the questions. Each question is to have at least two parts. Practical Note Book and Viva Voce is (5+5) 10 marks. Internal assessment shall be on 10 marks and the department shall decide the methods of internal assessment.

Aerial Photographs in Urban infrastructure planning and utility areas, Power and Drainage, Transport network analysis, Updating - Traffic/Transport Planning, Route alignment.

Analysis and identification of Settlement features from satellite images - Visual and digital data analysis techniques. Land use/Land cover/ Landscape mapping, classification system, Urban mapping.

Types of data for urban study: Urban morphology, Zoning systems, Urban land use zoning, slums, commercial and residential zones, Urban sprawl - Urban area delineation and change detection of Urban expansion and land suitability / identification for new township using Remote Sensing Data.

Information System Generation: Data Base Organisation - Geographic Information System on a large scale, data entry manipulation, retrieval, suitable software package, use of information for urban planning - case studies.

SEMESTER III
GSMIE 306 : Minor Elective, Theoretical
GEOSPATIAL SCIENCE AND APPLICATIONS
Credit: 2

Full Marks: 25. Minimum number of lectures to be delivered for this paper is 20.

Pattern of setting questions: Four questions of 10 marks are to be set and Students are required to answer Two questions. Each question is to have the pattern of 2+3+5 marks. Internal assessment shall be on 5 marks and the department shall decide the methods of internal assessment.

➤ **Concept and Principals of Geospatial Science**

Concept and scope of Geospatial Science; Concept of Map and Map Projection; applications and limitations of Geospatial Science

➤ **GIS - Major areas of Applications**

Definitions and Components of GIS; different fields of applications and limitations.

➤ **Major Tools and Data: Conventional and Contemporary**

Different conventional and advance cartographic and survey techniques and its application

➤ **Sources of Data, Softwares and their procurement**

Reference Scheme of Data procurement; Data sources and their import: Google earth (Pro), Bhuvan, GLCF, and USGS

➤ **Continuous Assessment**

SEMESTER III
GSSOP 307 :
COMMUNITY OUT-REACH PROGRAM
Credit: 2
Full Marks: 25.

SEMESTER IV
GST 401: Core Course
GRAND VIVA
Credit: 4

Full Marks 50.

A comprehensive oral examination at the end of the Course to judge the expertise/knowledge acquired by a student.

Examiner: Examiner: All Internal Examiners and One External Examiners for each board of Examination

SEMESTER IV
GST 402 Core Course
SEMINAR
Credit: 2

Full Marks 25.

Each of the students has to present one seminar lecture over the topic(s) as decided by the Geospatial Science Department using audio visual aids. It will be a 20 minutes presentation, followed by 5 minutes interaction session

Examiner:: All Teachers of the Geospatial Science Department

SEMESTER IV
GST 403 Core Course
DISSERTATION
Credit: 10

Full Marks: 125.

Project work/Dissertation is of Six Months duration i.e. entire IV Semester. The Project work may be assigned at different Institutions/laboratories of repute of the country including the University of Burdwan. At the Semester - IV Examination, a student has to submit a final dissertation based on the Project work performed along with a presentation and viva-voce examination on the Project work. Out of 125 marks, 75 is allotted for the Report and rest 50 marks on the seminar presentation, Viva-Voce on project report

Examiner: All Teachers of the Geospatial Science Department and One/Two External Examiners for each board of Examinations

SUGGESTED READING

I-SEMESTER

GST 1.1 PRINCIPLES OF EARTH SYSTEM AND GEO-SPECIAL SCIENCE

Environmental Modeling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Stewart

Fundamentals of GIS by MICHAEL N DEMERS. Published By John Wiley & Sons Inc.

Geographic Information Systems: A Management Perspective by Stan Arnoff.

Manual of Geospatial Science & Technology edited by John D. Bossler (Taylor & Francis).

Textbook of Remote Sensing and Geographical Information Systems M. Anji Reddy, BS Publication.

GST-1.2 CARTOGRAPHY & SURVEYING TECHNOLOGY

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

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

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

Anson, R. W. and Ormerling, F. J. 1993: Basin Cartography, Elsevier Applied Science Publishers. London.

Basic Cartography, Anson, R. W. and Ormerling, F. J. 1993: Elsevier Applied Science Publishers. London.

Dorling, D. and Fairbirn, D. 1997: Mapping Ways of Representing the World, Longman. England.

Elements of Cartography, Robinson, A. H., Morrison, J. L., Muehrcke, P. C., Kimerling, A. J., Guptill, S. C. 2002: John Wiley and Sons (ASIA). Singapore.

Elements of Cartography, By Arthur H. Robinson, Randall D. Sale, Joel L. Morrison, Phillip C. Muehrcke Published by John Wiley and Sons, New York

Elements of Practical Geography, Singh, R.L. and Singh, R.P.B. 1.991: Kalyani Pub. New Delhi.

Fundamentals of Cartography , By Prof. R.P. Mishra and Prof. A. Ramesh Concept Publishing House, New Delhi

Geoinformatics for Environmental Management by M. Anji Reddy, BS Publications

GPS fundamentals Surveying (vol I, and II), By BC Punmia, Standard book House, Nayasarak, New Delhi

How To Do Your Dissertation in Geography and Allied Disciplines. Parsons, T. and Knight, P.1995: Chapman and Hall, London.

Introductory Cartography, Campbell, John, Prentice Hall, Inc. Englewood Cliff, New.

Maceachren, A. M. and Taylor, D. R. F. 1994: Visualization in Modern Cartography, Permamon. UK.

Map Projections, Kellaway, G. P. 1970: Methun and Co. Ltd., London.

Mapping Ways of Representing the World, Dorling, D. and Fairbirn, D. 1997: Longman. England.

Maps and Diagrams: Their Compilation and Construction, Monkhouse F.J. and Wilkinson, H.R. 1971: B.I. Publications Private Limited, New Delhi.

Monkhouse F.J. and Wilkinson, H.R. 1971: Maps and Diagrams: Their Compilation and Construction, B.I. Publications Private Limited, New Delhi.

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

Principles of Cartography, Raisz, E. 1962: International Student Edition. Japan.

Visualization in Modern Cartography, Maceachren, A. M. and Taylor, D. R. F. 1994: Permamon. UK.

GST-1.3 GEODESY AND GPS

Essentials of GPS – by N.K.Agarwal.

Essentials of GPS by NK Agarwal, Spatial Network Pvt Ltd,Hyderabad.

Geodesy By G. Bomford, 3rd Edition, Oxford at the Clarendon Press

Fundamentals of Global Positioning System, Satyesh Gopi,

Introduction to GPS (Global Positioning System) by Leica.

Manual of Geospatial Science & Technology edited by John D. Bossler (Taylor & Francis).

GST-1.4 FUNDAMENTALS OF REMOTE SENSING AND GIS

Computer Processing of Remotely sensed Images: An Introduction. Paul M. Mather, 1999. John Wiley
Fundamentals of Remote Sensing; George Joseph: Universities Press India Pvt Ltd, Hyderabad, India

Land use Planning and Remote Sensing, Lindgren, D.T; 1985 , Nijhoff, Dordrecht.

Manual of Remote Sensing: American Society of Photogrammetry and Remote Sensing.

Manual of Geospatial Science and Technology Editors: John D. Bossler; John R. Jensen; Robert B. McMaster; Chris Rizo, 2001., November 2001, Vol 1 Part 1 and II.

Manual of Remote Sensing vol.I & II, Robert, G.R. (Ed), American Society of Photogrammetry, New York, 1978.

Principles of Remote Sensing, Paul Curran , English Language Book Society, London, 1988.

Remote Sensing by JAMES B. CAMPBELL Published by Taylor & Francis Ltd.

Remote Sensing techniques for environmental Analysis Estes, J.E. and LW Senger, 1974, , Hamilton, Santa Barbara, California.

Remote Sensing, Deekshatalu B.L. & Rajan Y.S. (Ed) Indian Academy of Sciences, 1984

Remote Sensing: Energy, Related Studies, Nejel Veziroglu , Hemisphere Publishing Corporation, Washington,

Remote Sensing: Optics and Optical System, Slater, PN, 1980, Addison-Wesley, Reading .

Remote Sensing: Principles and Interpretation Sabins, Floyd F, 1986, , Freeman, New York.

Remote Sensing; The Quantitative approach, Swain & Davis, Mc Graw Hill, 1978.

Remote sensing-Principles and Image interpretation by Floyd F Sabins.Jr. Published by Freeman & Co., New York.

Fundamentals of Remote Sensing and Image Interpretation: Lillesand, John Willy

Websites:

<http://www.itc.nl/~bakker/rs.html>

www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php

rst.gsfc.nasa.gov/

<http://www.r-s-c-c.org/rscc/v1m1.html>

www.isprs.org

www.spaceimaging.com

www.landsat.usgs.gov

www.spotimage.fr

www.nrsa.gov.in

IRS 1C handbook: http://www.euromap.de/docs/doc_013.html

IRS P6 Users handbook.

http://www.nrsa.gov.in/IRS_Documents/Handbook/Resourcesat-handbook_HTML_asterweb.jpl.nasa.gov

GST-1.5 COMPUTER PROGRAMMING, PHOTOGRAMMETRY, REMOTE SENSING AND GIS PRACTICAL

American Society of Photogrammetry, 1993, Manual of Remote Sensing, falls Church, Virginia

Analytical Photogrammetry By Ghosh Sanjiv K. Pergamon Press, New York, 1988

C Programming by Balaguru Swamy

C Programming by Kochan

Complete reference using C – C.C.R.

Computer Fundamentals By V.Rajaram

Concepts and Techniques of GIS, Lo C.P. & Yeung A.K.W., (2004). Prentice-Hall of India, New Delhi.

Dictionary of Remote Sensing, Rashid, S.M. and MMA Khan, 1993, Manak Publication Pvt. Ltd, New Delhi

Digital Image Processing in Remote Sensing, Muller, P.J., 1996, Taylor & Francis,

Digital Logic and Computer Design By M. Mano

Digital Photogrammetric Systems By Karlsruhe, Wichmann, 1991

Digital Remote Sensing, London.8. Nag, P. & Kudrat, M., 1996, Concept Publishing Company, New Delhi.

Elements of Photogrammetry, Wolf, Paul R., 1993, McGraw - Hill, New York.

Fundamentals of Computers - V.Rajaraman

Fundamentals of Remote Sensing, Joseph George (2003) University Press, Hyderabad.

Photogeology: Remote Sensing Application in Earth Science, Marcolongo, B. And Mantorani, F. 1997: Oxford and IBH Pub. Pvt. Ltd., New Delhi

Photogrammetry: Fundamentals and Standard Processes Vol 1, Ferd Dummlers Verlag, 1993 (Allied Publisher Ltd) By Kraus

Practical V.B. 6 – Bob Reselmanu and Richard Peasley.

Principles of Remote Sensing, Curran, Paul J., 1995, Longman, London

Programming in ANCI C - E. Balaguru Swamy

Remote Sensing and Image Interpretation, IVth Eds.Lillesand T.M and Keifer R.W. (2000) John Wiley and Sons, New York.

Remote Sensing of Environment, J. R. Jenson (2000) Pearson Education, New Delhi

Remote Sensing: Principles and Applications, 3rd edition, Sabins, F.F., 1997 : W.H. Freeman & Company, New York.

Space Technology for Sustainable Development, Rao, U .R. 1996 :, Tata McGraw-Hill, New Delhi

Space Today, Rajan, M.S. 1995 :, 2nd edition, National Book Trust, New Delhi.

“Let us C” by Yashwanth Kanithkar

GSTL 1.6 SURVEYING AND THEMATIC MAPPING

Cartographic Methods, Lawrence G.R.P. Methuen, London, 1974

A Text Book of Surveying, Kochher, C.L. 1993 : S.K. Katariya & Sons, Delhi:

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

Elementary Surveying, 8th edition, Elfic, M.H., Fryer, J.G. Brinkner, R.C. and Wolf, P.R. 1994: Harper Collins Publishers, London.

Elementary Surveying: An introduction to Geomatics, 12th edition(Amazon).

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

Hussain, S.K. and Nagaraj, M.S. 1992: Text Book of Surveying, S. Chand & Co. Ltd., New Delhi.

Kanetkar, T.P. and Kulkatni, S. V. 1.988: [Surveying and Levelling, Part I, Pune VidyarthiGriha Prakashan, Pune.](#)

[Kellaway, G. P. 1970: Map Projections, Methun and Co. Ltd., London.](#)

Kochher, C.L. 1993 :A Text Book of Surveying, S.K. Katariya& Sons, Delhi:

Surveying and Levelling, Part I, Kanetkar, T.P. and Kulkatni, S. V. 1.988: Pune Vidyarthi Griha Prakashan, Pune.

Surveying and Mapping Volume I and II by David Clarke by Mc. Graw Hill

Surveying, Punmia, B. C., Jain, A. K. 1990: Laxmi Publications. New Delhi.

[Surveying, Singh, N. Tata McGraw-Hill Publishing Company Ltd., New Delhi.](#)

Surveying (vol III), By BC Punmia, Standard book House, Nayasarak, New Delhi

Text Book of Surveying, Hussain, S.K. and Nagaraj, M.S. 1992: S. Chand & Co. Ltd., New Delhi.

SEMESTER II

GST-2.1 PRINCIPLES OF PHOTOGRAMMETRY

American Society of photogrammetry, 1960, Manual of Photographic interpretation, Falls Church, Virginia.

Avery, T.E. and GL Berlin, 1985, Interpretation of Aerial Photographs, Burgess, Minneapolis.

Burnside, C.D; 1979, Mapping froAerialPhotographs,Granda,London.

Elements of Phogrammetry Paul, R. Wolf, McGrew-Hill, International Book Company, Japan, 1993.

Elements of Photogrammetry by K.K.Rampal. Revised Syllabus - 2010

Geoinformatics for Environmental Management by M. Anji Reddy, BS Publications

Ghosh, S.K., 1979, Analytical Photogrammetry, Pergamon, New York.

Photogrammetry By F.H. Moffit and Mikhail, Edward M, International Text book Co. – 1980

GST-2.2 DIGITAL IMAGE PROCESSING

American Society of Photogrammetry, 1968, Manual of Color Photogrammetry, Falls Church, Virginia.

Analytical Photogrammetry, Ghosh, S.K., 1979, Pergamon, New York.

Computer Processing of RS Images, Paul. M. Mather-

Digital Image Processing Gonzalez Rafael C and Woods Richard E.: Addison Wesley, New York

Digital Image Processing of Remotely Sensed Data, Perspective Printice Hall, Englewood Cliffs, New York.7. Hord, R.M., 1982, Academic Press, New York.

Digital Image Processing in Remote Sensing, Muller, P.J., 1986, Taylor & Francis London.

Digital Image Processing Techniques, Ekstrom, M.P., 1984, Academic Press, New York.

Digital Image Processing, Pratt, W.K., 1978, John Wiley & Sons, New York.

Digital Remote Sensing, Nag, P. & Kudrat, M., 1996, Concept Publishing Company, New Delhi.

Digital Image Processing, Hord, R.M. Academic Press Pub. 1982.

Fundamentals of Digital Image Processing, Jain Anil K. Prentice Hall, New Jersey:

Geometric Aspects of Multisensor Image Fusion for Topographical Map updating in humid Tropics: 1996 Pohl Christine: ITC Publication, Enschede

[Introduction to Digital Image Processing: A Remote Sensing Perspective Jensen John R. Prentice hall, New Jersey](#)

Introduction to Remote Sensing, Campbell John B. Taylor & Francis, London

Introductory Digital Image Processing, John, R. Jensen, – Prentice Hall, New Jersey, 1986.

Manual of Remote Sensing, American Society of Photogrammetry, 1993, Falls Church, Virginia.

Principles of Remote Sensing, Curran, P. J., 1985, Longman, London

Remote Sensing Digital Image Analysis: An Introduction, Richards John A & Xiuping Xia, 2006. Birkhäuser.

[Remote Sensing and Image Interpretation, Lillesand, T.M. & Kiefer, R.W., 1987, , John Wiley & Sons, New York.](#)

Remote Sensing and Principles of Image Interpretation, Sabins Floyd. F: W H Freeman, New York

Remote Sensing in Geology, Siegal, B.S. & Gillespie, A.R., 1980, John Wiley & Sons, New York.

Remote Sensing: Optics and Optical Systems, Slater, P.N., 1980, Addison Wesley, Addison-Wesley Publishing Co. Inc, Reading, Massetts.

Techniques for image processing and classification in Remote Sensing, Robert, A. Schowengerdt. 1983.

Websites:

www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php

<http://www.r-s-c-c.org/rsc/v1m1.html> A comparative assessment of classification methods

<http://portal.acm.org/citation.cfm?id=873866> Classification Techniques in Pattern Recognition

http://wscg.zcu.cz/wscg2005/Papers_2005/Poster/K43-full.pdf

<http://en.wikipedia.org/wiki/NDVI> Manipulation of Normalized Difference Vegetation Index (NDVI) for Delineating Drought Vulnerable Areas

http://www.gisdevelopment.net/application/natural_hazards/drought/nhdr0005.htm

<http://www.csc.noaa.gov/crs/definitions/NDVI.html>

http://en.wikipedia.org/wiki/Principal_components_analysis

http://www.cs.otago.ac.nz/cosc453/student_tutorials/principal_components.pdf

http://en.wikipedia.org/wiki/High-pass_filter

<http://www.fmrrib.ox.ac.uk/analysis/techrep/tr01mw1/tr01mw1/node15.html>

<http://www.photoshopessentials.com/photo-editing/sharpen-high-pass/>

<http://www.cas.sc.edu/geog/rslab/Rsc/mod6/6-3/linear.html>

<http://www.cee.hw.ac.uk/hipr/html/stretch.html>

http://www.fas.org/irp/imint/docs/rst/Sect1/Sect1_12a.html

<http://www.castle.geographie.uni-kiel.de/r-kiel4/s3l4p080.htm>

<http://www.cee.hw.ac.uk/hipr/html/histeq.html>

<http://www.ph.tn.tudelft.nl/Courses/FIP/noframes/fip-istogram.html>

http://en.wikipedia.org/wiki/Histogram_equalization

GST-2.3 MICROWAVE AND HYPER SPECTRAL REMOTE SENSING

Image processing for remote sensing Robert M. Haralick and Simonett, 1983

Imaging Radar for Resources Surveys Travett. J. W.. Chapman and Hall, London 1986

[Introduction to the Physics and Techniques of Remote Sensing, Charles Elachi and Jakob Van Wiley Interscience, A John Wiley and sons Inc., 2006](#)

Manual of Remote Sensing Volume 1, Robert N. Colwell. American Society of Photo - grammetry 1983

Microwave Remote Sensing active and passive, Vol. 1, 2 and 3, ; Ulaby, F.T., Moore, R.K, Fung, A.K,

Remote sensing and Image interpretation by Thomas Lilliesand and Ralphw. Keifer Published by John Wiley & Sons.

Remote sensing-Principles and interpretation by Floyd F Sabins.Jr. Published by Freeman & Co., New York.

GST-2.4 GEOGRAPHICAL INFORMATION SYSTEMS

A Handbook on GIS, Misra HC –GIS India, Hyderabad, 1995.

An Introduction to Geographical Information System, Heywood I, et al, Longman, New Delhi, 1998.

An introduction to GIS, Ian Haywood Cornelius and Steve Carver –Longman, New York, 2000.

[Concepts & Techniques of Geographical Information System, Lo CP & Young AKW ,Prentice Hall of India, New Delhi 2003.](#)

Concepts and Techniques of Geoinformatics, Siddiqui, M.A.; 2011, Sharda Pustak Bhavan, Allahabad.

Fundamentals of Spatial Information Systems, Laurini, Robert and Dierk Thompson, 1992, Academic Press, ISBN 0-12-438380-7.

[Geographical information System, Maguire, D.J.; Goodchild, M.F.; Rhind, D.W. 1991. Longman, London, UK](#)

Geographical Information System for land Resources System, Burrough, P.A., 1986, Oxford Univ. Press, UK.

Geographical Information Systems by Demmeers

GIS, Smith T.R. and Piquet, London Press, London, 1985.

GIS: The Micro computer and Modern Cartography, Taylor DRF, Pergamon Press, Oxford, 1991.

Introduction to Geographical Information System, Siddiqui, M.A.; 2006, Sharda Pustak Bhavan, Allahabad.

Manual of Geospatial Science and Technology Edited By John. D. Bossler, Taylor And Francis, London

Spatial analysis and GIS. Taylor and Francis, Fotheringham, S.; Rogerson, P. (ed.), 1994 London, UK.

Text book of Remote sensing and GIS by M. Anji Reddy, BSP Publications, Hyderabad.

GSP-2.5 STATISTICAL METHODS

Basic Statistics, Kafka, F & G. Simpson, Oxford & I.B.H. Publishing Co., Calcutta, 1971.

Basics Statistics by B.L. Agarwal

Field Work in Geography, Jones, P.A., Longman, London, 1968

Fundamentals of Statistic, Elhance, D.N. , Kitab Mahal Allahabad, 1972

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

Introduction to statistical Analysis by Wilfred J. Dixon and Frank J. Massey JR

Multivariate Statistical Analysis in Geography, Johnston, R.A. Longman, London, 1978

Quantitative Methods in Geography, Cole, J.P. & Kind, C.A.M., John Willey & Sons, New York, 1968.

Statistical Analysis in Geography, King ,L.J., Prentice Hall, Englewood Cliffs, New Jersey, 1978

Statistical Geography: Methods and Applications, Alvi, Z. 1995 : Rawat Pub. New Delhi: .

[Statistical Method and the Geographer, Gregory, S, Longman, London, 1963](#)

Statistical techniques in Geography, Silk, J. 1979: George Allen and Unwin, London

[Statistics for Geoscientists, Pal, S.K. 1999 : Concept publishing Company, New Delhi](#)

[Theory and Problems of Statistics by Murray R. Spiegel and Larry J. Stephens](#)

GSP-2.6 PRACTICAL APPLICATION OF DIGITAL IMAGE PROCESSING

Data User Handbook, NRSA, 1995. IRS - IC, Hyderabad.

Digital Image Processing in Remote Sensing, Muller, P.J., 1996, Taylor & Francis, London.

Digital Image Processing of Remotely Sensed Data, Hord, R.M., 1992, Academic Press, New York

Digital Image Processing Techniques, Ekstrom, M.P., 1994, Academic Press, New York
Digital Remote Sensing, Nag, P. & Kudrat, M., 1996, Concept Publishing Company, New Delhi.
Elements of Photogrammetry, Wolf, Paul R., 1993, , McGraw - Hill, New York.
Introductory Digital Image Processing: A Remote Sensing, Jensen, J.R., 1996, Perspective, Printice Hall, Englewood Cliffs, New York.
Remote Sensing and Image Interpretation, Lillesand T.M and Keifer R.W. (2000) IVth Eds. John Wiley and Sons, New York.
Remote Sensing: Principles and Interpretation, Sabins, F.F. (2002), Freeman, New York

III -SEMESTER

GST-3.1 DIGITAL PHOTOGAMMETRY

Aerial Photography & Image Interpretation for Resource Management, David P. Paine –John Wiley & Sons, New York, 1981.
American Society of Photogrammetry and Remote Sensing (USA). by Jhon Jenson and Maury Nyquist
Analytical Photogrammetry, Sanjib K. Ghosh, 1979: New York: Pergamon Press
Digital Photogrammetry, Volume I, Toni Schenk, TerraScience.
Elements of Cartography Robinson, A.; Morrison, J.; Muehrke, P.; Kimmerling, A.; & Guptill, S. New York: Wiley
Elements of Photogrammetry, Paul Wolf, , McGraw Hill.
Elements of Photogrammetry, Wolf P.R. McGraw Hill, New York, 1983.
Fundamentals of computation Photogrammetry. Sanjib K. Ghosh. 2005 Concept publishing, New Delhi.
Fundamentals of Surveying, Schmidt Milton O and Rayner William Horace Van Nostrand Reinhold Company
GPS Satellite Surveying, Leick Alfred, 1995: Wiley Interscience.
Introduction to Modern Photogrammetry, Mikhail Edward, Bethel James and McGlone J Chris John Wiley & sons Inc.
Manual of Photogrammetry, Sloma C.C. American Society of Photogrammetry, Virginia, 1980.
Maps and Aerial Photographs, Dickinson G.G. Edward Arnold Ltd., London, 1969.

Web sites:

www.univie.ac.at/Luftbildarchiv/wgv/intro.htm
<http://www.geodetic.com/Whatis.htm>
<http://www.kth.se/student/studiehandbok/index.asp?lang=1>
<http://web.pdx.edu/~emch/maps/maps.html#A>
http://www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php
<http://www.r-s-c-c.org/rscc/v1m1.html>
ISPRS website: Links to several related sites
www.asprs.org/

GST-3.2 SPATIAL DATA ANALYSIS & MODELING

Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert
Fundamentals of GIS by Michael N Demers. Published By John Wiley & Sons Inc.
Getting to know Arc GIS Desktop, Ormsby T.E. Napoleon, R. Burke, C. Groessl, L. Feaster 2004. ESRI Press
Getting to Know ArcObjects Burke R.T. Tilton, A. Arana 2003. ESRI Press
[Introduction to Geographic Information Systems By Kang-Tsung Chang \(TATA McGRAW-HILL EDITION\).](#)

GST-3.3 DATABASE MANAGEMENT SYSTEMS (DBMS)

An Introduction to Database Systems, Bipin C. Desai, Galgotia Publications PVT LTD First edit 1993
An Introduction to Database Systems, C.J. Date, Addison Wesley, sixth edition, 1995
Database Management Systems by Gerald V Post- Tata Mc-Graw Hill edition.
Database Management Systems by Ramakrishnan- Tata Mc-Graw Hill edition.
Database System Concepts by Silberschatz- McGraw Hill Editon.
Fundamentals of Database Systems, Fourth Edition, Ramez Elmasri and Shamkant B. Navathe, Published by Pearson Education (Singapore) Pvt. Ltd.. 2004.
[ORACLE 8 -A Beginner's Guide, Michael Abbey and Michael J Corey, Tata Mc.Graw Hill, 1998](#)

GST-3.4 ELECTIVE PAPERS (SPECIALIZATION)

3.4.1 Forestry and Ecology

Geoinformatics for environmental management, Anji Reddy, M. 2004 :.B.S. Publications
Remote Sensing for sustainable forest management. Franklin S.E. 2001. Lewis Publication
Remote Sensing of the Environment: An Earth resource Perspective Jensen, J.R. 2000. Prentice Hall
Remote Sensing and Image Interpretation, Lillesand, T.M., and Kieffer, R.M., 1987: John Wiley.
Manual of Geospatial Science and Technology Edited By John. D. Bossler, Taylor And Francis, London
RS in Forest Resources by John. A. Howard, Chapman and Hall.

3.4.2 Geosciences

Aerial Photography and Image Interpretation for Resource Management. Paine, D.P., 1981: John Wiley.
Principles and Applications of Photogeology. Pandey, S.N., 1987: Wiley Eastern,
Photogeology. Miller, V.C., 1961: McGraw Hill.
Aerial Photographs in geologic Interpretations. Ray, R.G., 1969: USGS Prof, Paper 373. Remote sensing Principles and interpretation. Sabbins, F.F., 1985 W.H. Freeman and company
Environmental modeling with GIS and Remote Sensing. Skidmore A. 2002: Taylor and Francis
Image Interpretation in Geology. Allen and Unwin Drury, S.A., 1987:
Remote Sensing Geology. Gupta, R.P., 1990 Springer Verlag.
Remote Sensing of the Environmen, Jensen, J.R. 2000 : An Earth resource Perspective. Prentice Hall
Remote Sensing and Image Interpretation, IVth Lillesand T.M and Keifer R.W. (2000) Eds. John Wiley and Sons, New York.
[Remote Sensing in Geology, Siegal, B.S. and AR Gillespie, 1980, Wiley, New York.](#)
Remote Sensing Geology. Gupta, R.P., 1990: Springer Verlag.
RS in Geology by Siegal
Terrain Analysis: A Guide to Site Selection using Aerial Photo interpretation, Way, D; 1978, Dowden, Hutchinson & Ross, Stroudsburg

3.4.3 Human Settlement Analysis

Concepts and Techniques of Geographic Information Systems 2nd ed; LO & YEUNG (2009) PHI Learning Pvt. Ltd, New Delhi.
Concepts and Techniques of GIS, Lo, C.P. and Yeung AKW. (2004) Prentice – Hall of
Concepts and Techniques of GIS, Lo, C.P. and Yeung AKW. (2004), Prentice - Hall of India, New Delhi.
Essentials of GPS, N.K. Agarwal (2004), Spatial Network Pvt. Ltd.
Fundamental of Spatial Information Systems, Laurini, Robert and Direk Thompson, 1992, Academic Press
Fundamentals of Geographic Information Systems, 3ed, Demers (2004) Wiley India Pvt. Ltd., New Delhi.
[Fundamentals of Remote Sensing, Joseph George \(2003\) University Press. Hyderabad](#)
Geographic Information Systems: An Introduction, 3ed, Bernhardsen (2003) Wiley India Pvt. Ltd., New Delhi.
Geographical Information Systems, Maguire, D.J.; Goodchild, M.F.; Rhind, D.W. 1991. Longman, London UK.
IRS - IC Data User Handbook, NRSA, 1995. Hyderabad.

Remote Sensing Techniques for Environmental Analysis, Estes, J. E. and LW Senger, 1994, Hamilton, Santa Barbara, California

Remote Sensing of Urban Environment, India, Sokhi, B.S. and SM Rashid, 1999, Manak Publishers, New Delhi

3.4.4 REMOTE SENSING AND GIS APPLICATION IN MARINE SCIENCE

A history of the Ecosystem Concept in Ecology: more than the sum of the parts, Golley, F.B., 1993, Yale University Press, New Haven.

A review of remote sensing for the assessment and management of tropical coastal resources. Green, E P, Mumby P J et al, . 1996, Coastal Management, 24, 1 - 40

Determination of net shore drift direction of central west coast of India using remotely sensed data, Kunte P D & Wagle B G, 1993. Journal of Coastal Research, 9, 811 - 822

Guide to satellite remote sensing of the marine environment. International Oceanographic Commission, UNESCO, IOC (International Oceanographic Commission). 1992.

In Remote Sensing applications in Marine Science Sathyendranath, S., Morel, A., 1983; edited by A.P.Cracknell (Dordrecht: D.Reidel). pp.323-357.

In Remote Sensing Applications in Marine Science and Technology, edited by A.P.Cracknell (Dordrecht: D.Reidel), pp.137-167.

Introductory Digital Image Processing Jensen J R, 1986. (New Jersey : Prentice Hall)

Light emerging from the Sea - interpretation and users in remote sensing

Marine and Coastal Geographical Information Systems Wright, D. and Bartlett, D.J. (Editors) (1999) London: Taylor & Francis.

Ocean Environmental Management, Frankel, E.G., 1995, Prentice Hall PTR, New Jersey.

On the colour of the sea Ramanathan, K.R., 1923, Philos. Mag., 46, 543-553.

Physical Optics of Ocean Water. AIP translation series Shifrin, K.S., 1988, American Institute of Physics, New York.

Remote Sensing of optical properties of a stratified ocean: an improved interpretation, Gordon, H.R. and D.K. Clarke, 1980, Applied optics, 19, 3428-3430. Jerlov, N.G., 1951, Optical Studies of Ocean Water. Report of Swedish Deep-Sea Expeditions, 3, 73-97.

Selected topics of Coastal Zone Color Scanner (CZCS) data evaluation. Sturm, B., 1983

3.4.5 RS AND GIS APPLICATION IN WATER RESOURCES

Geoinformatics for environmental management, Anji Reddy, M. 2004 : B.S. Publications

[Advances in Hydro science, Chow, V.T., 1988: McGraw Hill](#)

Image Interpretation in Geology. Drury, S.A., 1987: Allen and Unwin

[Remote Sensing Geology. Gupta, R.P., 1990: Springer Verlag.](#)

Remote Sensing of the Environment: An Earth resource Perspective. Jensen, J.R. 2000 : Prentice Hall

Groundwater Assessment-Development and Management. Karanth, K.R., 1987: Tata McGraw Hill.

Remote Sensing and Image Interpretation, Lillesand, T.M., and Kieffer, R.M., 1987: John Wiley.

Photogeology. Miller, V.C., 1961: McGraw Hill.

Aerial Photography and Image Interpretation for Resource Management. Paine, D.P., 1981: John Wiley.

Principles and Applications of Photogeology. Pandey, S.N., 1987: Wiley Eastern,.

Remote sensing Principles and interpretation. Sabbins, F.F., 1985: W.H. Freeman and company

Groundwater Hydrology. Todd, D.K., 1980: John Wiley

Integrated Watershed Management. Rajora, R., 2003: Rawat Publication

GSP 3.5 PRACTICAL APPLICATION OF DIGITAL PHOTOGRAMMETRY

Elements of Photogrammetry by Paul R. Wolf, Mc. Graw Hill

Digital Photogrammetry: An Addendum to Manual of Photogrammetry Cliff Greve and ASPRS

Digital Photogrammetry. Kasser Michel and Egles Yves Taylor & Francis. London & New York.

Digital Photogrammetry – An addendum to Manual of Photogrammetry by Tina Cary,