**ACADEMIC REGULATIONS, COURSE STRUCTURE AND**

**DETAILED SYLLABUS**

**M.Tech. Program**

**in**

**GEOINFORMATICS AND SURVEYING TECHNOLOGY**

**CENTRE FOR SPATIAL INFORMATION TECHNOLOGY**

Institute of Science and Technology

**2015-16**

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**Kukatpally, Hyderabad-500 085, Telangana, India.**

**R 15 - COURSE STRUCTURE (CBCS) FOR PG PROGRAMMES**

**M.TECH (GIST) 2015**

**I YEAR, I SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** |  | **COURSE TITLE** | **INT. MARKS** | **EXT. MARKS** | **L** | **P** | **C** |
| **GIST – 1.1** | Core Course I | Surveying | 25 | 75 | 4 | - | 4 |
| **GIST – 1.2** | Core Course II | Basics of Remote Sensing | 25 | 75 | 4 | - | 4 |
| **GIST – 1.3** | Core Course II | Fundamentals of GIS & Database | 25 | 75 | 4 | - | 4 |
| **GIST – 1.4** | Core Elective I | Elective\* | 25 | 75 | 4 | - | 4 |
| **GIST – 1.5** | Core Elective II | Elective\* | 25 | 75 | 4 | - | 4 |
| **GIST – 1.6** | Open Elective I | Photogrammetry | 25 | 75 | 4 | - | 4 |
| **GIST – 1.7** | Laboratory I | GIST LAB – I (DIP) | 25 | 75 | - | 4 | 2 |
| **GIST – 1.8** | Seminar I | Seminar | 50 | - | - | 4 | 2 |
|  |  | **Total** |  | **24** | **8** | **28** |

**Electives\*:**

1. Statistics and Computation

2. Cadastral Surveying and Mapping

3. Digital Image Processing

## I YEAR, II SEMESTER

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** |  | **COURSE TITLE** | **INT. MARKS** | **EXT. MARKS** | **L** | **P** | **C** |
| **GIST – 2.1** | Core Course IV | Digital Photogrammetry | 25 | 75 | 4 | - | 4 |
| **GIST – 2.2** | Core Course V | GNSS Surveying | 25 | 75 | 4 | - | 4 |
| **GIST – 2.3** | Core Course VI | Remote Sensing Applications | 25 | 75 | 4 | - | 4 |
| **GIST – 2.4** | Core Elective III | Elective\* | 25 | 75 | 4 | - | 4 |
| **GIST – 2.5** | Core Elective IV | Elective\* | 25 | 75 | 4 | - | 4 |
| **GIST – 2.6** | Open Elective II | GIS Analysis and Applications | 25 | 75 | 4 | - | 4 |
| **GIST –2.7** | Laboratory II | GIST LAB – II (GIS) | 25 | 75 | - | 4 | 2 |
| **GIST – 2.8** | Seminar II | Seminar | 50 | - | - | 4 | 2 |
|  |  | **Total** |  | **24** | **8** | **28** |

**Electives\*:**

* 1. Advanced Digital Image processing
	2. Internet GIS
	3. Disaster Management

**Note: 1 session of theory = 1hr 40 minutes = 2 periods**

 **1 session of practical = 3 hrs 20 minutes = 4 periods**

**II Year, I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl. No** | Subject | **INT. MARKS** | **EXT. MARKS** | **L** | **P** | **C** |
| **1** | Comprehensive viva voce | - | 100 | - | - | 4 |
| **2** | Project Work Review I | 50 | - | - | 24 | 12 |
|  | **Total** |  |  |  | **24** | **16** |

**II Year, II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl. No** | Subject | **INT. MARKS** | **EXT. MARKS** | **L** | **P** | **C** |
| **1** | Project Work Review II | 50 | - | - | 8 | 4 |
| **2** | Project Evaluation (Viva-Voce) | - | 150 | - | 16 | 12 |
|  | **Total** |  |  |  | **24** | **16** |

**GST – 1.1 –SURVEYING**

**Unit - I: Fundamentals of Surveying:**

Principles of surveying, types of surveying, classification of surveys & maps, Systems of Co-ordinates, Plan Vs Map, Accuracy Vs Precision, sources and kinds of error; error propagation, Least Squares adjustments and applications.

**Unit - II: Surveying & Levelling:**

Chains: types, errors in chaining, chain triangulation, basic problems in chain surveying; Compass: types, designation of bearings, azimuth, bearing, relationship between bearings & azimuths. Plane table: instruments used for plane table survey, methods of plane tabling;

Leveling – definition, leveling instruments, methods of leveling (Dumpy level, Theodolite , Digital Level); Tacheometric surveying – principle, methods to determine horizontal distance, uses of Tachometric Surveying.

**Unit - III: EDM & Total Station:**

Principle, instrument characteristics, accessories, operation, EDM without reflecting prisms; **Total Station –** types, instrument description, field techniques, Traversing, motorized total stations; field procedures for total stations in topographic surveys.

**Unit - IV: Topographical Surveying: Concepts and Techniques:**

Definition, Procedure in topographic surveying , uses of topographical maps, Relief, methods of representing relief, contour and contour interval, characteristics of a contour, methods of locating contours, Interpolation of contours, Dam Surveys.

**Unit - V Project Planning I:**

 Systems of Co-ordinates, constitution of survey party, Planning, execution and completion of a topographical survey, Quality Vs Quantity. Case Studies.

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**TEXT BOOKS:**

1. Text Book of Plane Surveying By David Clark Part I and Part II

2. Text Book of Surveying by Punmia Part I and Part II

3. Theory of Error by Edward Mikhail

**REFERENCES:**

1. Surveying and Leveling – Agor
2. Principles of Cartography – K. S. Singh

**GST – 1.2 –BASICS OF REMOTE SENSING**

**Unit - I: Fundamentals:**

Definition – Scope - chronological development – Energy sources – Electro Magnetic Radiation-Electromagnetic Spectrum

Energy matter interactions: in atmosphere – atmospheric windows, with earth surface features- spectral reflectance patterns. Factors affecting remote sensing Spectral response pattern.

Resolution: Spatial, Spectral, Temporal, Radiometric & Angular Resolution

Platforms: Types of Platforms. Advantages and limitations of satellite remote sensing.

**Unit - II: Satellites and Sensors:**

Major satellite programs of the world - Geostationary satellites and their orbits: sensor characteristics and their applications. Earth observation satellites : coarse, medium and high resolution satellites - LANDSAT, SPOT, IRS, IKONOS , Quick bird, World View and other recent satellites – scanning and orbiting mechanisms – Elements of image interpretation.

**Unit - III: Thermal Remote Sensing:**

Thermal infrared radiation-Radiant flux – heat transfer – thermal properties of materials – emissivity – thermal inertia-heat capacity.

Thermal IR detection and imaging – characteristics of TIR images. Factors controlling IR survey – applications.

**Unit - IV: Microwave Remote Sensing:**

Concept, side looking airborne radar system (SLAR) – components, – range and azimuth resolution – Real aperture and Synthetic aperture systems, geometry of radar images; Image characteristics: wavelength, surface roughness, orientation, moisture content, polarization, look direction and look angle, physical properties, electrical properties: dielectric constant, Topographic factors, layover, fore shortening, radar shadow, corner reflection

**Unit - V: Hyper Spectral Remote Sensing:**

Concept of hyper spectral remote sensing, Hyperion /HYSI, Hyper spectral data, Image cube, Hyper spectral data analysis, spectral library, Application of Hyper spectral data.

**TEXT BOOKS:**

1. Lillisand T.M and R.W.Kiefer (2004) 4th edition. Remote sensing and image interpretation, John Wiley & Sons, New York.

 2. JOHN R.JENSEN “Remote sensing for Environment ”Pearson edition Pvt Ltd, New Delhi.

1. Anji Reddy, M., (2001) Remote Sensing and Geographical Information Systems, 2nd edition, BS Publications, Hyderabad.
2. George Joseph,(2005) Fundamentals of Remote sensing 2nd edition , University press, Pvt, Ltd, Hyderabad .
3. Remote sensing by JAMES B.CAMPBEL published by Taylor & fancies Ltd.

 6. Sabins F.F Jr Latest Remote Sensing: Principles and Interpretation, W.H.Freeman &

 Co., New York

 7. Campbell, J.R. 2000, Introduction to Remote Sensing. Taylor & Francis, London.

**REFERENCES:**

1. Hayesm L., [1991] Introduction to Remote Sensing, Taylor and Fransis Publication, London.
2. Gibso, P., and Clare H.Power, [2000] Introductory Remote Sensing Principles and concepts, Routledge, 1st edition, London.
3. Henderson, F. M., and Anthony J. Lewis, 1998, Manual of Remote Sensing, Volume 2, Principles and Application of Imaging Radar, 3rd Edition, John Wiley and Sonc Inc, Canada, USA.

## GST – 1.3 – Fundamentals of GIS & Database

**Unit - I: Introduction to GIS & Data Structures:**

Spatial Elements (Developing spatial awareness), Spatial Measurement Levels, Spatial Location and Reference, Spatial Patterns, Geographic Data Collection, Populations and Sampling Schemes, Inferences from Samples, Map Scale and Map Characteristics, Map Projections, Grid Systems.

Data Structures**:** Computer Database Structures for Managing Data, Hierarchical Data Structures, Network Systems, Database Management Systems, RDBMS,Relational Model **–** Structure, Relational algebra, Relational calculus, Commercial query languages, SQL, Query –by- example, QUEL.

**Unit - II: Types of GIS Data Models and Input Devices:**

Graphic Representation of Entities and Attributes, GIS Data Models, Raster Models, Vector Models, Input Devices, Raster, Vector, Reference Frameworks and Transformations, Map Preparation and the Digitizing Process.

**Unit - III: GIS Data Input Methods and Data Storage and Editing**:

Methods of Vector Input, Method of Raster Input, Remote sensing, Data Input, GPS Data input, Secondary data, Meta data and Meta data Standards.- Storage of GIS Databases, Detecting and Editing, Entity Errors: Vector, Attribute Errors: Raster and Vector, Dealing with Projection Changes, Edge Matching, Conflation and Rubber Sheeting, Templating.

**Unit - IV: Database Systems & Entity Relationship Model:**

Definition, Purpose, Data abstraction, Instances and Schema, Data independence, Introduction to DDL, DML, Database manager, Database administrator, Database users, Overall system structure.

Entity Relationship Model**:** Entities, Entity sets, Relationships, Relationship sets, Mapping constraints, Primary keys, E-R diagrams, Reduction of E-R diagrams to tables, Generalization, Aggregation.

**Unit - V: Concepts of Data Warehousing & ETL Architecture:**

Basic concepts, Data warehouse Implementation Approach, Architecture – Data Acquisition – Extraction, Transformation and Loading- Data Mart, comparison of OLTP & DSS -Schemas, Dimension table – Facts- Different Scenarios

**TEXT BOOKS**:

1. **Fundamental of GIS** by MICHAEL N DEMERS – Published by John Wiley & Sons Inc
2. **Principles of GIS** by P.A. Burrough and Rachael Mc Donnell
3. **3. Principles of Geographical Information Systems for Land Resources Assessment** by P.A. Burrough
4. **Database System concepts** by HENRY F. KORTH, Abraham Siberschatz et.al., Mc Graw Hill
5. **Database Management Systems** by Raghurama Krishnan and Johannes Gehrke, TATA McGrawHill 3rd Edition.

**6.** **Data Warehousing, Data Mining & OLAP**, by Alex Berson and Stephen J.Smith, “Tata McGraw – Hill Edition, Tenth Reprint 2007.

**REFERENCES:**

**1. Geographic Information System- An Introductory** – Jeffrey Star and John Estates – Pretence Hall Inc.

1. **Basic Readings in Geographic Information System –** Marble, D.F and Calkins, H.W – Spad Systems Ltd.
2. **Database Management Systems by P.Radha Krishna HI-TECH Publications 2005.**

**GST – 1.6 – PHOTOGRAMMETRY**

 **Unit - I: Introduction to Photogrammetry & Vertical Photographs:**

Aerial Camera, Film and Filter combination: film processing, Printing of Aerial Photos.

Cartography: terms & definition, Map Projection, Map numbering systems, Map legend symbols- Design and layout of map.

 Definition of Photogrammetry - types of photographs, vertical aerial photographs, Geometry of vertical photographs, Scale of a vertical photograph over flat terrain, Scale of a Vertical photograph over variable terrain - average photo scale, methods of determining scale of vertical photographs, Ground coordinates from a vertical photograph, Relief Displacement, Flying height of a vertical photograph, Error evaluation.

 **Unit - II: Stereoscopic Parallax:**

Principle of the Floating Mark – Stereoscopic methods of Parallax Measurement – Parallax equation – Elevations by parallax Differences – Approximate Equation for elevations from Parallax Differences – Measurement of Parallax Differences with Stereoscope& Parallax Bar- Parallax Correction Graph – Computing Flying Height and Air Base – Error Evaluation.

 **Unit - III: Elementary Methods of Planimetric Mapping for GIS, Photomaps & Mosaics :**

Planimetric Mapping by Direct Tracing – Planimetric Mapping with Reflection and Projection Instruments – Georeferencing of Digital Imagery – Planimetric Mapping Using a Tablet Digitizer – Heads-up Digitizing – Photomaps and mosaics, Kinds of mosaics, uncontrolled digital mosaics, semi controlled Digital mosaics and Controlled Digital Mosaics

**Unit - IV: Tilted Photographs:**

Introduction, Angular Orientation in Tilt, Swing, and Azimuth, Auxiliary Tilted Photo coordinate system, Scale of a Tilted Photograph, Relief Displacement on a Tilted Photograph, Tilt Displacement, Angular Orientation in Omega, Phi and Kappa, Determining the elements of Exterior Orientation, Rectification of Tilted photographs,  Geometry of Rectification,   Analytical Rectification,  Optical-Mechanical Rectification,  Digital Rectification, Atmospheric Refraction in tilted aerial photographs.

**Unit - V: Stereoscopic Plotting Instruments:**

Classificationof stereoscopicPlotters**-**Direct optical projection Stereo plotters: components, Projection systems, Viewing systems, Measuring and tracing systems, Interior Orientation, Relative Orientation, Absolute Orientation, Analytical plotter: Introduction, System components and Methods of operations and its advantages. Project planning: Flight planning: Introduction, Photographic end lap and side lap, Purpose of the Photography, Photo Scale, Flying Height, Stereoscopic Plotter Considerations, Ground coverage, Weather conditions, Season of year, Flight Map, Specifications, Cost estimating and Scheduling.

**TEXT BOOKS:**

1. **Elements of Photogrammetry** by PAUL R. WOLF, 3rd edition, ISBN 007-123689-9

**2 Introduction to Modern Photogrammetry (Paperback)** by [Edward M. Mikhail](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=Edward%20M.%20Mikhail), [James](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=James%20S.%20Bethel)

[S. Bethel](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=James%20S.%20Bethel)

**REFERENCES:**

1. **Manual of Photogrammetry – American Society of Photogrammetry** By ALBERT.D
2. **Aerial Photographic Interpretation** by D. R. Lueder, McGraw-Hill Companies
3. **Photogrammetry- Vol I**by Krauss, J., - Springler – Verlag Publications
4. **Photogrammetry 3rd Edition by** Moffitt, Francis H. & Mikhail, Edward M., - Harper and Row Publishers.
5. **Principles and Applications of Photo Geology** By SHIV PANDEY

**GST– [ELECTIVE-1] STATISTICS AND COMPUTATIONS**

**Unit I: Measurements and Their Analysis**

Introduction, Direct and Indirect Measurement, Measurement Error Sources.

Sample versus Population, Range and Median, Graphical Representation of Data.

**Unit II: Random Error Theory**

Introduction, Theory of Probability, Properties of the Normal Distribution Function, Probability

of the Standard Error, Uses of Percent Errors

**Unit III: Hypothesis Testing**

Hypothesis Testing: Test of Hypothesis for the Population Mean, Test of Hypothesis for the Population Variance: Test of Hypothesis for the Ratio of Two Population Variances.

**Unit IV: Error Propagation in Traverse Surveys**

Introduction, Derivation of Estimated Error in Latitude and Departure, Derivation of Estimated

Standard Errors in Course Azimuth, Computing and Analyzing Polygon Traverse Misclosure

Errors, Computing and Analyzing Link Traverse Misclosure Errors

**Unit V: Neural Network and Fuzzy Logic**

Introduction: Basic Concepts of Neural Networks and Fuzzy Logic, Differences Between Conventional Computing and Neuro-Fuzzy Computing, Characteristics of Neuro-Fuzzy Computing. Fuzzy Set Theory: Basic Definitions and Terminology and Membership Functions – Formulation and Parameters, Neural Networks, Fuzzy Logic and Genetic Algorithm

**TEXT BOOK:**

1. Adjustment Computations (Statistics and Least Squares in Surveying and GIS ) - Paul

R.Wolf & Charles D. Ghilani

2. Finite Element by Buchnan, TataMcgraw Hill, 2006

**REFERENCES:**

1. Neural Networks by Satish Kumar,Tata Mcgraw Hill,2004.

**GST – [ELECTIVE-2] CADASTRAL SURVEYING AND MAPPING**

**UNIT I : INTRODUCTION**

History and Principles of Cadastral Survey - Status and Types of survey in India , Legal cadastre -Graphical and Numerical cadastre, Land and Property registration system , Legal Characteristics of Records, Record of Rights ( RoR ), Torrens System.

**UNIT II : METHODS of SURVEYING**

Cadastral Survey Methods - Steps in survey of a Village boundaries, Instruments used for Cadastral survey & Mapping - Orthogonal, Polar survey Methods - Boundary survey - Rectangulation, Calculation of area of Land Parcels, Functions of GPS / DGPS and Electronic Total Station ( ETS ), LiDAR, Terrestrial Scanners , UAV'S in Land surveying.

**UNIT III : MAINTENANCE and MEASUREMENTS**

Cadastral survey maintenance – Resurveys and Relocation of parcels - Measurement of division / sub-division of Parcels , Consolidation of Parcels - Measurement of obstructed lines, Relaying of missing pillars - Survey of Urban areas - Control requirement for Urban survey, Property Tax, , Land management-land acquisition,, land settlement and consolidation of land holdings.

**UNIT IV : PHOTOGRAMMETRIC METHODS**

Photogrammetry for Cadastral surveying and Mapping and Updation, Data Processing procedures, Orthoimage generation and Map – Accuracies and Errors , Use of Satellite Imagery in boundary fixing, Land Assets, Quality control measures - National / International Application scenario.

**UNIT V : MAPPING PROCEDURES and LAND INFORMATION SYSTEM ( LIS )**

Cadastral Map generation procedures – Datum, Scale and Map Projection ( Cassini, LCC, UTM ) and Co-ordinate systems / conversions for Cadastral maps, Automated cadastral maps, Indian Grid ,Conventional / GIS symbols - Digitization and Map reproduction processes - Computerization of Cadastral Land records ( CLR ) Data, Land Register, Concepts and Creation of Land Information System ( LIS ). Integrating LIS - FMB, Revenue records, Land administration.

**TEXT BOOK:**

1. James, M. Anderson and Edward N. Mikhail, Introduction to Surveying, McGraw Hill

Book Co, 1985

2. Survey of India, Hand book of Topography, 1971

**REFERENCES:**

1. Alias Abdul Rahman, Siyka Zlatanova,Volker Coors, Innovations in 3D geo information

systems, 2006

2. Kahmen & Faig, Surveying, Walter de Gruyter, Berlin, 1993.

3. Peter F. Dall, John D. MeLauglin, Land information management, Oxford Press.1988

**GST – [ELECTIVE 3]- DIGITAL IMAGE PROCESSING**

**Unit - I: Sources and characteristics of remote sensing images**

Characteristics of digital image data, spatial data sources. Types of spatial data resolutions- spatial, spectral, radiometric, temporal and angular. Data acquisition & storage - data formats. Image processing systems- IDRISI, ILWIS, ERDAS Imagine, ENVI, e-Cognition etc...

**Unit - II: Image Preprocessing**:

Sources of radiometric distortion-Effect of atmospheric, instrumentation errors. Correction of radiometric distortions

Sources of geometric distortions, earth rotation effects, panoramic distortions, earth curvature, scan time skew, etc… Correction of geometric distortion- use of polynomials for image corrections, mathematical modeling, image registration, ortho-rectification.

**Unit - III: Image Enhancements:**

Radiometric enhancement techniques: Contrast modification, Histogram equalization, Histogram matching, density slicing.

Geometric enhancement techniques: Neighbourhood operations, image smoothing, low pass filtering, edge detection & enhancement, line detection.

Detecting geometric properties- texture, spatial correlation- semivariogram, shape detection

**Unit - IV: Image Interpretation/Analysis:**

Introduction to image interpretation, digital/ Quantitative analysis-pattern recognition-pixel vector labeling, unsupervised classification, supervised classification.

**UNIT-V: Accuracy Assessment:**

Precision versus Accuracy, types of accuracy: positional, thematic, sources of errors in thematic maps, Error matrix analysis, report of accuracy.

**TEXT BOOKS:**

1. John R.Jenson, .Introductory Digital Image Processing., Prentice Hall Series, 1996.

2. John A. Richards, Springer-Verlag, .Remote Sensing Digital Image Analysis. 1999.

3. Lillisand T.M and R.W.Kiefer (2004) 4th edition. Remote sensing and image interpretation, John Wiley & Sons, New York.

4. Rafael C.Gonzalez, .Digital Image Processing (2nd Edition)., Prentice Hall, 2002.

5. Remote sensing models and methods for Image processing. Schowengerdt 2nd edition.

6. Gao J., 2009, Digital analysis of Remote Sensely Imagery.Mc Graw Hills

7. Remote Sensing: The Quantitative Approach, edited by Swain, P.H.and Davis, S.M. Mc Graw Hills.

8. Richards J.A. & Xiuping, 2006. Remote Sensing Digital Image Analysis, Springer.

9. Liu and Mason, 2009. Essential Image processing and GIS for Remote sensing, Wiley-Blackwell.

10. Campbell J.R., 2000. Introduction to remote sensing, Springer.

**REFERENCES :**

1. David L. Verbyla .Satellite Remote sensing of Natural Resource Management., Lewis

publishers, Florida

2. Anil K. Jain .Fundamentals of Digital Image Processing. Prentice Hall Publications, USA.

3. Image Analysis, Classification and change Detection in Remote Sensing . Mortan J.Century

 Taylor and Francis, 2007.

**GST – 1.7 – GST LAB – I (DIGITAL IMAGE PROCESSING LABORATORY)**

1. Reading and Displaying Satellite image Data from BIL, BSQ and BIP formats & Generation of False Color Composite (FCC)
2. Geo referencing the base map
3. Geometric correction of satellite image
4. Extraction of area of interest
5. Mosaic Preparation of digital images
6. Image Fusion Techniques
7. Enhancement using Band ratio
8. Enhancement using different Filtering techniques
9. Principal Component Analysis (PCA)
10. Fourier Analysis
11. Unsupervised Classification
12. Supervised Classification & accuracy assessments
13. Change detection
14. Spatial model maker

**GST -2.1 - DIGITAL PHOTOGRAMMETRY**

# Unit I: Introduction & Digital Photogrammetric Work Stations

# Definition of Digital Photogrammetry & Its Development, Comparison between Three Phases of Photogrammetry (Analogue, Analytical and Digital) Advantages of Digital Photogrammetry,

# Hardware & Software Components of DPWS, Various Inputs for Digital Photogrammetry: Control Point selection, Scanned Photo, Digital Photographs, Remote Sensing Imagery

# Photogrammetric Scanners: Principle of Image Scanning, Configuration of Scanners, Method of Scanning, File Format and Size.

# Unit II: Image Measurements & Their Refinement

# Introduction to Coordinate Systems And Image Measurements, Simple Scales for Photographic measurements, Measuring Photo Coordinates with Simple Scales, Trilaterative method of Photo Coordinate Measurement, Measurement of Photo Coordinates with Tablet Digitizers, Mono Comparator measurement of Photo Coordinates.

 Refinement of Measured Image Coordinates: Distortions of Photographic Films and Paper, Shrinkage Correction, Lens Distortions Corrections, Atmospheric Refraction Correction, Earth Curvature Correction, Reduction of Coordinates to an Origin at the Principal Point.

# Unit III: Orientation Procedures in Digital Photogrammetry

 Inner orientation (IO), Mathematical transformations, Epipolar geometry, Exterior Orientation (EO), Auto Tie Point Generation, Digital Image Matching Process: Area Based, Feature and Relation Based, Co linearity Condition

Space Resection Method, Space Intersection, Aerial Triangulation and Bundle Block Adjustment, Use Of GPS And IMU in Digital Photogrammetry

**Unit IV: 3D Visualization & Stereo-Compilation**

Principle and Method of 3d Visualization: Anaglyph Polarized and Hybrid Techniques, Feature Extraction, Feature Coding, Data Model and Feature Class.

Definition DEM, DTM, DSM, Various Inputs to DEM/DTM, DTM Specification And Accuracy, Application of DTM, Various Interpolation Techniques: Grid, TIN, Break Lines, Mass Points, Digital Orthophoto Generation (Pre-processing, Main processing, Post processing) and its uses.

**Unit V: Air Borne Laser Terrain Mapping (LIDAR)**

Introduction to Laser Ranging, Principle of LiDAR, System Components, Range Measurements, LiDAR Error Sources, Accuracy, Applications & Advantages of ALTM.

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# TEXT BOOKS:

# Elements of Photogrammetry with application in GIS (3rd edition)- Paul R. Wolf & bon A. Dewitt, McGraw Hill

# Digital Photogrammetry by Karl Krauss

 3. Introduction to Modern Photogrammetry (Paperback)by [Edward M. Mikhail](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=Edward%20M.%20Mikhail), [James S.](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=James%20S.%20Bethel)

 [Bethel](http://www.amazon.com/s/ref%3Drdr_ext_aut?_encoding=UTF8&index=books&field-author=James%20S.%20Bethel)

# REFERENCES:

# Manual of Photogrammetry – American society of Photogrammetry & R.S by Albert.D

Photogrammetry by Francis H. Moffitt, Edward M. Mikhail.

# Modern Photogrammetry – Deward M. Midhail.

# Photogrammetry Vol-I by – Drauss J, Springler- Verlag publication.

# Digital Photogrammetry by –Michel Kasser & Yves. Egels.

# Geographic information systems an introduction by Bernhardsen, 3rd edition.

**GST – 2.2 – GNSS SURVEYING**

**UNIT - I Basics**

Definition - Fundamental goals of Geodesy - Definitions - basic concepts - Historical perspective - development applications in Satellite Geodesy - Geoid and Ellipsoid, Earth Geoid models(EGM), satellite orbital motion - Keplerian motion - Kepler‟s Law - Perturbing forces - Geodetic satellite

**UNIT - II Different Techniques**

Determination of direction by photography - SECOR - Electronic observation techniques - Doppler effect - Positioning concept - Development of TRANSIT satellites.

**UNIT - III Satellite System**

GPS - Different segments - space control and user segments - satellite configuration - GPS signal structure - Orbit determination and Orbit representation Anti Spoofing and Selective Availability - Task of control segment - GPS receivers - main receiver components - Example of GPS receivers.

**UNIT - IV GPS Data Processing**

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation - data processing - software modules – ambiguity resolution and cycle slips, RINEX format. Concepts of rapid static methods with GPS semi kinematic and pure kinematic methods - basic constellation of satellite geometry & accuracy measures.

**UNIT - V Applications of Satellite Geodesy**

Geodetic control surveys, Cadastral surveying, Photogrammetry & Remote Sensing, Engineering applications and Monitoring - GPS. GLONASS , GALILEO, COMPASS and IRNSS satellite configuration comparison - Satellite Laser Ranging & Applications - Concepts of satellite altimetry.

**TEXT BOOKS:**

1. Satellite Geodesy by GUNTER SEEBER, Copy Right 2003 by WALTER DE GRUYTER 1993, ISBN: 3-11-017549-5.
2. Global Positioning System – Theory and Practice – Hofmann W.B, Lichtenegger. H, Collins. J – Springer Verlag Wein, New York.-2008
3. “GPS Satellite Surveying”, Alfred Leick 3rd Edition, John Wiley and Sons 2004.

**REFERENCES:**

1. Global Navigation Satellite Systems by G. S. Rao 2010 Tata McGraw Hill Education Pvt Ltd.
2. “GPS Theory, Algorithms and Applications .Guocheng Xu,” Springer-Verlag, 2003.

**GST – 2.3 – REMOTE SENSING APPLICATIONS**

**Unit I: Geosciences Applications:**

Geological & Geo morphological Mapping, Mineral and Ground Water Exploration, Identification of sites for ground water recharge.

**Unit II: Forest Cover & Water Resources:**

**Forests** – Forest cover mapping using remote sensing data, density mapping. Forest stock mapping. Forest change detection. Forest fire detection and burned area mapping and fire vulnerability assessment. Applications of Laser in vegetation studies – aerial and terrestrial.

**Water** – Surface water resources assessment and management, Reservoir sedimentation. Performance evaluation of command areas. Integrated watershed development, water quality mapping & monitoring. Wetland mapping. Snow and glaciers: Mapping & monitoring –role of spectral indices in discrimination of Snow and clouds

**Unit III: Soil & Agriculture Applications:**

**Soils***–* Soil resources mapping including generation of derivative maps like land capability, land irrigability and suitability for specific purpose, soil resources database. Land degradation mapping, monitoring and modeling. Soil moisture estimation using microwave and thermal data.

**Agriculture**- (a) Crop inventory and acreage estimation. (b) Crop yield modeling – (c) Crop production forecasting- FASAL program. -Crop condition assessment, Vegetation Indices: Precision farming.

**Unit IV: Landuse Applications:**

Concepts of Urban and Regional planning and its applications, urban services and network planning, Urban landuse planning Urban growth /Sprawl; Slum detection, monitoring and updating, Study of Transportation Systems.

**Unit V: Environmental Studies and Natural Disaster Management:**

Role of remote sensing in environmental studies, water and air pollution. Environmental Policy. Environmental Impact Assessment.

Types of natural disasters – floods, agricultural drought, earthquakes and tsunamis – volcanoes – landslides. Familiarization with Decision Support System (DSC) and National Database for Disaster Management (NADDM).

**TEXT BOOKS**:

1. Lillisand T.M and R.W.Kiefer (2004) 4th edition. Remote sensing and image interpretation, John Wiley & Sons, New York.
2. JOHN R.JENSEN “Remote sensing for Environment”Pearson edition Pvt Ltd, New Delhi.
3. Anji Reddy, M., (2001) Remote Sensing and Geographical Information Systems, 2nd edition, BS Publications, Hyderabad.
4. George Joseph,(2005) Fundamentals of Remote sensing 2nd edition , University press, Pvt, Ltd, Hyderabad .
5. Remote sensing by JAMES B.CAMPBEL published by Taylor & fancies Ltd.
6. Sabins F.F Jr Latest Remote Sensing: Principles and Interpretation, W.H.Freeman & Co., New York.
7. Nyle C. Brady, Nature and Properties of Soils 9th Edition Eurasia Publishing House (P) Ltd., New Delhi.
8. Ravi P. Gupta, 2003, Remote Sensing Geology. Springer-Verlag Berlin, Heidelberg, Germany.

**REFERENCES:**

1. American Society of Photogrammetry, (Latest edition). Manual of Remote Sensing , ASP, Fall church, Virgina.
2. Barett, E.C.,[1990] Satellite Remote Sensing for Hydrology and Water Management, Garden and Breach Science Publications, Switzerland.
3. Buiter, H.J., and Jan G.P.W. Clevers, [1999].Land Observation by Remote Sensing, Taylor and Francis, 1999, London.
4. Skidmore, A., and Hendrik Prins ( Editors),[2002] Environmental Modelling with GIS and Remote Sensing, Taylor and Francis Ltd., 2 nd Edition, London.
5. Alexey Bunkin and Konstantin Voliak, Laser Remote Sensing of the Ocean, John Wiley and Sons. 2001, Canada.

**WEBSITES:**

ww2010.atmos.uiuc.edu/(Gh)/guides/rs/sat/goes/home.rxml

www.ccrs.nrcan.gc.ca/ccrs/misc/issues/hazards\_e.html#spills

www.crisp.nus.edu.sg/~research/research/forest/forest.html

www.cr.usgs.gov/earthshots/slow/tableofontents

www.indiana.edu/~climate/336/rsdata.html

www.nrsa.gov.in/engnrsa./spacesolutions/index.html

www.unn.ac.uk/~evgpl/eog/rsguide/rsguide.htm

www. terraweb.wr.usgs.gov/coastal.html

**GIST– 2.4 – ADVANCED DIGITAL IMAGE PROCESSING**

**Unit – I: Image Restoration**

Correction and calibrations- Global, Local and Periodic, radiometric calibrations, Senor Calibrations, Atmospheric Correction, Topographic Correction.

**Unit -II: Advanced Image Enhancement**

Multispectral transformations: PCA, noise-adjusted PCA, Kanth-Thomas, Tasseled cap transformation, MNF transformation and independent Component Analysis, Image arithmetic, band ratios and vegetation indices.

Fourier transformation: spectral functions, Fourier series, Fourier transform, convolution

Data fusion methods-IHS transformation, Brovey, Wavelet.

**Unit – III: Image Compression Techniques**

Data compression: Methods- lossless & Lossy –Techniques- DFT, Wavelet, JPEG, Cosine transformations.

**Unit – IV: Image Classifications**

Classification of image analysis methods: Parametric & Non Parametric, hard & soft classifiers. Mahalonobis classifiers, Table look up classification, KNN (K-nearest neighbour classifier), Gaussian mixture model, and context classification

Non-parametric classification: Linear discrimination, support vector classifiers, Neural Network Approach (ANN), Decision Tree Classifier. Object-oriented classification, support vector machine (SVM).

**Unit – V: Hyper Spectral Image Analysis & Change Detection**

Data Visualization, Dimensional Reduction, Feature Extraction – Characteristic of hyper spectral data, Pixel Purity Index, Hyper Spectral Data Analysis Methods: - SAM, Spectral Feature Filtering, Spectral Unmixing.

Change Detection: Scope, Change Detection Methods-Spectral Differencing, NDVI-based Analysis, Post classification change detection, Principal Component Analysis (PCA).

**TEXT BOOKS**

1. John R.Jenson, “Introductory Digital Image Processing”, Prentice Hall Series, 1996.
2. John A.Richards, Springer-Verlag, “Remote Sensing Digital Image Analysis” 1999.
3. Rafael C.Gonzalez, “Digital Image Processing (2nd Edition)”, Prentice Hall, 2002.
4. Remote sensing models and methods for Image processing – Schowengerdt 2nd edition
5. Anil K. Jain “Fundamentals of Digital Image Processing” Prentice Hall Publications, USA.
6. Gao J., 2009, Digital analysis of Remote Sensely Imagery.Mc Graw Hills
7. Remote Sensing: The Quantitative Approach, edited by Swain, P.H.and Davis, S.M. Mc Graw Hills.
8. Richards J.A. & Xiuping, 2006. Remote Sensing Digital Image Analysis, Springer.
9. Liu and Mason, 2009. Essential Image processing and GIS for Remote sensing, Wiley-Blackwell.
10. Campbell J.R., 2000. Introduction to remote sensing, Springer.

**REFERENCES**

1. David L. Verbyla “Satellite Remote sensing of Natural Resource Management”, Lewis publishers, Florida
2. Image Analysis, Classification and change Detection in Remote Sensing – Mortan J.Century ,Taylor and Francis, 2007.

**GST – 2.6 – GIS ANALYSIS & APPLICATIONS**

**Unit I: Spatial Analysis**

**Spatial analysis:** Introduction, Analysis framework, defining spatial characteristics, working with higher level objects, measuring polygons, measuring shape, measuring distance

**Classification**: Classification Principles, Reclassification Elements, Neighborhood Functions, Polygonal Neighborhoods, Buffers

**Statistical Surfaces**: Surfaces, surface mapping, sampling the statistical surface, DEM, Raster surfaces, interpolation- methods, Uses, Weighted Analysis,

**Unit II: Spatial Arrangements:**

**Spatial Arrangements**: Point patterns, Thiessen Polygons, Area patterns, linear patterns, Directionality and continuity of linear and aerial objects, Gravity model, Routing and Allocation, missing variables, Overlay and types

**Unit III: Natural Resource Applications:**

**Forest management**: Forestry: Resource Inventory, Forest Fire Growth modeling – Wild life management.

**Land:** Land use Planning, Watershed Management studies, Identification of Ground Water Recharge zones , Resource Information System.

**Unit IV: LIS, Utilities & LBS Applications:**

**LIS:** Land Information System (LIS) - Tax mapping - Other LIS applications.

Utilities applications: Water - Electric & Telecommunication.

**LBS:** Location Based Services Applications (LBS): Automatic Vehicle Location (AVL) - Components of AVL: In Vehicle Equipment, Various Communication Channels, Web Server, Client - Vehicle Tracking - Alarms used in Vehicle Tracking, Fleet Management - Vehicle Navigation - Emergency Call: Address Geocoding, Distress Call Application

**Unit V**: **Health & Environment Applications:**

**Health applications:** Disease Surveillance, Health Information System - 3D GIS.

**Environment:** Planning & Policy - Water Pollution - Air Pollution –Noise Pollution -Climate Change.

**REFERENCES:**

1. Laura Lang, Managing Natural Resources with GIS, ESRI Press,1998.
2. Uzair M.Shamsi, U.M.Shamsi GIS Tools for Water, Wastewater and Stormwater Systems, Asce Press, 2002.
3. Alan L., MD Melnick, Introduction to Geographic Information Systems for Public Health, Aspen Publishers, 1st Edition,2002.
4. Amim Hammad, Hassan karimi, Telegeoinformatics: Location-based Computing and Services, CRC Press, 1st Edition,2004.
5. Paul A Longley, Michael F Goodchild, David J Maguire, David W Rhind, Geographical Information Systems, Volume I and II, John Wiley and Sons, Inc., 1999
6. Van Dijk M.G.Bos, GIS and Remote Sensing Techniques in Land-And-Water\_Management, Kluwer Academic Publishers, 2001
7. Laura Lang, GIS for Health Organizations, ESRI Press, 2000
8. Lisa Godin, GIS in Telecommunications Management, ESRI Press, 1st Edition, 2001.
9. Websites.

**GST– [ELECTIVE 1]**

**ADVANCED DIGITAL IMAGE PROCESSING**

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2. John A.Richards, Springer-Verlag, “Remote Sensing Digital Image Analysis” 1999.
3. Rafael C.Gonzalez, “Digital Image Processing (2nd Edition)”, Prentice Hall, 2002.
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6. Gao J., 2009, Digital analysis of Remote Sensely Imagery.Mc Graw Hills
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10. Campbell J.R., 2000. Introduction to remote sensing, Springer.

**REFERENCES**

1. David L. Verbyla “Satellite Remote sensing of Natural Resource Management”, Lewis publishers, Florida
2. Image Analysis, Classification and change Detection in Remote Sensing – Mortan J.Century ,Taylor and Francis, 2007.

**GST - [ELECTIVE 2] - INTERNET GIS**

**Unit I: Introduction to Distributed Internet GIS:**

Introduction, Distributed GIS – Basic components, Applications. Networking**:** Network environment protocols, (TCP/IP, LAN, WAN, Data exchange b/w 2 terminals ……..).

**Unit II: Client/Server Computing:**

Client, server, glue, client-server system partition, 2-tier, 3-tier & n-tier architectures, advantages & disadvantages of client-server architecture.

**Unit III: Distributed Component Framework:**

Introduction to Microsoft .NET framework: arrays, operators, flow control statements, functions and properties, collection and generics. Getting started with ASP.NET, Error handling, debugging and tracking ASP.NET.

DCOM and .NET, DCOM Architecture and Interface, Advantages & disadvantages of DCOM, CORBA, CORBA Architecture and Interface, advantages & disadvantages CORBA.

**Unit IV: Web Services in GIS Domain:**

ADO.NET programming objects and architecture, connected model (command objects), disconnected model (data sets).

Interoperability in GIS, OGC and its specifications, OGC specifications for GIS web services (WMS, WFS, WCS, WPS, SLD etc) Google Earth, KML Virtual Earth & Bhuvan.

**Unit V: Web Mapping:** Static map publishing, clickable maps, architecture of static web publishing, web mapping architecture

Client -HTML viewer, HTTP server with CGI, Map server & other server, side applications, Web-Mapping options & objects, Web mapping applications.

**TEXT BOOK**

**Internet GIS –** “Distributed Geographic Information Services for Internet and Wireless Networks” – by Zhong-ren peng and Ming- Hsiang Tsou

**GST– [ELECTIVE 3] - DISASTER MANAGEMENT**

**Unit I : Geologic Hazards:**

Earthquake, landslide: Meaning and types of disasters – earthquakes and Tsunamis – volcanoes – landslides – selection of variables – creation of GIS layers – space-time analysis – commissions and boards-case studies.

**Unit II: Floods and Cyclones:**

cyclone related parameters and effects on land and sea – Life cycle, Classification, movement & Cyclone intensity, Flooding: topography, land use and flooding – space-time integration – GIS based parameters and layers – flood prone area analysis and management – risk assessment – commissions and boards, Soil erosion – coral / mangrove depletion – forest fire-mining – overlay analysis – GIS modeling – case studies.

**Unit III : Drought and Desertification:**

Types of droughts – factors influencing droughts – variable identification – vegetation index – land use /ground water level changes – delimiting drought prone areas – processes of desertification – over utilization of water and land resources layer creation – GIS based management strategies – case studies.

**Unit IV: Anthropogenic Disasters & Marine Disasters:**

Atmospheric Disasters: Ozone layer depletion – green house / global warming – acid rain – snow melt – sea level rise – related problems layer creation – coastal erosion and deposition – parameters/factors identification – over lays – analysis / management strategies – commissions and boards -case studies.

**Unit V: Ecology related Disasters & Decision support system:**

Ecological degradation – nuclear disaster and biodiversity loss – parameters (mapping of forest types, protected areas and natural forests) – habitant loss – conserving bio-diversity (species and subspecies).

**Text Books:**

1. Babar, Md.: Environmental Changes and Natural Disasters, New India Publishing Agency, 2007

2. D.B.N. Murthy – Disaster Management – Deep and Deep Publication, 2008

3. GIS and Emergency Management in Indian Ocean Earthquake/ Tsunami Disaster, An ESRI® White Paper, 2006

4. Orhan, R. Backhaus, P. Boccardo, S. Zlatanova (eds.), Geoinformation for Disaster and Risk Management Examples and Best Practices, Joint Board of Geospatial Information Societies and United Nations Office for Outer Space Affairs, Denmark, 2010.

**References:**

1. Korte, G. B., (2001) the GIS book: 5th edition, Onward Press, Australia. Barett, E.C. and Anton Micallef (Editors),[1991]. Remote Sensing for Hazard Monitoring and Disaster Assessment, Taylor and Francis, London.
2. Anji Reddy, M., (2001) Remote Sensing and Geographical Information Systems., 2nd edition, BS Publications, Hyderabad.
3. Demers, Michael N., (2000) Fundamentals of Geographic Information Systems, John Willey and sons. Inc. New York.

**GST – 2.7 – GST LAB –II (GIS LAB)**

1. Map Scanning & Geo referencing
2. Map Reading: Topomap, Satellite Image, Aerial Photos, Watershed Atlas
3. Image Interpretation for base map preparation
4. Preparation of Drainage Maps
5. Preparation of Slope maps
6. Preparation of Watershed Maps
7. Preparation of Land Use/Land Cover Maps
8. Change Detection and Map updation.
9. Hands on pocket and Mirror Stereoscope.

 10. Surveying with Total Station, GPS & DGPS

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