**ACADEMIC REGULATIONS, COURSE STRUCTURE AND**

**DETAILED SYLLABUS**

**M.Tech. Program**

**In**

 **SPATIAL INFORMATION TECHNOLOGY**

**CENTRE FOR SPATIAL INFORMATION TECHNOLOGY**

**Institute of Science & Technology**

**2015**



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

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

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

**M.TECH (SIT) 2015**

**I YEAR, I SEMESTER**

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

**Electives\*:**

1. Web Technologies

2. Concepts of big data – Geo statistics

3. Object oriented concepts and Spatial Databases

## I YEAR, II SEMESTER

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

**Electives\*:**

1. Visual C#.NET
2. Mobile GIS technologies and applications
3. Geospatial tools and customization
4. Remote Sensing and GIS for Urban infrastructure & Utilities Planning and 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** |

**SIT – 1.1- 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

1. Anil K. Jain .Fundamentals of Digital Image Processing. Prentice Hall Publications, USA.
2. Image Analysis, Classification and change Detection in Remote Sensing . Mortan J.Century Taylor and Francis, 2007.

**SIT – 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.
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. 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.

**SIT– 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 GISby P.A. Burrough and Rachael Mc Donnell
3. Principles of Geographical Information Systems for Land Resources Assessmentby P.A. Burrough
4. Database System conceptsby HENRY F. KORTH, Abraham Siberschatz et.al., Mc Graw Hill
5. Database Management Systemsby 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.
2. Basic Readings in Geographic Information System – Marble, D.F and Calkins, H.W – Spad Systems Ltd.
3. Database Management Systems by P.Radha Krishna HI-TECH Publications 2005.

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

**REFERENCE**

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.

**SIT- [ELECTIVE 1] - WEB TECHNOLOGIES**

**Unit - I: Introduction to Web Technologies and Web 2.0**

Introduction to client server systems, HTTP protocols, Common tags in HTML: List, Tables, Forms, Frames, Images, Links and Addressing, Cascading Style Sheet (CSS).

 XML: Comparative study of XML and HTML, Document Type Definition, Schema, Parsers (Dom and SAX).

Introduction to JavaScript, JavaScript objects, programming using java script if-else, switch, popup box, while loop, for loop, event handling.

Introduction to Web 2.0, Data and Web 2.0, Convergence, Web Services: SOAP, JSON, Building Rich Internet Applications with AJAX, Servlets.

**Unit - II: HTML5&CSS3**

HTML5 Document Structure Changes, Forms, Form elements, Video and Audio, Semantic elements, Structural elements.

Introduction to CSS3, Style inclusion methods, selectors, properties, fonts, colors.

**Unit - III: Introduction to Microsoft .NET framework**

Introduction to Microsoft .NET framework: arrays, operators, flow control statements, functions and properties, collection and generics. Getting started with ASP.NET – web forms, controls-web form validation, website navigation, enhancing websites using master pages.

**Unit - IV: .NET framework and web services**

Web services and .NET framework(exposing web services, consuming web services, .NET remoting, namespace, web service architecture), ADO.NET programming objects and architecture, connected model (command objects), disconnected model (data sets), introduction to LINQ.

**Unit - V: Working with GeoServer and OpenLayers**

Introduction to map server and web server, map file concept and format, geographic data formats.

OpenLayers: Understanding OpenLayers Syntax, Layers, Controls, Formats, Overlays, Styling. Geoserver: Publishing data in GeoServer, Different types of Services: WMS, WFS,WCS.

**TEXT BOOK**

1. The Complete Reference: HTML and CSS, 2nd & 5th Editions by Thomas A. Powel, McGraw Hill.
2. JavaScript 2.0 Complete Reference, 2nd Edition by Thomas A. Powel, McGraw Hill.
3. Ajax: The Complete Reference – Thomas A. Powel, McGraw Hill, 2008.

**REFERENCES**

1. Professional AJAX – Nicholas C Zakas et al, Wrox publications, 2006.
2. Pro  ASP.Net 4 in C# 2010 by Mathew MacDonald, Adan Freeman (paperback).
3. Beginning ASP.net 4: in C# & VB (Wrox programer to programmes by Ima Spanjaars (paper back).
4. An Introduction to Web design and programming, Wang, Thomson.
5. [Beginning MapServer, Opensource GIS Development](http://www.apress.com/book/bookDisplay.html?bID=443), by Bill Kropla.

**SIT- [ELECTIVE 2] – CONCEPTS OF BIG DATA – GEO STATISTICS**

**Chapter I: Introduction to Big Data**

 Introduction to big data, Challenges in big data, Structured and Unstructured data, V3 concepts, general statistical concepts and principles.

**Chapter II: Hypothesis testing and Regression**

Hypothesis testing: a comparative list of many statistical tests, multiple testing, causal inference.

Regression: Linear regression (model and interpretation; model fitting; model diagnosis), Logistic regression, local polynomial regression.

 **Chapter III: Classification, Dimension Reduction and Regularization**

Classification: Bayes rule, linear, quadratic, and mixture discriminant analysis, nearest neighbor classifier, classification and regression tree, separating hyperplanes.

Dimension reduction:principal components analysis, canonical analysis, multi-dimensional scaling, supervised dimension reduction.

Regularization:general form of loss + regularization, L2 regularization, L1 regularization and its variants (Lasso; adaptive Lasso; least angle regression; elastic net; Dantzig selector; sure independence screening, Other regularizations (L∞; fussed Lasso, etc).

 **Chapter IV: Big data representation, computation and visualization**

Basis expansion and kernel methods: splines, wavelets, reproducing kernel Hilbert space, kernel methods: support vector machines; kernel logistic regression; kernel principal components analysis.

 Additive models: generalized additive models, multivariate adaptive regression splines, boosting, neural networks, random forest.

 Unsupervised and semi-supervised learning: association analysis and market basket problem, clustering (hierarchical clustering; k-means; model-based clustering, factor analysis, Google’s PageRank algorithm, semi supervised learning.

**Chapter V: Networks and graphical models**

concepts about networks, network models, modeling of the vertex attributes (Markov random fields; nearest neighbor prediction; kernel method; kriging), modeling of the links (informal scoring; association networks; random graph models), networks clustering and community detection, data storage(Hadoop), retrieval and computing (Map Reduce) for big data.

Recommendation system: the Netflix challenge, content based recommendation, collaborative filtering, Google’s Adwords problem, bandits and dynamic treatment regime.

**TEXT BOOK**

1. An Introduction to Statistical Learning, by James, Witten, Hastie, and Tibshrani. However, it takes a very different approach from us and only partially overlaps on material.

**REFERENCES**

1. Elements of Statistical Learning by Hastie, Tibshrani, and Friedman
2. Pattern Recognition & Machine Learning by Bishop and (the encyclopedic) Machine Learning by Murphy.

**SIT- [ELECTIVE 3] - OBJECT ORIENTED CONCEPTS AND SPATIAL DATABASES**

**Unit - I: Getting started with OOPs concepts**

Principles of object oriented programming, Beginning with C++, Tokens, Expressions and control structures, Functions in C++, Classes and objects.

Constructors and Destructors, Operator Overloading, Type Conversions, Inheritance, Pointers, Virtual functions and Polymorphism.

Managing console I/O operations, working with files, Templates, exception handling, manipulating strings.

**Unit - II: Introduction of JAVA**

Principles of object oriented programming, The Genesis of Java, an overview of Java, Comparative study of C++ and JAVA: Data types variables and arrays, operators, control statements, methods and classes, inheritance. Packages and interfaces, exception handling.

**Unit - III: Some Advanced Concepts of JAVA**

Multithreaded programming, I/O, Applets, string handling, input/outputs, Applet class, event handling, AWT, AWT controls, Layout managers and menus.

**Unit – IV: Introduction to Spatial Databases**

Introduction to Spatial databases, Spatial Concepts and Data Models, Spatial data standards, metadata, Spatial Query Languages: SQL3, OGIS, Spatial Storage and Indexing: R-tree, Grid files, Query Processing and Optimization: Strategies for range query, nearest neighbor query, Spatial joins (e.g. tree matching), cost models for new strategies, impact on rule based optimization.

**Unit – V: Working with Spatial Databases**

Introduction to PostGIS, Creating and loading Spatial databases, Representation of Spatial features – point, line, area, Spatial Queries, Spatial Relationships, Spatial Joins, Spatial Indexing, Working with buffers, clusters.

**TEXT BOOK**

1. Programming in C++ byBalaguruswamy, 4th edition, Tata McGraw Hill Education Pvt. Ltd.
2. Java: The Complete Referenceby Herbert Scheldt McGraw-Hill, 2011.
3. Spatial Databases : A Tour By Shashi Shekhar and Sanjay Chawla.
4. Manual of PostGIS from *http://postgis.net/docs/manual-2.1/*

**REFERENCES**

1. C++ Primer plus by Stephen Prata, 6th edition, Person education.
2. Problem Solving in C++, The OOP by W.Savitch 4th edition, Pearson education.
3. Object Oriented Analysis and Design with Applications by Grady Booch, 2nd edition, Pearson education.
4. Schaum's Outline of Programming with C++ by John R. Hubbard, 2nd edition, Mcgraw Hill.
5. Spatial Databases: with application to GIS By Philippe Rigaux, Michel Scholl, and Agnes Voisard.
6. GIS A Computing Perspective, Taylor and Francis By M.R. Worboys.

**SIT – 1.7 – SIT LAB –I (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. Surveying with GPS & DGPS.
10. Programming in C++ / Java, C#.

**SIT – 2.1 – 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.

**SIT – 2.2 – SATELLITE GEODESY**

**Unit – I:** **Fundamentals**

Reference coordinates systems, Time, Signal Propagation.

**Unit – II: Satellite Orbital Motion**

Fundamentals of Celestial Mechanics, Two-Body Problem, Satellite Orbits and Constellations.

**Unit – III: GPS Fundamentals & Receivers, Observables**

Space segment, Control segment, Observation principle and signal structure, Orbit determination and representation, Intentional limitation of the system accuracy, system development.

Receiver Concepts and main receiver components, Examples of GPS receivers**:** Classical receivers, Geodetic receivers, Navigational and Handheld receivers, Future developments. Code and carrier phases

**Unit – IV: Data Processing & Error Budget Corrections:**

Parameter Estimation, Data Handling, Adjustment Strategies and software Concepts. Concepts of Rapid methods with GPS, Navigation with GPS.

Basic considerations, Satellite geometry & Accuracy measures, Orbits and clocks, Signal propagation, Receiving System, Issue of integrity.

**Unit – V: Permanent reference Networks & Applications**

DGPS, RTK GPS and Multiple reference Stations.

Geodetic control surveys, Geodynamics Height Determination, Cadastral Surveying, GIS, Fleet Management, Marine navigation & geodesy, Airborne GPS.

**TEXTBOOK**

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 by Guocheng Xu” Springer-Verlag, 2003.

**SIT – 2.3 – REMOTE SENSING APPLICATIONS**

**Unit - I: Geosciences Applications**

Geological & Geomorphologic 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: Land use Applications**

Concepts of Urban and Regional planning and its applications, urban services and network planning, Urban land use 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**

1. ww2010.atmos.uiuc.edu/(Gh)/guides/rs/sat/goes/home.rxml
2. www.ccrs.nrcan.gc.ca/ccrs/misc/issues/hazards\_e.html#spills
3. www.crisp.nus.edu.sg/~research/research/forest/forest.html
4. www.cr.usgs.gov/earthshots/slow/tableofontents
5. www.indiana.edu/~climate/336/rsdata.html
6. www.nrsa.gov.in/engnrsa./spacesolutions/index.html
7. www.unn.ac.uk/~evgpl/eog/rsguide/rsguide.htm
8. www. terraweb.wr.usgs.gov/coastal.html

**SIT 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 Storm water 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.

**SIT – [ELECTIVE 1] – VISUAL C#.NET**

**Unit I: Dot NET Frame Work & C#.NET Language Basics:-**

.NET frame Work main Objectives, Introduction to the .NET platform, Common Language Run Time (CLR), .NET Frame work Compactable Languages, Frame work Class Library (FCL)

C#.NET Language Basics-Working with Data Types **-**Type Conversion, Boxing & Unboxing, Conditional Statements (if, switch condition), Looping Arrays, Enumerations

**Unit II: Objects Oriented Programming**

 OOPs Concepts, Encapsulation, Inheritance, Polymorphism, Class and Object- Constructors & Destructors, Dynamic types, Static method and Static classes, Method of overloading, overriding, sealed classes, Partial Classes & Methods.

**Unit III: Data Base Programming (ADO.NET)**

ADO .NET Introduction, Working with ADO.NET, OleDB connection & command class, Data Providers in .Net. Data Readers- Dataset and Data Adapters, Managed and Unmanaged Providers, Data grid View with DML operations, working with ODBC Concept - Stored Procedures and Transactions.

**Unit IV: GUI Application Development & Windows Services**

Windows forms and Event Controls.

Windows Services- Service base class, Service Process installer, Service Installer, Creating a Windows Service

**Unit V: Assemblies File Handling & Security in .NET**

Assemblies-Private Assemblies, Shared Assemblies & Global Assembly Cache

File Handling -System .IO namespace, File Stream- Stream Reader, Stream writer.

Security in .NET -Cryptography, Role based security.

**REFERENCES**

1. C# Programming Tutorial by Davide Vitelaru.

Url: http://davidevitelaru.com/tutorials/programming/Lesson%201%20- %20Introduction%20to%20Programming.pdf

# Visual C# .NET Programming

Url: <http://www.homeandlearn.co.uk/csharp/csharp.html>

**SIT – [ELECTIVE 2] – MOBILE GIS TECHNOLOGIES AND APPLICATIONS**

**Chapter I: Introduction to Mobile Platforms**

Introduction to different mobile operating systems: Android, Windows, Symbion, Apple iOS, Blackberry, Bada, Palm OS, Openweb OS, Maemo, Meego and Verdict etc. Introduction to operating system native, third party mobile platforms.

**Chapter II: Mobile Application Development using JQuery Mobile**

Introduction, Creating Buttons, Icons, Popups, Toolbars, Navigation bars, Panels, Collapsibles, Tables, Grids, Lists, List Views, List Content, Filter Items, Forms, Themes. Working with Events, Touch, Scroll and Orientation, Using PhoneGap for platform independence.

**Chapter III: PhoneGap API**

Introduction, Geolocation, Camera, Compass, Accelerometer Contact, Device, Events, Files, Storage.

**Chapter IV:** **Google Maps API and Open Street Maps API**

Introduction, Working with Google Maps API – Map overlays, Map Events, Map controls

Working with Open Street Maps API - Tiles, Layers, Creating first maps, bounding box, search tools.

**Chapter V:** **Mapping with Mobile GIS**

Surveying, inaccuracy, Photographing, mosaic, GCP, Ground truth.

**REFERENCES**

Online resources available in Internet on suggested topic, published research papers, articles and technical manuals, Wikipedia- the free encyclopedia.

**SIT – [ELECTIVE 3] – GEOSPATIAL TOOLS AND CUSTOMIZATION**

**Unit - I: Introduction to Web and Internet GIS:**

Distributed Geospatial Services, Server side Internet GIS, Client side Internet GIS and different web GIS architectures, evolution of web mapping.

**Unit - II: Centralized and Distributed Web GIS Application Framework:**

Introduction to centralized, distributed, enterprise and mobile GIS applications, database servers in enterprise environment, web service framework, XML, SOAP and other web service standards .

**Unit - III: Web Services in GIS Domain:**

Interoperability in GIS, OGC and its specifications, OGC specifications for GIS web services (WMS, WFS, WCS, WPS, SLD etc)

GIS Servers –commercial (Arc GIS Server) and open source (UMN Map Server, Geo-server), OGC GML and metadata standards, Quality of web GIS Service and Security issues in Distributed GIS.

**Unit - IV: Web mapping application development tools:**

Introduction to HTML, JavaScript, PHP, .Net framework for web applications, web GIS API (Open Layer or Arc GIS), EPSG and Proj4 libraries, XML and GML schema creation, OGC web service publishing and consuming (WMS, WFS and WCS), SLD creation.

Data querying, processing and analysis in multi-user environment, introduction to AJAX, Web 2.0, 3D web geo-visualizations and Semantic web service. Data security, performance tuning for web mapping application.

**Unit - V: Web Mapping Services & Open Source GIS Software:**

Spatial data infrastructure- NSDI, Distributed geo-processing, spatial decision analysis in web GIS environment, OGC WPS, Symantec web

Architectures and Database connections, GRASS, POST GRE SQL, JUMP, etc.

**TEXT BOOKS**

1. Network GIS- Yang, Chaowei, Wong, David W.S., Kafatos, Menas, ISBN: 978-3-540-36768-0.
2. Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks- Zhong-Ren Peng and Ming-Hsiang Tsou John Wiley and Son Inc.
3. Distributed GIS- Frederic P. Miller, Agnes F. Vandome and John McBrewster, ISBN: 6130275595.

**SIT – [ELECTIVE 4] REMOTE SENSING AND GIS FOR URBAN INFRASTRUCTURE**

 **AND UTILITIES PLANNING AND MANAGEMENT**

**Unit 1: Concepts and Introduction to Urban Infrastructure and Utilities**

Concept and importance of Urban Planning and Development, Understanding URDPFI & Town Planning Guidelines on Key features of Urban Infrastructure & Utilities / Amenities , Urban Infrastructure Schemes / Projects, Urban Land use Zoning Regulations.

**Unit 2: Urban Amenities**

 Transport - Roads & Bridges, Metro Rail Corridors , Water / Gas Pipelines , Sewerage & Strom Water Drainage drains , Electricity & Telecommunication lines , Airports , Solid Waste / Landfill Sites , Treatment Plants : STP / ETP's , Parking Areas and others .

**Unit 3: Use of geospatial technologies**

Use of Remote Sensing Data / Ground Data & GIS Techniques in Physical Infrastructure Surveys Mapping & Planning , Use of 3D City Models , GPS , Total / Smart Station , Ground Penetrating Radar ( GPR ) , HRSI , ALTM , UAV's/ brones , Mobile Mapping & Services , GIS in Network Routing Analysis & Connectivity , Utility Mapping using GIS , Location Suitability Analysis for Urban Utilities , Proximity and Threshold Analysis.

**Unit 4:Application and case studies**

Application based Case Studies examples from Metros and Municipalities ; Cost Benefit of using different Geospatial Technologies ; Monitoring of Urban Infrastructure / Utilities ; Information Systems / Web GIS ; Emerging and New Applications in Infrastructure / Utilities Studies .

**Unit 5: Urban environment and modeling**

Urban design, urban spaces, urban conservation, levels of planning and steps for preparation of town plan and techniques, rainwater harvesting structure in urban area , urban environmental issues, urban and transport policies, urban/ infrastructure project in program, urban stimulation modeling.

**Texts/ references:**

1. Peter Hall, urban and regional planning, routledge,4th edition,2002
2. K.V. Sundaram, urban and regional planning in India, Vikas pub. House , fifth Edition, 1977
3. Peter Hall and M.tewdwr-jones, urban and regional planning, Routledge, fifth edition,2010

**SIT – 2.7 –SIT LAB – II (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
15. Introductory Lab work in digital Photogrammetry

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