**ANNA UNIVERSITY, CHENNAI**

**UNIVERSITY DEPARTMENTS**

**REGULATIONS – 2015**

**CHOICE BASED CREDIT SYSTEM**

**M.E. REMOTE SENSING AND GEOMATICS**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

I. To prepare students to excel in research or to succeed in Remote Sensing and Geomatics profession through global, rigorous post graduate education.

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve Remote Sensing and Geomatics problems.

III. To train students for gaining knowledge on concepts and applications leading to modelling of earth resources management using Remote Sensing and Geomatics.

IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Remote Sensing and Geomatics issues to broader social context.

V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

**PROGRAMME OUTCOMES (POs):**

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve Remote Sensing and Geomatics problems.
3. Graduate will demonstrate an ability to analyze and interpret data.
4. Graduates will be fully equipped with concepts, methodologies and applications of Remote Sensing and Geomatics Technology.
5. Graduates will demonstrate an ability to visualize and work on multidisciplinary tasks.
6. Graduate will demonstrate skills in handling instruments, software tools, techniques and modeling while using Remote Sensing and Geomatics Technolology.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.

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| Programme Educational Objectives | Programme Outcomes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| I | ✓ | ✓ | ✓ | ✓ | | | | | | |
| II | | | | | ✓ | ✓ | ✓ | | | |
| III | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| IV | | | | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| V | | ✓ | ✓ | ✓ | | | | | ✓ | ✓ |

| | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR 1 | SEM 1 | Statistical methods for Engineers | ✓ | | | | | | | | | |
| | | Optical Remote Sensing | | ✓ | ✓ | ✓ | | | | | | |
| | | Computational Photogrammetry | ✓ | ✓ | ✓ | ✓ | | | | | | |
| | | Spatial Information System | | ✓ | ✓ | ✓ | | ✓ | | | | |
| | | Elective I | | | | | | | | | | |
| | | Remote Sensing and Photogrammetry Laboratory | | ✓ | ✓ | ✓ | | ✓ | | | | |
| | | Spatial Information System Laboratory | | ✓ | ✓ | ✓ | | ✓ | | | | |
| | SEM 2 | Satellite Image Processing | ✓ | ✓ | ✓ | ✓ | | | | | | |
| | | Microwave Remote Sensing | ✓ | ✓ | ✓ | ✓ | | | | | | |
| | | Programming for Spatial Data Processing | ✓ | ✓ | ✓ | ✓ | | | | | | |
| | | Elective II | | | | | | | | | | |
| | | Elective III | | | | | | | | | | |
| | | Satellite Image Processing Laboratory | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| | | Microwave Remote Sensing Laboratory | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| YEAR 2 | SEM 1 | Elective IV | | | | | | | | | | |
| | | Elective V | | | | | | | | | | |
| | | Elective VI | | | | | | | | | | |
| | | Industrial Training (2 weeks) | | | | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| | | Project Work Phase I | | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| | SEM 2 | Project Work Phase II | | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ |





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**UNIVERSITY DEPARTMENTS**

**M.E. REMOTE SENSING AND GEOMATICS**

**REGULATIONS – 2015**

**CHOICE BASED CREDIT SYSTEM**

**CURRICULA AND SYLLABI**

**SEMESTER I**

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MA7160 | Statistical Methods for Engineers | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | RG7101 | Computational Photogrammetry | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | RG7102 | Optical Remote Sensing | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | RG7103 | Spatial Information System | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | |
| 6. | RG7111 | Remote Sensing and Photogrammetry Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 7. | RG7112 | Spatial Information System Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **24** | **16** | **0** | **8** | **20** |

**SEMESTER II**

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | RG7201 | Microwave Remote Sensing | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | RG7202 | Programming For Spatial Data Processing | FC | 5 | 3 | 2 | 0 | 4 |
| 3. | RG7203 | Satellite Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | | Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | | Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | |
| 6. | RG7211 | Microwave Remote Sensing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 7. | RG7212 | Satellite Image Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **25** | **15** | **2** | **8** | **20** |

**SEMESTER III**

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | | Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective VI | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | |
| 4. | RG7311 | Industrial Training (2 weeks during summer vacation at the end of Semester II) | EEC | - | 0 | 0 | 0 | 1 |
| 5. | RG7312 | Project Work (Phase I) | EEC | 12 | 0 | 0 | 12 | 6 |
| | | | **TOTAL** | **21** | **9** | **0** | **12** | **16** |

**SEMESTER IV**

| Sl.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICAL** | | | | | | | | |
| 1. | RG7411 | Project Work (Phase II) | EEC | 24 | 0 | 0 | 24 | 12 |
| | | | **TOTAL** | **24** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS: 68**

## FOUNDATION COURSES (FC)

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Statistical methods for engineers | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | | Programming for Spatial Data Processing | FC | 5 | 3 | 2 | 0 | 4 |

## PROFESSIONAL CORE (PC)

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Optical Remote Sensing | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | | Computational Photogrammetry | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | | Spatial Information System | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | | Remote Sensing and Photogrammetry Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 5. | | Spatial Information System Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 6. | | Satellite Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 7. | | Microwave Remote Sensing | PC | 3 | 3 | 0 | 0 | 3 |
| 8. | | Satellite Image Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | | Microwave Remote Sensing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |

## PROFESSIONAL ELECTIVES (PE)

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | RG7001 | Airborne and Terrestrial Laser Scanning for Large Scale Mapping | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | RG7002 | Disaster Management and Geomatics Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | RG7003 | Electronic Surveying | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | RG7004 | Geodesy | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | RG7005 | Geomatics in Environmental Monitoring and Modelling | PE | 3 | 3 | 0 | 0 | 3 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6. | RG7006 | Open Source Software for Geomatics | PE | 4 | 2 | 2 | 0 | 3 |
| 7. | RG7007 | Planetary Remote Sensing | PE | 3 | 3 | 0 | 0 | 3 |
| 8. | RG7008 | Remote Sensing and Geomatics for Agriculture and Forestry | PE | 3 | 3 | 0 | 0 | 3 |
| 9. | RG7009 | Remote Sensing and Geomatics for Urban Planning and Management | PE | 3 | 3 | 0 | 0 | 3 |
| 10. | RG7010 | Satellite Meteorology | PE | 3 | 3 | 0 | 0 | 3 |
| 11. | RG7011 | Soft Computing Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 12. | RG7012 | Spatial Data Modelling | PE | 3 | 3 | 0 | 0 | 3 |
| 13. | RG7013 | Thermal and Hyper Spectral Remote Sensing | PE | 3 | 3 | 0 | 0 | 3 |
| 14. | RG7014 | Web Technology Programming for GIS | PE | 4 | 2 | 2 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Industrial Training (2 weeks during summer vacation at the end of Semester II) | EEC | - | 0 | 0 | 0 | 1 |
| 2. | | Project Work (Phase I) | EEC | 12 | 0 | 0 | 12 | 6 |
| 3. | | Project Work (Phase II) | EEC | 24 | 0 | 0 | 24 | 12 |

**MA7160 STATISTICAL METHODS FOR ENGINEERS L T P C**
**4 0 0 4**

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few statistical methods and apply them to various engineering problems.

**UNIT I ESTIMATION THEORY 12**

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.

**UNIT II TESTING OF HYPOTHESIS 12**

Tests based on Normal, t, $X^2$ and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

**UNIT III CORRELATION AND REGRESSION 12**

Multiple and Partial Correlation - Method of Least Squares- Plane of Regression - Properties of Residuals - Coefficient of Multiple Correlation - Coefficient of Partial Correlation - Multiple Correlation with total and partial correlations - Regression and Partial correlations in terms of lower order coefficients.

**UNIT IV DESIGN OF EXPERIMENTS 12**

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

**UNIT V MULTIVARIATE ANALYSIS 12**

Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

**TOTAL : 60 PERIODS**

**OUTCOME:**

- It helps the students to have a clear perception of the power of statistical ideas, tools and would be able to demonstrate the applications of statistical techniques to problems drawn from industry, management and other engineering fields.

**REFERENCES:**


1. Johnson, R. A. and Gupta, C. B., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, Seventh Edition, 2007.
2. Devore, J.L., “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, Fifth Edition, 2002.
3. Johnson, R.A., and Wichern, D.W., “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Sixth Edition, 2007.
4. Gupta, S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, 2002.
5. Spiegel, M.R. and Stephens, L.J., ”Schaum’s outlines,-Statistics”, Tata McGraw-Hill, Third Edition, 2000.
6. Freund, J.E., “Mathematical Statistics”, Prentice Hall of India, Fifth Edition, 2001.

**RG7101** **COMPUTATIONAL PHOTOGRAMMETRY** **L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To introduce basics and concepts of aerial photography, acquisition and mapping from aerial photographs using different types of stereo plotters

**UNIT I INTRODUCTION TO PHOTOGRAMMETRY 9**

Principles - Stereoscopic depth perception – aerial photo-aerial camera -Scale – overlaps – stereoscopy – concepts – viewing and measuring system – principle of floating mark – methods of parallax measurement – vertical photographs – geometry, scale, parallax equations, planimetric mapping – Tilted photograph – Geometry, Coordinate system, Scale, Planimetric mapping

**UNIT II TRANSFORAMTIONS 9**

Coordinate systems for Photogrammetry - Map projections, Datums and conversions- 2D Coordinate transformations-Collinearity and Space resection-Analytical stereomodel and relative orientation- Three dimensional Coordinate transformations

**UNIT III PHOTOGRAMMETRY AND MAPPING 9**

Concepts of interior, relative, absolute orientation – direct georeferencing – object, image relation - collinearity and coplanarity conditions – effect of orientation elements - Elements and principles of Aerotriangulation – Independent Models-Simultaneous bundle adjustment - ortho mosaic

**UNIT IV DIGITAL IMAGE HANDLING 9**

Digital cameras- CCD camera- full frame, frame transfer, interline CCD camera - Time delay integration- spectral sensitivity of CCD sensor – geometry and radiometry problem of CCD image - Image Generation - Data Compression - formats – Georeferencing - Stereo viewing - Display modes - image matching techniques - Image measurements.

**UNIT V DP PROCEDURES AND APPLICATIONS 9**

Review of space resection & intersection - Automatic tie point generation - Automatic Block triangulation, feature collection and plotting–DEM Generation - accuracy of DEMs, Orthorectification - regular & irregular data collection methods - contour generation - watershed delineation - Satellite Photogrammetry principles – missions - stereo image products.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall

- Acquire knowledge about photogrammetry principles, methods and products generation strategies in both Analytical and digital photogrammetry system.
- Understand the problem related to generation of products and solving them.

**REFERENCES:**


1. Paul R.Wolf, Elements of Photogrammetry, McGraw-Hill Science, 2001, ISBN 0070713464, 9780070713468
2. Karl Kraus, Photogrammetry, Fundamentals and standard processes, Dümmler, 2000, ISBN 978 3 11019007 6
3. Micheal Kasser and Yves Egels, “Digital Photogrammetry”, Taylor and Francis, 2002, ISBN 0 748 40944 0
4. Francis h. Moffitt, Edward M. Mikhail, Photogrammetry, TBS The Book Service Ltd, 1968, ISBN 13: 9780700221370
5. Edward M. Mikhail, James S.Bethel, J.Chris McGlone, Introduction on “Modern Photogrammetry”, John Wiley & Sons, Inc., 2001, ISBN 0-471-30924-9
6. Wilfried Linder, “Digital Photogrammetry”-Theory and Applications, Springer-Verlag Berlin Heidelberg New York, 2003, ISBN 3-540-00810-1

**RG7102** **OPTICAL REMOTE SENSING** **L T P C**
**3 0 0 3**

**OBJECTIVE:**

- The objective of this course is to familiarize about the principles of remote sensing ,data acquisition and analysis of satellite data.

**UNIT I PHYSICS OF REMOTE SENSING 9**

Remote Sensing - Defintion - Components - Electro Magnetic Spectrum – Basic wave theory – Particle theory – Stefan Boltzman law - Wiens-Displacement Law - Radiometric quantities - Effects of Atmosphere- Scattering – Different types –Absorption-Atmospheric window- Energy interaction with surface features – Spectral reflectance of vegetation, soil and water –atmospheric influence on spectral response patterns- multi concept in Remote sensing.

**UNIT II PLATFORMS 9**

Orbit elements – Types of orbits – Motions of planets and satellites – Launch of space vehicle – Orbit perturbations and maneuvers – escape velocity - Types and characteristics of different remote sensing platforms – sun synchronous and geo synchronous satellites.

**UNIT III OPTICAL SENSORS 9**

Classification of remote sensors – selection of sensor parameters - resolution concept - Spectral, Radiometric and temporal resolution – Quality of images in optical systems – imaging mode – photographic camera – opto-mechanical scanners – pushbroom and whiskbroom cameras – Panchromatic, multi spectral , hyperspectral scanners – geometric characteristics of scanner imagery - Earth resource satellites operating with optical sensors- Landsat, SPOT, IRS, WorldView

**UNIT IV DATA RECEPTION AND DATA PRODUCTS 9**

Ground segment organization – Data product generation – sources of errors in received data – referencing scheme – data product output medium – Digital products – Super structure, Fast, GeoTIFF, Hierarchical and HDF formats – Indian and International Satellite Data Products – ordering of data

**UNIT V DATA ANALYSIS 9**

Data products and their characteristics – Elements of visual interpretation – interpretation keys – Digital image processing – Preprocessing – Image rectification – Image enhancement techniques – Image classification – Supervised and unsupervised classification algorithms for multispectral and hyperspectral images – Accuracy assessment.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Acquire knowledge about the principles and physics of Remote sensing and data acquisition.
- Get familiarized with various data analysis techniques.

**REFERENCES:**


1. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, VI edition of John Wiley & Sons-2000.
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
3. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 1999.
4. Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
5. Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.

6. Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W.H.Freeman & Co,1978.
7. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Pvt Ltd, Hyderabad, 2003

**RG7103 SPATIAL INFORMATION SYSTEM L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Expose the students with concepts of cartography as major components of input and output related to cartography.
- To provide exposure to data models and data structures in GIS and to introduce various Raster and Vector Analysis capabilities.
- To expose the concept of quality and design of cartographic outputs in open GIS environment.

**UNIT I FUNDAMENTALS OF CARTOGRAPHY AND GIS 9**

Definition of Map - Mapping Organsiation in India- Classification based on Function, Scale, Characteristics – Ellipsoid and Geoid – Co-ordinate Systems - Rectangular and Geographic Coordinates – UTM and UPS - Projection – Function - Types of Map Projections – Transformations – Function - Affine transformation - Choice of Map Projection – Evolution of cartography- Geo-Spatial, Spatial and Non-spatial data – Definition of GIS – Evolution GIS – Components of GIS.

**UNIT II GIS DATA MODELS AND DATA INPUT 9**

Point, Line Polygon / Area, elevation and surface –Tessellations - Attributes and Levels of Measurement - Data Sources – Ground and Remote Sensing survey – Collateral data collection – Input: Map scanning and digitization, Registration and Georeferencing – Concepts of RDBMS - Raster Data Model – Grid – Data Encoding - Data Compression – Vector Data Model – Topological properties – Arc Node Data Structure – Raster Vs. Vector Comparison – File Formats for Raster and Vector – Data conversion between Raster and vector.

**UNIT III RASTER AND VECTOR DATA ANALYSIS 9**

Raster Data analysis: Local, Neighborhood and Regional Operations – Map Algebra – Vector Data Analysis: Topological Analysis, point-in-polygon, Line-in-polygon, Polygon-in-Polygon – Proximity Analysis: buffering, Thiessen Polygon – Non-topological analysis: Attribute data Analysis- concepts of SQL– ODBC

**UNIT IV NETWORK ANALYSIS AND SURFACE ANALYSIS 9**

Network – Creating Network Data - Origin, Destination, Stops, Barriers – Closest Facility Analysis, Service Area Analysis, OD Cost matrix analysis, Shortest Path Analysis – Address Geocoding – Surface Analysis – DEM, DTM - Point data to Surface interpolation – DEM Representaiton - Applications

**UNIT V DATA OUTPUT AND WEB BASED GIS 9**

Map Compilation – Cartographic functionalities for Map Design – Symbolization – Conventional signs and symbols – Spatial Data Quality – Lineage, Positional Accuracy, Attribute Accuracy, Completeness, Logical Consistency - Meta Data – Web based GIS: Definition, Merits - Architecture – Map Server – Spatial Data Infrastructure – Spatial Data Standards

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall

- Acquire knowledge about cartographic principles, spatial data models and spatial analysis.
- Understand the cartographic outputs in open GIS environment.

**REFERENCES:**


1. C.P. Lo, Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006, ISBN-13: 9780131495029
2. Kang-tsung Chang, Introduction to Geographic Information Systems with Data Set CD-ROM, 6th Edition, Mc Graw Hill, 2013, ISBN-10: 0077805402,. ISBN-13: 978-0077805401
3. John Jensen, Ryan Jensen, Introductory Geographic Information Systems, International Edition, Pearson Publishers, 2012, ISBN-10: 0136147763, ISBN-13: 9780136147763


**RG7111 REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVE:**

- This course will facilitate the students to have hands on experience on different steps of visual interpretation of satellite images & photographs and digital interpretation of photographs.

**REMOTE SENSING EXERCISES**

1. Map reading - Survey of India Topo sheets. 4
2. Preparation of Base Map from Survey of India Topo sheets 4
3. Preparation of Land use/land cover map using Satellite Data / Aerial Photograph. 4
4. Preparation and analysis of spectral signatures using handheld spectroradiometer for
   (a) Vegetation 4
   (b) Soil 4
   (c) Water 4

**PHOTOGRAMMETRY EXERCISES**

1. Testing stereovision with test card and Stereoscopic acquity 4
2. Mirror stereoscope- base lining and orientation of aerial photographs 4
3. Use of parallax bar to find the height of point 4
4. Scale of vertical photographs and Photo interpretation 4
5. Orientations using digital photogrammetric workstation 4
6. ATM using small blocks – Part I 4
7. ATM using small blocks – Part II 4
8. DEM,DSM,DTM and Orthogeneration 4
9. Feature Extraction by Stereoplotting and Monoplotting 4

**TOTAL : 60 PERIODS**

**OUTCOME:**

- On completion of this course, the student shall be able to acquire skills to carry out the Lab Exercises independently on visual interpretation of satellite images and digital processing of aerial photographs.

**RG7112 SPATIAL INFORMATION SYSTEM LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- The exercises are designed to give practical exposure to the students to data input, data storage, data analyses and data output capabilities of a standard GIS software.
- It also adds skills in mapping techniques and map outputs.

1. Rectification and Spatial Referencing of Digital Map
2. Onscreen Digitization and Database Creation
3. Projection and Reprojection of spatial data
4. Data Conversion – Vector to Raster, Raster to Vector
5. Populating Attribute data base and querying on attribute data
6. Generation of DEM: from contours, spot heights, GRID and TIN, Isometric mapping
7. Vector Analysis – Buffering, Overlay and Network analysis, flood mapping
8. Raster Analysis – Measurement - Arithmetic overlaying, Logical overlaying, Class interval selection, choropleth maps
9. Map Output - Bar charts, Pie charts and symbols
10. Map compilation
11. Modelling spatial variability
12. Weighted theisson polygon and districting
13. Customisation and scripting

**TOTAL: 60 PERIODS**

**OUTCOME:**

On completion of this course, the student shall be able to

- Acquire skills to carry out the Lab Exercises independently on spatial information system analysis and customisation.

**RG7201 MICROWAVE REMOTE SENSING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To impart the knowledge of Microwave Remote sensing and its applications.

**UNIT I PASSIVE MICROWAVE REMOTE SENSING 9**

Introduction - History, plane waves, antenna systems - Radiometry - Emission laws - Brightness temperature - Antenna temperature - Power - temperature correspondence, interaction with atmospheric constituents – interaction with earth features, Missions - applications.

**UNIT II ACTIVE MICROWAVE REMOTE SENSING 9**

Radar basics - RADAR operation and measurements - Radar frequency bands - Antenna Configuration, SLAR - Imaging Geometry - Resolution Concepts, SAR – Concepts - Doppler principle & Processing System Parameters and fading concepts – SAR focusing, Geometric Distortions, Operational limitations, RADAR energy quantification, Interaction with Earth surface and vegetation , Scattering Models- Surface and volume scattering.

**UNIT III PHYSICS OF MICROWAVES 9**

Light Theory , Wave description of simple harmonic waves - Complex wave description,Energy and power of waves – Brightness or Intensity – Polarization property of Microwaves – Wave equation for polarized waves, Wave combination – Interference- Coherence, Phase as a relative distance measure – Interference pattern – Fraunhofer criterion, Microwave propagation – Maxwell equation - Signal loss through lossy media.

**UNIT IV PLATFORMS, SENSORS AND DATA PROCESSING 9**

Airborne, Space borne and Indian missions, Modes of Acquisition, Data products and selection procedure, SAR Image Processing software - Measurement and discrimination – Header extraction – Slant range to ground range – Multi-looking from SLC – Filtering technique - Geometric correction, Factors affecting geometrical correction – Backscattering coefficient – speckle processing – Image Interpretation, SAR Image Fusion.

**UNIT IV SPECIAL TOPICS 9**

Polarimetry, interferometry, Altimetry, Scatterometry – Principles – Data & Resource availability – Principle & Applications in Agriculture, Forestry, ocean, Geology, Hydrology, cryospace studies, landuse mapping and ocean related studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**On completion of this course, the student shall be able to**

- Understand concepts of passive and active microwave system
- Gain knowledge in the principles of Microwave image analysis and interpretation
- Understand the various application domains of microwave satellite data
- Gain exposure to Interferrometry and Polarimetry concepts

**REFERENCES:**


1. Ulaby,F.T.,Moore,K.R. and Fung, Microwave remote sensing vol-1,vol-2 and vol-3, Addison - Wesley Publishing Company, London,1986.
2. Floyd.M.Handerson and Anthony, J.Lewis “Principles and applications of Imaging RADAR”, Manual of Remote sensing, 3rd edition, vol.2, ASPRS, Jhumurley and sons, Inc, 1998.
3. Philippe Lacomme,Jean clande Marchais,Jean-Philippe Hardarge and Eric Normant, Air and spaceborne radar systems - An introduction, Elsevier publications 2001.
4. Iain H.woodhouse, Introduction to microwave remote sensing, 2004, CRC Press; 1st edition,ISBN-13: 978-0415271233
5. Roger J Sullivan, Knovel, Radar foundations for Imaging and Advanced Concepts, SciTech Pub, 2004.
6. Ian Faulconbridge, Radar Fundamentals, Argos Press, 2002.
7. Eugene A.Sharkov,Passive Microwave Remote Sensing of the Earth: Physical Foundations, Springer, 2003.


**RG7202 PROGRAMMING FOR SPATIAL DATA PROCESSING L T P C**
**3 2 0 4**

**OBJECTIVE :**

- The objective of the course is to make the students to understand the concepts of OOPS, C++ Programming,MATLAB, IDL and VISUAL BASIC

**UNIT I CONCEPTS OF OOPS AND INTRODUCTION TO C++ 9+6**

Abstract Data types – Inheritance – Polymorphism – Object Identity – Object Modeling – Object Oriented Programming Languages –– Object Oriented Analysis – Object Oriented Design – Introduction to C++ - Keywords, Identifiers – Data types – Variables – Operators – Manipulators – Operator Overloading – Operator Precedence – Control Statements – Functions – Call by Reference – Arguments – Function Overloading – Exercises

**UNIT II C++ PROGRAMMING 9+6**

Classes and Objects – Member Functions – Private and Public Member function – Nesting of Member Functions – Array of Objects – Pointer to Members – Constructors – Destructors – Type Conversions - Inheritance – File Modes – File Pointers – Random Access – Error Handling - Exercises

**UNIT III PROGRAMMING USING MATLAB 9+6**

Basics- Syntax, operators, data types, array indexing and manipulation - Two and three-dimensional plots, images, animation, visualization - Program files, control flow, editing, debugging – GUI Building

**UNIT IV PROGRAMMING USING IDL 9+6**

Introduction – The IDL interface – data types –constants, arrays – Creating batch process – IDL Statements - Contour –surface plot – Mapping

**Unit V GIS CUSTOMISATION PROGRAMMING USING VISUAL BASIC 9+6**

Accessing databases with the Data Controls – ADO Object Model – ODBC and data access Objects – ODBC using DAO and Remote Data Objects – Data Environment and Data Report – ActiveX Controls – GIS Customisation – Case studies

**TOTAL (L:45 + T:30) :75 PERIODS**

**OUTCOME:**

- Understanding the concepts of OOPS, C++ Programming,MATLAB, IDL and VISUAL BASIC in spatial data processing.

**REFERENCES:**


1. Balagurusamy.E., Object Oriented Programming with C++, Tata Mc.Graw Hill Publications, 2001
2. Stanley B.Lippman, A C++ Primer, 2nd Edition, Addison Wesley Publications, Second Edition 2000
3. Paul J. Deitel and Harvey M. Deital “Visual Basic 2005 for Programmers”, 2nd Edition, Pearson Education, 2007.
4. J. H. Mathews and K.D. Fink, Numerical methods using MATLAB, Pearson Education.
5. Kenneth P. Bowman, An Introduction to Programming with IDL: Interactive Data Language, Academic Press**,** First edition, 2005


**RG7203 SATELLITE IMAGE PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- The objective of the course is to describe about the procedure of satellite data acquisition and analysis.

**UNIT I FUNDAMENTALS 9**

Satellite systems and data – acquisition - storage - orbits – Data formats –Data products – Image processing system – factors to be considered- Image display systems – Image sampling and quantization - Basic relationship between pixels.

Attested



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**UNIT II SENSOR AND DATA MODEL 9**

Sensor model – pixel characters - Image formation – Histogram -Types- Uni-variate & multi-variate image statistics – spatial statistics – Image registration and ortho rectification - Geometric and radiometric correction - noise models.

**UNIT III IMAGE ENHANCEMENTS 9**

Spectral signatures – Image characteristics, feature space scatterogram- point, local and regional operation – contrast, spatial feature and multi image manipulation techniques - Fourier transform - principle component analysis - Optimal Rotation Transformation – Scale-space transform, wavelet transform. multi-image fusion

**UNIT IV INFORMATION EXTRACTION 9**

Training sits - Supervised, Unsupervised and Hybrid classifiers -– Baye's Theorem – parametric Classification - -Decision tree – other Non - parametric classifiers - sub-pixel and super-pixel classification – Hyper-spectral image analysis – Accuracy assessment.

**UNIT V IMAGE ANALYSIS 9**

Pattern recognition - boundary detection and representation - textural and contextual analysis - decision concepts: Fuzzy sets - evidential reasoning - Expert system - Artificial Neural Network – Case studies

**TOTAL: 45 PERIODS**

**OUTCOME:**

- On completion of this course, the student shall be able to Get familiarized about various image enhancement and image processing techniques.

**REFERENCES:**


1. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
2. Robert Shcowebgerdt, Remote sensing models & methods for image processing, 3 rd edition, 2004.
3. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 1999.
4. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.
5. W.G.Rees - Physical Principles of Remote Sensing, Cambridge University Press, 2nd edition, 2001.


**RG7211 MICROWAVE REMOTE SENSING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVE :**

- To provide the exposure for the students with hands on experience into the Microwave Image Processing Using softwares

1. Reading, displaying and header extraction of SAR images and to Generate Multilook Images. 4
2. Geocoding with Dem and without DEM 4
3. Speckle Filtering Techniques and Backscatter extraction 4
4. Visual Image Interpretation and SAR Image fusion with Optical data 4
5. Scattering Matrix and Scattering properties retrieval 8
6. Polarimetric Classification 8
7. Interferometric processing-Base line estimation and Registration 4
8. Interferogram Generation and Phase values extraction 4

9. Phase unwrapping and Interferogram Interpretation. 4
10. Altimetry Processing- To import and display from Netcdf format 4
11. Correction methodologies and Sea surface height calculation 4
12. Scatterometry- reading and displaying the backscatter values 4
13. Retrieval of Wind parameters from backscatter values. 4

**TOTAL :60 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Geocode the SAR images and to perform Filtering
- Analyse the polarimetry and interferrometry microwave data
- Phase Unwrap the image for interpretation
- Process the scatterometer and altimeter data

**RG7212 SATELLITE IMAGE PROCESSING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- This course will facilitate the students to have hands on experience on different steps of satellite image processing using various softwares.

**EXERCISES:**

1. Reading and Displaying satellite data from BIL, BSQ and BIP Formats
2. Generating False Colour Composite (FCC)
3. Extracting area of Interest (AOI)
4. Generating Histogram of various bands
5. Georeferencing the base image
6. Geometric correction of satellite image
7. Enhancement using Band ratio and NDVI
8. Enhancement using different Filtering techniques
9. Enhancement using Image Fusion
10. Principal Component Analysis (PCA)
11. Fourier analysis
12. Unsupervised Classification
13. Supervised Classification
14 Classification using Neural Network and Fuzzy Logic
15. Accuracy Assessment and Change detection study

**TOTAL: 60 PERIODS**

**OUTCOME:**

- Understanding different steps involved in satellite image processing.

**RG7311** **INDUSTRIAL TRAINING** **L T P C**
**0 0 0 1**

**OBJECTIVE:**

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Remote Sensing and Geomatics in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

**SYLLABUS:**

The students individually undertake training in reputed Industries during the summer vacation for a specified period of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

**OUTCOME:**

- Students are trained in tackling practical field/industry orientated problems related to Remote Sensing and Geomatics.

**RG7312** **PROJECT WORK (PHASE I)** **L T P C**
**0 0 12 6**

**OBJECTIVE:**

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**SYLLABUS:**

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**TOTAL: 180 PERIODS**

**OUTCOME:**

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

**RG7411 PROJECT WORK (PHASE II) L T P C**
**0 0 24 12**

**OBJECTIVE:**

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze the data and discuss the results, and make conclusions.

**SYLLABUS:**

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners including one external examiner.

**TOTAL: 360 PERIODS**

**OUTCOME:**

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

**RG7001 AIRBORNE AND TERRESTRIAL LASER SCANNING FOR LARGE SCALE MAPPING**

**L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To provide exposure to LiDAR mapping and its applications

**UNIT I LASER AND SPACE BORNE LASER PROFILERS 9**

LASER, Components of LASER: Active Material, Energy Source, Reflection Mirror – LASER Production- LASER Classification: Eye Safety, Class I to Class IV Lasers - Comparison of Various methods of deriving terrain height – LASER RANGING- Types of LiDAR: Range Finder LiDAR, Doppler LiDAR, DIAL – Principles of Laser Ranging: Pulse Laser, Continuous Wave Laser – Space Borne Laser Missions – Geo Science Laser Altimeter System (GLAS), LiDAR In-Space Technology Experiment (LITE), Chandrayan

**UNIT II AIR BORNE LASER SCANNERS 9**

Components of Airborne Laser Scanning System – GPS, IMU, LASER Scanner, Position and Orientation System(PoS) – Types of Scanning Mechanism and Ground Measuring Pattern – Synchronisation of Laser Scanner and PoS- LASER Scanners Specification and Salient Features – Concept of Multi return – 3D Cloud Points – Reflectivity of Ground features – Range Correction Factor

**UNIT III LIDAR DATA PROCESSING 9**

Pre Processing: Direct Georeferencing, Combining Inertial and Navigation Data - Determination of Flight Trajectory - Data processing – Co-ordinate Transformations – Geolocating Laser Foot Prints – Strip Adjustment – Digital Surface Model to Digital Elevation Model : Filtering, Ground Point Filtering – Flight Planning – Quality Control Parameters – Preparation of flight plan

**UNIT IV LIDAR DATA MANAGEMENT AND APPLICATIONS 9**

Airborne Laser Scanner Error Sources - LiDAR data format: ASCII vs Binary, LAS Format – Software used for LiDAR data processing and management – Merits of Airborne Laser Terrain Mapping - Overview of LiDAR Applications - 3D city models – Road and Building Extraction – Forestry Applications – Power Line Mapping.

**UNIT V TERRESTRIAL AND BATHYMETRIC LASER SCANNER 9**

Terrestrial Lidar: Static and Mobile (Vehicle Mounted) LiDAR -Terrestrial LASER Scanner Specification – Applications of Terrestrial LASER Scanning –Bathymetric LASER Scanner – Specification – Depth of Penetration: Secchi Depth – Applications of Bathymetric LASER Scanner

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the components of Airborne Laser Scanning System
- Plan for Airborne Laser Scanning data Acquisition
- Understand the concepts for generating DEM from Digital Surface Model by filtering
- Get exposed to various domain applications of Airborne Laser Scanner data

**REFERENCES:**


1. Jie Shan and Charles K., Topographic laser ranging and scanning : principles and processing, CRC Press, Taylor & Francis Group, 2008
2. Mathias Lemmens, Laser Altimetry: Principles and Applications, CRC Press 2006.
3. Roger Read and Ron Graham, Manual of Aerial Survey: Primary Data Acquisition, Whittles Publishing, 2002.
4. Zhilin Li Qing Zhu, Chris Gold, Christopher Gold, Digital Terrain Modeling: Principles and Methodology, CRC Press, 2004.
5. Zhilin Li, Jun Chen, Emmanuel Baltsavias, Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences, CRC Press; 1 edition, 2008


**RG7002 DISASTER MANAGEMENT AND GEOMATICS APPLICATIONS**

**L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To teach about the various principles involved and also the various mitigation to be adopted during the disasters.

**UNIT I DISASTER PRINCIPLES 9**

Disaster - Concepts and principles - Classification -— Causes, characteristics and effects of various types of natural and manmade disasters – Global scenario – vulnerability profile in India – Institutional frame work for disaster management - Role of government administration and NGOs - International disaster assistance – Sharing technology and technical expertise

**UNIT II LONG TERM MITIGATION MEASURES 9**

Needs and approach towards prevention – components of disaster mitigation - Disaster legislation and policy - Insurance – Cost effective analysis – Utilisation of resources – Training – Education – Public awareness –Role of media.

**UNIT III PREPAREDNESS, RESPONSE AND RECOVERY 9**

Forecasting of disasters – institutional arrangement for forecasting – role of university and research organizations – support by satellite remote sensing agencies – preparedness – trigger mechanism – crisis management plan – recovery – Reconstruction after disasters: Issues of practices.

**UNIT IV SAFETY RATING OF STRUCTURES 9**

Structural safety of Hill Slopes, Dams, Bridges, Hospital, Industrial structures – planning seawalls and groynes - Cyclone shelter projects and their implications – Disaster resistant construction practices - Low cost housing for disaster prone areas

**UNIT V REMOTE SENSING AND GIS FOR DISASTER MANAGEMENT 9**

Remote sensing applications: Hazard evaluation – Zonation – Risk assessment and vulnerability – Damage assessment – Land use planning and regulation for sustainable development –- Post disaster review GIS Applications: Spatial and non-spatial data bank creation - Operational emergency management – Vulnerability analysis of infrastructures and settlements – Pre-disaster and post disaster planning for relief operations – Disaster mapping

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the fundamentals and measurements of disaster management
- Gain knowledge in concepts of long term mitigation measures
- Gain exposure to various space based input for disaster management
- Understand the use of spatial data for emergency planning

**REFERENCES:**


1. Sisi zlatanova & Andrea Fabbri jonathanli, Geometrics solutions for Disaster management, Springer Verlag, 2007.
2. C. Emdad Haque, Mitigation of natural Hazards & disasters, Klwuer Acadamic publishers group, 2005.
3. Linda C. Bottersll & ponald A.wilhite, from Disaster response to Risk management. Klwuer Acadamic publishers group, 2005.
4. Gerard Blokdijk, Disaster recovery planning and services, Gennaio publishers, 2008.
5. Mohamed Gad Large scale disasters : prediction, control and mitigation, Cambridge university press, 2008


**RG7003 ELECTRONIC SURVEYING L T P C**
**3 0 0 3**

**OBJECTIVES** :

- To understand the working of Total Station and GPS equipment and solve the surveying problems.

**UNIT I FUNDAMENTALS OF TOTAL STATION AND GPS 9**

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Global Navigation System, Regional Navigation System and SBAS - Basic concepts of GNSS, Glonass,IRNSS - Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion - Keplerian motion – Kepler‟s Law - Perturbing forces - Geodetic satellite - Doppler effect- Different Coordinate and Time System.

**UNIT II ELECTROMAGNETIC WAVES 9**

Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI-Computation of group for light and near infrared waves at standard and ambient conditions-Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -Total atmospheric correction- Use of temperature - pressure transducers.

**UNIT III ELECTRO OPTICAL AND MICRO WAVE SYSTEM 9**

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments– Applications of COGO functions -Traversing and Trilateration – Downloading and mapping - Recent trends.

**UNIT IV GPS SATELLITE SYSTEM 9**

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

**UNIT V GPS DATA PROCESSING 9**

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data -data processing – software modules -solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static methods with GPS - semi Kinematic, pure Kinematic and Real time kinematic methods -basic constellation of satellite geometry & accuracy measures - applications- use of different softwares.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

On completion of this course students shall be able to

- Understanding the concepts of Electromagnetic waves and impact of Refractive Index.
- Work with Electro optical and microwave Total Station and understand error sources**.**
- Understand the advantages of electronic surveying over conventional surveying methods
- Understand the working principle of GNSS , it‟s components, signal structure, and error sources
- Understand various GNSS surveying methods and processing techniques used in GNSS observations
- Familiarise various areas of GNSS applications and new developments.

**REFERENCES:**


1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th edition, 1996
2. Satheesh Gopi, rasathishkumar, N.madhu, " Advanced Surveying, Total Station GPS and Remote Sensing " Pearson education , 2007 isbn: 978-81317 00679
3. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.
4. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 2003.
5. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
6. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 1998


**RG7004 GEODESY L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To understand the concept of geodetic surveying and solve the geodetic problems.

**UNIT I FUNDAMENTALS 9**

Definitions, classifications, applications and problems of geodesy. Historical development and organization of geodesy. Reference surfaces and their relationship, Engineering, lunar and planetary geodesy, Geodetic control(Horizontal and vertical)-Standards, methods and computations.

**UNIT II GEOMETRIC GEODESY 9**

Basics-Geodetic,Geocentric, Reduced Spheroidal latitudes and their relationship. coordinates in terms of reduced, geodetic and geocentric latitude. Radius of curvature in the meridian &prime vertical and their relationship. Mean Radius of curvature at any azimuth. Length of the meridian arcs and arcs of parallel and area of trapezium on the spheroid. Curves on the spheroid, properties of geodesic and Everest spheroid. Natural or Astronomical coordinate system, Geodetic or Geographical coordinate system, Rectangular or Cartesian coordinate system and relationship between them. Curvilinear coordinate system. Deflection of vertical, spherical excess. Astro-geodetic method of determining the reference spheroid.

**UNIT III PHYSICAL GEODESY 9**

Gravity field of earth, Concept of equipotential, geopotential and spheropotential surface Normal gravity, The significance of gravity measurements, Measurement of absolute and Relative gravity, Reduction of gravity measurements, Isostasy. Gravity networks, Gravity anomaly and Gravity disturbance. Funtamental equation of physical Geodesy. Determination of Geoid and Deflection of vertical. Orthometric height, Normal height, Dynamic height and their corrections. spheroidal height and Geoidal height.

**UNIT IV GEODETIC ASTRONOMY 9**

Basics-Horizon, hour angle, Right Ascension, Ecliptic co-ordinate systems and relationship with Cartesian co-ordinate system, Transformation between them. Special star positions, Major constellation. Rising and setting of stars with respect to declination, hour angle and azimuth. Culmination, Prime vertical Crossing and Elongation. Variation in celestial co-ordinates. Sidereal time, Universal time, Zone time and Atomic time. Determination of Astronomical azimuth, latitude and longitude. Star catalogues, Ephemerides and Almanacs.

**UNIT V GEODETIC COMPUTATION 9**

Rectangular and Polar co-ordinates. First and Second geodetic problem. Similarity and Helmert's transformation. Point determination by Intersection, Resection and Arc Section.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understanding of Geodetic surfaces and interrelationship
- Acquire knowledge of Gravity measurements and their use in determination of elevation
- Understand the relationship between astronomical observations and geodetic parameters
- Understand principles involved in computing of Coordinates using Geodetic Measurements.

**REFERENCES:**


1. George l. Hosmer, Geodesy, Kessinger publishing 2007.
2. Howard gore J., Elements of Geodesy, Kessinger publishing 2007.
3. Wolf gang torge, Geodesy, Walter De Gruyter Inc.Berlin, 2001
4. Geometrical Geodesy Maarten Hooijberg, Springer verlag 2005.
5. Physical Geodesy Berhard Hofmann-wellenhot & Helmut moritz, springer verlag 2006.
6. Petr Vanicek and Edward J.Kakiwsky, Geodesy, the concepts north Holland publications co, Amsterdam, 1991.
7. Heribert Kahmen and wolf gang faig, surveying, watter De Gruyter, Berlin, 1998.
8. Schwarze, V.S.Geodesy, The challenge of the 3rd millennium, spinger verlag, 2002.




**RG7005 GEOMATICS IN ENVIRONMENTAL MONITORING AND MODELLING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To understand the various remote sensing and GIS technological applications in the field of Environmental Engineering.

**UNIT I SATELLITE FOR ENVIRONMENTAL MANAGEMENT 9**

Introduction - Environmental satellite Mission: GEOS, NOAA, AVHRR, CZCS, Oceansat, Kalpana and others – Spectral characteristics - Data Products – Analysis Tools - Monitoring land, water, atmosphere and ocean using Remote Sensing Data

**UNIT II WATER QUALITY MANAGEMENT 9**

Classification of water quality - Sampling procedure - Quality analysis and GIS modeling Pipe Network Design using GIS - Spectral responses of clear and contaminated water –Aquifer Vulnerability: Intrinsic and specific vulnerability - DRASTIC, SINTACS – Ground Water Quality Modelling: MODFLOW, MT3D – Sea water Intrusion Modelling – pollution diffusion model in river - Case studies.

**UNIT III AIR QUALITY AND NOISE MANAGEMENT 9**

Air Quality Standards – Chemical and Physical Components - Sampling – Mapping of atmospheric pollution - Air pollution due to industrial activity - Plume behaviors - Dispersion model: Gaussian Plume model - Remote Sensing to monitor atmosphere constituents - Case Studies. Noise pollution: Standards - Measurement of noise and its intensity - Sources - Effects – noise modeling.

**UNIT IV SOLID WASTE MANAGEMENT 9**

Definition – sources – identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site – Waste allocation – design of leachate and gas collection in sanitary landfills – leachate model - case studies.

**UNIT V GLOBAL PROSPECTIVE AND CLIMATE CHANGE 9**

Prevention and Control measures – Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status - case studies - Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate system components - Green house effect – Carbon cycle - case studies

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Acquire knowledge of various components of environment and assessment of their quality
- Gain exposure to current and future satellite missions used for environmental assessment and modeling

**REFERENCES:**


1. Ian L.Pepper, Charles P.Gerbaand Mark L.Brusseau, Environmental and Pollution science, Academic Press, 2nd Edition, 2006. ISBN : 978-0125515030
2. David N.Miclsen, Environmental Site Characterization and Ground water Monitoring, 2nd edition, CRC Press, 2005, ISBN: 978-1566705899
3. Roger D.Griffin, Principles of Air Quality Management, 2nd edition, 2006, CRC Press
4. Donald L.Wise, Remediation for Hazardous waste contaminated soils, CRC Press; 1st Edition (1994)
5. Michele Campagna, GIS for sustainable development, CRC Press; 1st Edition, 2005.
6. Tchobanoglous George, Hilary Theisen, Samuel Vigi, Integrated Solid Waste Management, Mc Graw – Hill Inc, Singapore. 1993.
7. Dr Owen Harrop, “Air Quality Assessment & Management”, CRC Press; 1st edition, 2001
8. Robert Scally, “GIS for Environmental Management”, ESRI Press, 2006
9. Shukla P R , Subobh K Sarma, NH Ravindranath, Amit Garg and Sumana Bhattacharya, Climate Change and India: Vulnerability assessment and adaptation, University Press (India) Pvt Ltd, Hyderabad.

**RG7006 OPEN SOURCE SOFTWARE FOR GEOMATICS L T P C**
**2 2 0 3**

**OBJECTIVE:**

- Promoting open source software is basic for research and providing cost effective solutions. The students shall equip with concepts and uses of Open source GIS facilities.

**UNIT I INTRODUCTION 6+6**

Software licenses – types - Proprietary license - GNU General Public License – types – Open Source definition – open source popular licenses – comparison among open source licenses – merits and demerits – open source software for geospatial – OSGeo functions and goals – FOSS4G

**UNIT II DATABASE 6+6**

File database : SQLite - Non spatial data – creation of tables views, triggers – SQL queries – RDBMS : PostgreSQL - client server connection - creation of tables views, triggers Grant and Revoke privileges – SQL queries. Spatial data model - Spatial data creation, querying, topological functions, spatial analysis on SQLite with SpatiaLite and on PostgrSQL with PostGIS

**UNIT III BASIC GIS 6+6**

Introduction on QGIS environment - various plugins supported – data handling capabilities – vector data formats supported – Data capture editing techniques - selecting, attribute querying and spatial querying – styling map – import and export data – connecting web data and external databases – raster data handling - calculating geometries measuring the elements - Coordinate Reference Systems conversions - preparing map layout

**UNIT IV ADVANCED GIS 6+6**

Introduction to Geographic Resources Analysis Support System (GRASS) GIS - Raster data handling – Reclassification, recode - map algebra - Resampling and interpolation of raster data – Overlaying - Spatial analysis Neighborhood analysis and cross-category statistics - Buffering - Cost surfaces - Terrain and watershed analysis – Modeling raster data – Vector data handling - Topological operations – Buffering – Overlay – Dissolve – clip,union intersect – Network analysis – Spatial interpolation – handling lidar point cloud data

**UNIT V IMAGE PROCESSING AND GPS 6+6**

GRASS image processing – preprocessing - Radiometric transformations - image enhancements - image ratios – Principle component transformation – image fusion – unsupervised and supervised classification – segmentation. GPS: RTKLIB - Post processing - RINEX Converter - Plot Solutions and Observation Data - Downloader for GNSS Products and Data

**TOTAL (L:30+T:30) : 60 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the important of Open source technology in GIS and various options available in its implementation.
- Acquire skills in using open source software along with the principles of handling licenses and source code modification.

**REFERENCES:**


1. Lawrence Rosen “Open Source Licensing: Software Freedom and Intellectual Property Law” Prentice Hall; 1 edition 2004 ISBN-13: 978-0131487871
2. Andrew M St Laurent “Understanding Open Source and Free Software Licensing” O'Reilly; 1 edition 2004 ISBN-13: 978-0596005818
3. Markus Neteler, Helena Mitasova "Open Source GIS A GRASS GIS Approach" Springer; 3rd edition 2007 ISBN-13: 978-0387357676

4. Anita Graser “Learning QGIS 2.0” Packt Publishing Limited 2013 ISBN-13: 978-1782167488
5. Regina Obe ,Leo Hsu "PostGIS in Action” Manning Publications; 1 edition 2011 ISBN-13: 978-1935182269
6. RTKLIB Manual - http://www.rtklib.com/rtklib_document.htm
7. using SpatiaLite - http://www.gaia-gis.it/spatialite-2.4.0-4/spatialite-cookbook

**RG7007 PLANETARY REMOTE SENSING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- The objective of the course is to impart knowledge about universe, solar system, planetary atmosphere and planetary geology. The students will be exposed to various Remote Sensing Applications to planetary science.

**UNIT I UNIVERSE AND SOLAR SYSTEM 9**

Origin of Universe - Big Bang, Steady state and Inflationary hypothesis, Illustris model, Solar System - planets, satellites, asteroids, meteorites and comets and internal differentiation of the planets; general features of Terrestrial planets.

**Unit II EARTH AS A REFERENCE MATERIAL 9**

Geology and geophysics of terrestrial planets: mars, venus and mercury; Jupiter, Uranus and Saturn and their satellites; physical properties, composition, mineralogy and petrology of the Moon.

**UNIT III PLANETARY ATMOSPHERE 9**

Exo-and Endogenic processes associated with origin and internal evolution of planets – planetary volcanism, craters, impact of cratering processes, mineralogy and petrology; thermal, seismic and magnetic properties, and chronological techniques.

**UNIT IV REMOTE SENSING TECHNIQUES APPLICABLE TO PLANETARY GEOLOGY 9**

Approaches to remote sensing analysis of the composition of planetary surfaces, applications derived from interaction of electromagnetic radiation (X-ray, gamma-ray, visible, near-IR, mid-IR, radar) with geologic materials.

**UNIT V PAST, PRESENT AND FUTURE PLANETARY EXPLORATION MISSIONS 9**

Analyses and Interpretation of data gathered through various missions: identification of surface and morphological features.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- On completion of this course, the student shall gain knowledge about remote sensing applications on universe, solar system, planetary atmosphere and planetary geology.

**REFERENCES:**

1. Manual of Remote Sensing, Third Edition, Volume 3, pp. 509-564, A.N. Rencz, Editor, John Wiley & Sons, 1999.
2. Origin of Electronic Spectra of Minerals in the Visible-Near Infrared Region. In Remote Geochemical Analysis: Elemental and Mineralogical Composition , ed. C.M. Pieters and P.A.J. Englert, pp. 3-29. Cambridge: Cambridge Univ. Press. Burns R.G., 1993.
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7. Reflectance spectroscopy and asteroid surface mineralogy. In Asteroids II , R.P. Binzel, T. Gehrels, and M.S. Matthews, eds., pp. 98-127. Tucson: Univ. Arizona Press. Gaffey M.J., Bell J.F., and Cruikshank D.P., 1989.
8. Impact cratering mechanics and structures, in Shock Metamorphism of Natural Materials, B.M. French and N.M. Short, eds., pp. 87-99, Mono Books, Baltimore. Gault, D.E., W.L. Quaide, and V.R. Oberbeck, 1968.
9. Planetary Landscapes, Allen and Unwin, Inc., Winchester, MA, 275 pp. Greeley, R., 1987.
10. Meteorites and the Early Solar System, Univ. Arizona Press, Tucson AZ, 1269 pp. Kerridge, J.F. and M.S. Matthews, editors, 1988.

**RG7008 REMOTE SENSING AND GEOMATICS FOR AGRICULTURE AND FORESTRY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- The content of this course enable the students to understand the application potentialities of remote sensing data separately and in combination with GIS techniques for Agriculture and Forestry.

**UNIT I CROPS ACREAGE AND YIELD ESTIMATION 9**

Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy – crops identification and crop inventory – crop acreage estimation – vegetation indices and biophysical model – Yield modeling – crop condition assessment – command area monitoring and management – Microwave RS for crop inventory – Case studies

**UNITII SOILMAPPING 9**

Soil classifications – Soil survey, Types and methods – Hydrological Soil grouping - Factors influencing soil reflectance properties – Characteristics of saline & alkaline Soils –principle component analysis and orthogonal rotation transformation - Soil mapping - watershed management - Problem soil identification – land evaluation – Case studies.

**UNITIII DAMAGEASSESSMENT 9**

Detection of pest & diseases – Flood mapping and Assessments of crop loss – drought assessment – Land degradation – Soil erosion & sedimentation – Soil loss assessment – Soil conservation – Agriculture damage prediction modeling.

**UNITIV FORESTRY 9**

Forest taxonomy – inventory of forest land – forest types and density mapping – Forest stock mapping – factors influencing degradation of forest – Delineation of degraded forest - Forest change detection and monitoring – Forest fire mapping & damage assessment –– biomass estimation - carbon storage – ALTM for Forest studies – urban forestry issues

**UNITV CLIMATICIMPACTOFAGRICULTUREANDFORESTRY 9**

Concepts of Integrated surveys– global effects and climatic changes: land degradation and desertification, extreme events, - effect on forest produces health, forest hazards, sustainable forest Management and practice - biodiversity issues – invasive biotics – mitigation and adaptation – RS & GIS for drawing out action plans – watershed approach – landuse planning for sustainable development – precision farming – Case studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the concepts involved in mapping of crop acreage and yield estimation
- Understand the principles space based input for crop damage assessment
- Gain skills in various applications of Forestry and sustainable watershed management

**REFERENCES:**


1. John G. Lyon, Jack MCcarthy, Wetland & Environmental application of GIS,1995.
2. Margareb Kalacska, G. Arturosanchez, Hyper spectral RS of tropical and sub tropical forest, 2005.
3. Shunlin liang, Advances in land RS: System, modeling invention and applications, 2001.
4. Joe Boris dexon, Soil mineralogy with environmental application, Library of congress catalog, 2004.
5. James B, Introduction of Remote sensing, Third edition Campbell, 3rd edition Guilford Press, 2002.
6. David H. White, S. Mark Howden, Climate Change: Significance for Agriculture and Forestry,


**RG7009 REMOTE SENSING AND GEOMATICS FOR URBAN PLANNING AND MANAGEMENT L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the concepts of urban and regional planning
- To explore the use of the geospatial technology in advanced analysis in planning.

**UNIT I FUNDAMENTALS 9**

Concepts of Urbanization and Urban Areas - concept of regions - formal and functional regions - census classification of urban areas - Planning Goals: Natural Resources Management; socio-economic management and infrastructure planning - Planning physical structures and functional domains - data and information for urban and regional planning by Remote Sensing - Planning goals for urban areas and regions.

**UNIT II URBAN INVENTORY AND MAPPING 9**

Digital and image records of the Urban areas and Regions – classification of settlement patterns and structures – Segmentation of Built-up areas – Classification algorithms – Inventory of resources and measurements - Land use/ Land cover mapping – Deduction of sprawl, renewal and morphological changes – resolution of RS data in feature extraction and object delineation - mapping resources, developments and demography by choropleth and isopleth techniques - high resolution remote sensing data in urban analysis..

**UNIT III URBAN LANDUSE PLANNING AND MANAGEMENT 9**

Urban morphology – Housing typology – Population estimation from remote sensing – Infrastructure demand analysis – Land suitability analysis for Urban renewal – Plan formulation for sectoral and regional, development – Use of remote sensing and GIS in assessment, estimation and projections - Design of Urban and regional information systems – revenue and tax collection GIS - planning facilities and amenities

**UNIT IV URBAN TRANSPORTATION AND INFRASTRUCTURE PLANNING 9**

Site specific GIS: Housing development, parks and social facilities planning- Utility Planning and Asset Management – urban and regional transportation corridors - wholesale and retail trade interactions - commuting-Classification of traffic – Optimum route and plans / shortest path – Alignment planning – Traffic and flow management – Accident analysis – case studies.

**UNIT V URBAN MODELLING TECHNIQUES 9**

Urban growth modeling – GIS modelling - local and regional interaction potential- Expert systems in AM/FM planning – 3D city models – digital terrain of the urban areas and regions- DEM and socio-economic – Land use Transportation interaction models – Intelligent transportation systems –Risk, vulnerability models in crime, accidents and disasters - case studies .

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course students shall be able to

- Gain knowledge of urban and regional planning concepts, the use of geomatics technology in planning and management in urban areas and regions.
- Familiarize with case studies, inputs from Remote Sensing and GIS
- Get exposure in modelling in urban land use and its forecasting.

**REFERENCES:**


1. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.
2. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003. CRC Press, 2nd Edition, 2009, ISBN: 978-1439808702
3. Paul Longley, Michael Batty, Spatial Analysis: Modeling in a GIS Environment Wiley, 1997.
4. Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks, Carol Johnston, David Maidment, Michael Crane, Sandi Glendinning, GIS and Environmental Modeling: Progress and Research Issues (Hardcover) by,Publisher: Wiley; 1st edition, 1996.
5. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007.
6. Said Easa, Yupo Chan, “Urban Planning and Development Applications of GIS”, Amer Society of Civil Engineers, 1999, ISBN: 978-0784404614




**RG7010 SATELLITE METEOROLOGY L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To impart knowledge in Concepts in Meteorology, Radio and Satellite Meteorology and its Applications

**UNIT I GENERAL CONCEPTS IN METEOROLOGY 9**

Weather and Climate- composition of atmosphere- weather elements and characteristics - Global temperature, pressure and wind belts - scales of atmospheric processes, Land/Ocean Coupling, Vegetation types and climate, climatic classification by Koppen and Thornthwaithe, energy in the atmosphere - Indian monsoons - weather systems and seasons, Indian Climatology - Radiation transfer- radiation spectrum – Absorption and emission of radiation by molecules- Radiation laws- scattering principles – atmospheric particles and radiations - Mechanism of cloud formation- Types of Clouds- Precipitation processes-weather stations, data, maps and symbols.

**UNIT II RADIO METEOROLOGY 9**

Principles and classifications of Radar- Meteorological Applications of radar – atmosounding Radio Sonde - pilot balloons - Wind estimation through Radar - Rawin Sonde - Doppler techniques for precipitation estimation – Precipitation Radar (PR) - Global Precipitation Measurement (GPM), Ozone soundings – principle and satellite measurements of ozone – Aerosol soundings Tracking of weather Thunderstorms, Tropical cyclones, Tornadoes through Radar – Hydro meteorological Applications of Radar - Applications to aviation meteorology – TIROS Operational and Vertical sounder – Retrieval methods and algorithms.

**UNIT III SATELLITE METEOROLOGY 9**

Orbital dynamics of satellite – Critical velocities – Polar and Geostationary weather satellites - Active and passive sensors (Radar/Lidar/Radiometery,scatterometer and altimeter) - Absorption bands of atmospheric gases - Design and characteristic of different types of sounders and imagers used in Meteorological satellites – Viewing geometry - INSAT/Icachana Meteorology - Data Processing System (IMDPS), IRS series – APT – AVHRR - Need for Remote Sensing techniques in weather forecasting and Numerical Weather Prediction (NWP) - imaging and non imaging techniques in Meteorology.

**UNIT IV METEOROLOGICAL APPLICATIONS 9**

Precipitation – soil moisture - estimation and their Applications – Normalised Difference Vegetation Index – Ocean Colour monitoring – Coastal zone mapping - Satellite communication systems in operational meteorological Applications (Cyclone Warning Dissemination system / Automatic Weather stations – Meteorological data dissemination) - Estimation of snow and ice cover – Water body boundary mapping – aerosols – Dust storms and Volcanic ash clouds and fires – maritime, dwelt, floods and agriculture.

**UNIT V GLOBAL METEOROLOGICAL APPLICATIONS 9**

Global and subglobal events – tracking of large weather system – Cloud motion vector – Dvorak‟s techniques of Cylone Intensity estimation - T-phi and other climatic charts - T number and current intensity No. – Applications to storm surge estimation - Satellite soundings – Global Warming – Sealevel changes and Consequences.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the concepts of Meteorology and various application areas of Meteorology.
- Gain knowledge on Radio and Satellite meteorology
- Acquire knowledge about various climatic charts

**REFERENCES:**


1. Kidder and VonderHarr, “Satellite Meteorology: An introduction”, Academic Press, San Diego, CA, 1995
2. Arthur P. Cracknell, “The Advanced Very High Resolution Radiometer (AVHRR)”, 1997, CRC Press, ISBN: 9780748402090.
3. Smith and Schreiner, “Advances in Remote Sensing”, Deppak Publications
4. Asnani, G.C “Tropical Meteorology”, Vol. I and II, 1993
5. Richard J. Doviak, Dusan S. Zrnic, “Doppler Radar and Weather observations”, Dover Publications; 2nd Edition 2006, ISBN: 978-0486450605
6. Ellingson, “Satellite Data Applications: Weather and Climate”, Proc.of AO I Symp., COSPAR, Birmingham, UK, Elsevier, MD, USA. Pergamon Pr; 1st Edition 1997
7. Sauvageot, 1992, “Radar Meteorology”, Artech House Publishers, Norwood, MA. 1992
8. Hartwig Dobesch, Pierre Dumolard, Izabela Dyras, “Spatial Interpolation for Climate Data: The Use of GIS in Climatology and Meteorology”, Wiley Publication, (2007 – Print), 2010 – Online)
9. Raghavan S. , “Radar Meteorology”, Springer, 2003, ISBN: 9781402016042


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**RG7011** **SOFT COMPUTING TECHNIQUES** **L T P C**
**3 0 0 3**

**OBJECTIVE :**

- The objective of the course is to make the students to understand the concepts of Artificial Neural Network, Fuzzy logic and Genetic algorithms and also their application in Geomatic.

**UNIT I SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS 9**

Soft Computing : Introduction - soft computing vs. hard computing - soft computing techniques – applications - ANN : definition - Structure and Function of a single neuron: Biological neuron, artificial neuron, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Widrow & Hebbian learning rule/Delta rule, ADALINE, MADALINE - Introduction of MLP - Geomatic Applications.

**UNIT II FUZZY SYSTEMS 9**

Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp and fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction and features of membership functions,Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making and Geomatic Applications

**UNIT III NEURO-FUZZY MODELLING 9**

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

**UNIT IV GENETIC ALGORITHM 9**

Genetic algorithm : Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method.

**UNITV SOFT COMPUTING AND CONVENTIONAL AI 9**

AI Search algorithm-Predicate calculus –Knowledge acquisition and representation - rules of interface - Semantic networks-frames-objects-Hybrid models – Geomatic applications

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students will be able to apply the techniques such as Artificial Neural Network, Fuzzy logic and Genetic algorithms for geomatic applications.

**REFERENCES:**


1. Freeman J.A. and Skapura B.M., "Neural Networks, Algorithms Applications and Programming Techniques", Addison-Wesely, 1990
2. Jang J.S.R.,Sun C.T and Mizutami E - Neuro Fuzzy and Soft computing Prentice hall New Jersey,1998
3. Timothy J.Ross:Fuzzy Logic Engineering Applications. McGraw Hill,NewYork,1997.
4. Laurene Fauseett: Fundamentals of Neural Networks. Prentice Hall India, New Delhi,1994.
5. George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall Inc., New Jersey,1995
6. Nih.J. Ndssen Artificial Intelligence, Harcourt Asia Ltd.,Singapore,1998.

**RG7012** **SPATIAL DATA MODELLING** **L T P C**
**3 0 0 3**

**OBJECTIVE** :

- To provide complete understanding of the concepts of Spatial Data Modelling

**UNIT I MODELLING SPATIAL PROBLEMS 9**

Introdution - Need for Spatial models- Conceptual model for solving spatial problems- steps involved , Types of Spatial Models- Descriptive and Process models- Types of Spatial Models- Descriptive and Process models - Types of Process models - Creating Conceptual models - Site Suitability model

**UNIT II RASTER MODELLING 9**

Understanding Raster Data set - Composition of Raster Dataset Coordinate space and Raster Dataset - Discrete and Continuous data - resolution - Raster encoding - Representing Features in Raster data set - Assigning attributes.

**UNIT III SPATIAL ANALYSIS 9**

Understanding spatial analysis - Operators and Functions - Local , focal, zonal, global and application functions - surface analysis: slope, hill shade, contour and hydrologic analysis - mapping distance: shortest path - mapping density - cell statistics - neighbourhood statistics - reclassification

**UNIT IV CREATING SURFACE MODELS 9**

Inrodution - creating raster surface from points - interpolating a raster surface - creating TIN surface vector data - building TIN - creating a TIN from a raster- creating a raster from a TIN

**UNIT V GPS DATA PROCESSING 9**

Analyzing Surfaces - Understanding the shape of a surface - calculating slope, mapping contours - deriving contour lines from a surface - calculating area and volume

**TOTAL : 45 PERIODS**

**OUTCOME:**

- Students will gain thorough knowledge on the concepts of Spatial Data Modelling.

**TEXTBOOK:**

1. Heywood.L, Comelius.S and S.Carver An Introdution to Geographic Information Systems, Dorling Kinderseley(India) Pvt.Ltd, 2006.

**REFERENCE:**

1. TsungChang-Kang, Introduction to Geographic Information Systems, Tata McGraw Hill Publishing Company and Limited NewDelhi, 2002.

**RG7013 THERMAL AND HYPERSPECTRAL REMOTE SENSING L T P C**

**3 0 0 3**

**OBJECTIVE**:

- To make the post graduate students understand principles, processes and applications of thermal and hyper spectral remote sensing for earth resources.

**UNIT I FUNDAMENTALS OF THERMAL REMOTE SENSING 9**

Radiation science basics - Thermal radiation principles, thermal interaction behavior of terrain elements, thermal sensors and specifications – MUST (Medium Scale Surface Temperature Missions) infrared sensors and radiometers - aerial thermal images - Image characters, spatial and radiometry- sources of image degradation –radiometric and geometric errors and correction – interpretation of thermal image

**UNIT II THERMAL IMAGE AND INTERPRETATION 9**

Extraction of environmental variables – LST retrieval methods – mapping of surface energy balance components – surface flux studies – thermal and optical RS for plant biophysics – hydrology, Forestry and Agriculture applications - case studies.

**UNIT III FIELD AND IMAGE SPECTROMETRY 9**

Spectral radiometry - imaging spectrometry : considerations - experimental design and instrumentation – factors affecting the field spectrum – hyperspectral sensor systems-imaging spectrometry – scattering principles - BDRF and hemispherical reflectance –models; MODTRAN - Sensors and platforms – data characteristics.

**UNIT IV HYPERSPECTRAL IMAGE ANALYSIS 9**

Virtual dimensionality – representation systems - hypercube – red edge – indices - Hughes phenomenon - multivariate analysis for data reduction - data calibration, normalization – spectral library – response functions – MNF transformation – Kalman filters- library matching, spectral angle mapper, BBMLC-spectral mixture analysis – endmember extraction – spectral unmixing-MIA analysis concepts - PCF, PCA, WPCA spectral transformation – band detection, reduction and selection principles -data compression

**UNIT V HYPERSPECTRALIMAGEAPPLICATIONS 9**

Application to lithology, mineral exploration – agricultural crop systems – stress detection, plant production, vegetal bio physics and bio chemistry, soil moisture , soil characteristics, degradation status - forestry canopy characters, ecosystem, forest health, biodiversity, Gap dynamics, environmental and resource management.

**TOTAL 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- Understand the principles and properties of Hyper spectral and Thermal Remote Sensing.
- Acquire skills in analysing Thermal and Hyperspectral Remote Sensing data for various thematic mapping and its applications.

**REFERENCES:**


1. Dale A Quattarochi and Jeffrey C Luvall, “Thermal Remote Sensing in Land surface Processes” e-book, 2005 Taylor & Fancis, ISBN 0 203 50217 5
2. John A. Richards and Xiuping Jia, “Remote sensing digital Image Analysis – an introduction” fifth edition, Springer Verlag., 2012 ISBN 978 3 642 30061 5.
3. Chein I Chang, “Hyperspectral Imaging: Techniques for Spectral Detection and Classification”, Kluwer Academic/Plenum Publishers, New York, N.Y., 2003.(ISBN: 0-306-47483-2)
4. Marcus Borengasser and William C., Hungate and Russel Watkins, “Hyper spectral Remote sensing: principles and application” CRC, 2008,

**RG7014** **WEB TECHNOLOGY PROGRAMMING FOR GIS** **L T P C**
**2 2 0 3**

**OBJECTIVE:**

- This course provides skills in learning a set of scripts and their applications for providing web based services using GIS technology.

**UNITI INTRODUCTION ON HTML 6+6**

Internet Standards – Introduction to www – www Architecture – Protocols – HTTP, FTP, SMTP. **Markup Language (HTML):** Introduction to HTML and HTML5 - Formatting and Fonts – Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms.

**UNIT II CASCADING STYLE SHEET (CSS) 6+6**

The need for CSS, Introduction to CSS – Basic syntax and structure - Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and Padding - Positioning using CSS.

**UNIT III JAVA SCRIPT 6+6**

Data types and Variables - Operators, Expressions, and Statements -Functions - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations.

**UNIT IV PHP 6+6**

Introduction - Programming basics - Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Reading Data in Web Pages - Embedding PHP within HTML – Establishing connectivity with database.

**UNIT V GEOSERVER 6+6**

Introduction – Web Administration – Geoserver data directory –loading and working with data – shape file – postgis file – other web format data - styling the layers – services : WMS, WFS, WCS – security – demos and case studies on Geo server.

**TOTAL (L:30+T:30) : 60 PERIODS**

**OUTCOME:**

- On completion of this course, the student shall be able to write scripts for web technology programming for GIS.

**REFERENCES:**


1. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011. ISBN-13: 978-0132151009
2. Thomas Powell, "HTML & CSS: The Complete Reference" Fifth Edition, McGraw-Hill, 2010 ISBN-13: 978-0071496292
3. Thomas Powell, Fritz Schneider "JavaScript The Complete Reference" 3rd Edition, TATA McGraw Hill, 2013 ISBN-13: 9781259064685
4. Steven Holzner, "PHP: The Complete Reference" 1st Edition TATA McGraw Hill ,2008 ISBN: 9780070223622
5. Stefano Iacovella, Brian Youngblood "GeoServer Beginner’s Guide" Packt Publishing 2013, ISBN-13: 978-1849516686
6. http://docs.geoserver.org/