FIRST SEMESTER

DGI 101 Principles of Remote Sensing and Photogrammetry- (3-0)

Remote Sensing:
Definition of Remote sensing, Advantages and limitations, Remote sensing process, Electromagnetic Radiation (EMR): EMR Spectrum and its properties, EMR wavelength regions and their applications, Atmospheric windows, Interaction of EMR with matter, Spectral signatures, Resolutions: Spectral, Spatial, Temporal and Radiometric
Spectral Signature and its Response: of Soil, Vegetation and Water, Basics of visual interpretation of satellite images

Orbits of satellite, Kepler's laws of motion, IRS Series of Satellites, LANDSAT, SPOT, IKONOS, QUICKBIRD, MODIS, RADARSAT, NOAA, TERRA, MOS and ERS, Brief introduction to Weather and Communication Satellites

Fundamentals of aerial photography, Vertical and Oblique aerial photography, Aerial cameras, Photogrammetry; Basic concepts of scale, object height and length, object area and perimeter, grayscale tone/color of objects, Photo interpretation techniques, Stereo photogrammetry and stereovision, Parallax bar and its applications.

Photographic System: Cameras, Sensor classification: Active and Passive, along track and across track scanners, Infrared Scanners, Thermal Sensors and Microwave Sensors

Introduction to Thermal Infrared Radiation Properties: Kinetic Heat, Temperature, Radiant Energy and Flux, methods of transferring heat, Thermal properties of terrain: Thermal Capacity, Thermal conductivity, Thermal Inertia, Thermal Infrared Multispectral scanners, Thermal IR Remote sensing examples

Passive Microwave Sensors, Active Microwave Sensors, Side looking RADAR, Scatterometer, SAR Interferometry

Hyper-spectral remote sensing

Photogrammetry:
Camera calibration - representation of digital images B/W, RGB, HIS, CCD cameras, time delay integration, spectral sensitivity of CCD sensor, geometry problem of CCD image -, image measurement, coordinate system, image movement, image transformation, geometric and radiometric transformation, Tilted photos: Rectification, Mathematical photogrammetric principles, Analog vs Analytical vs Digital models - Orientation: Interior, Relative, Absolute - Collinearity and Coplanarity - Image matching - Ground control - Aerotriangulation - ortho photo generation, digital elevation model, LASER mapping - automated mapping, feature extraction, image enhancement, virtual reality modeling, non-topographic Photogrammetry, video metrology.

Textbooks
1. Elements of Photogrammetry with Application in GIS, Fourth Edition -2014 by Paul R

Wolf, Bon A. Dewitt, McGraw-Hill.
2. Kraus K.: Photogrammetry. Berlin: de Gruyter, 2007. ISBN 978-3-11-019007-6. (EN)
3. Introduction to Modern Photogrammetry by Edward M. Mikhail, Janan S. Bethel & Chris McGlone, Wiley & Sons Inc,2000.

TEXT BOOKS

1. Jensen, J.R., "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000
2. George Joseph, "Fundamentals of remote sensing", Universities press (India) Pvt. Ltd., Hyderabad, 2003
3. Elements of Photogrammetry with Application in GIS, Fourth Edition -2014 by Paul R Wolf, Bon A. Dewitt, McGraw-Hill.
4. Kraus K.: Photogrammetry. Berlin: de Gruyter, 2007. ISBN 978-3-11-019007-6. (EN)
5. 3. Introduction to Modern Photogrammetry by Edward M. Mikhail, Janan S. Bethel & Chris McGlone, Wiley & Sons Inc,2000.
6.

REFERENCE BOOKS

1. Sabins, F.F. Jr., 'Remote Sensing – Principles and Interpretation", W.H. Freeman & Co., 2002 Edition.
2. Reeves, Robert G., "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA
3. Lillesand, Thomas M. and Kiefer, Ralph, W., "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York, 2000
4. Rampal, K.K., Handbook of Aerial Photography and Interpretation, Concept Publishing Company, New Delhi, 1999

DGI 102 Principles of Geographic Information Systems (GIS) – (3-0)

Basic Concepts about spatial information, Philosophy and definition of GIS, features, pictures, variables: points, lines, areas, Position on the earth; Basics of map.

Fundamentals of Data Storage, Information Organization and Data Structure Basic File Structures; Tabular Databases; Advantages of Databases, Types of Databases-hierarchical systems, network systems, relational systems and Object-oriented database systems (OODS), Data Models-Entity Relationship model, Relational Model, Data Structures; Raster Structures, Vector Structures.

GIS Data Requirement, sources and collection, Methods of data capture-scanning, digitization and associated errors, Conversion from Other Digital Sources, Attribute data input and management, Edge matching, creating digital data - remote sensing; generating data from existing data ; Metadata ;Different Kinds of geospatial data, , Detecting and Evaluating Errors, Data Quality Measurement and Assessment, digital output options.

Image storage formats, Data retrieval, Data compression, NSDI, GSDI; geographic information in decision making; human resources and education; Interactive data exploration, Vector & Raster data query, Geographic visualization;

Raster data and structure, Local operations, Neighborhood operations, Zonal operations, Distance measure operations, Spatial auto correlations, DEM generation, Spatial

Modeling, combining data; terrain mapping finding and quantifying relationships; spatial interpolation;

Vector data base , Topological Relationships; Creation of Topology and Error Correction; Accuracy and Precision; The Importance of Error, Accuracy, and Precision, types of error, sources of error, data quality, Spatial interpolation, Overlay Operations and Buffering, Neighborhood functions Distant Measurement , Map Manipulation, Network analyses,

GIS and Remote Sensing data Integration, Thematic Mapping, GIS and Integration of other types of data, Virtual GIS and SDSS, Project design and management, need assessment.

TEXT BOOKS

1. Kang-tsung Chang 2002,'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
2. C. P. Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.

REFERENCE BOOKS

1. Burrough, Peter A. and Rachael McDonnell,1998, ' Principles of Geographical Information Systems' Oxford University Press, New York.
2. 2Magwire, D. J., Goodchild, M.F. and Rhind, D. M. Ed. 1991,'Geographical Information Systems: Principles and Applications', Longman Group, U.K.

DGI 103 Global Navigation Satellite System (GNSS) and Cartography & Digital Mapping – (3-0)

Introduction of Global Positioning System, Satellite constellation, GPS signals and data, Geo-positioning-Basic Concepts. NAVSTAR, GLONASS

Basic geodesy, Geoid /datum/ Ellipsoid,- definition and basic concepts, Coordinate Systems, Special Referencing system, Map Scale, Scale factors, Indian geodetic System

Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning

Methods-Static & Rapid static, Kinematic-Real time kinematic Survey- DGPS-GPS data processing and Accuracy.

Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna

GPS Application in Surveying and Mapping, Navigation Military, Location Based Services, Vehicle tracking.

Basic Concept of cartography, Categories of maps, Interpretation of topographic maps, Cartographic databases, data measurement, cartographic design issues, colour and pattern, map lettering, map compilation, map scale, Generalization, symbolization, dot,

isopleth and choropleth mapping, multivariate and dynamic mapping, map production, methods of map composing and printing,

Basic Assumptions of projection system, Map Projections, Grouping of map projections: conic projection, cylindrical projection, Zenithal, Projection Types: Mercator, Transverse Mercator, Polyconic, Lambert, Orthomorphic, UTM Projections and their comparison, Choosing a Map Projection, Map Projection transformation, Analysis and visualization of distortion,
Visualization of geospatial data: Design aspects, Multiscale and geometric aspects scale, dissemination of (visualized) geospatial data, data products, use and users of products, Various issues in map visualization.

Computer Cartography, the nature of Data, Database and Data structures, Data Input: Method of data capture, digitisation and scanning method, Techniques and procedure for digitising, Vector and Raster; Data output: Screen display system, file organization and formats, rectification of digital maps, software for digital mapping.

TEXT BOOKS

1. Leicka. A.: GPS Satellite Surveying, John Wiley & Sons, use. New York
2. Terry-Karen Steede, 2002, Integrating GIS and the Global Positioning System, ESRI Press
3. N. K. Agrawal Essentials of GPS, Spatial Network Pvt Ltd 2004
4. Sathish Gopi , GPS and Surveying using GPS
5. Keates, J.S. (1973): Cartographic Design and production, London, Longman
6. Ramesh, P. A. (2000): Fundamentals of Cartography, Concept Publishing Co., New Delhi.
7. Rampal, K.K. (1993): Mapping and Compilation, Concept Publishing Co.,New Delhi.
8. Anson, R.W. & Ormeling, F.J. (1993), Basic Cartography, Vol. 1, 2nd ed., Elsevier Applied Science, Publishers, London.

REFERENCE BOOKS

1. Robinson A.H. & Morrison J.L, (1995) Elements of Cartography, John Wiley & Sons
2. Gregory, S. (1978): Statistical Methods for Geographers, Longman
3. Singh, R.L & Dutt. P.K, “Elements of Practical geography”, Students Friends Allahabad
4. Peterson, M.P. (1995) “Interactive and Animated Cartography” Upper Sadde River, NJ: Prentice Hall.

DGI 104 Mathematical Methods and Scientific Computing for Geospatial Data Analysis

Probability mass, density, and cumulative distribution functions, Expected value, variance, Conditional expectation, Probability Distributions: Binomial, Poison and Normal. Central Limit Theorem and its Applications. Probabilistic inequalities, Markov chains.

Sampling theory: Random samples, Parameter, Statistic and its Sampling distribution. Standard error of statistic. Sampling distribution of sample mean and variance in random

sampling from a normal distribution (statement only) and related problems. sampling distributions of estimators, Point and interval estimation of parameters.

Sampling theory (Continued): Testing of Hypothesis: Simple and Composite hypothesis. Critical region. Level of significance. Type I and Type II errors. One sample and two sample tests for means and proportions. Chi-Square - test for goodness of fit. Introduction to multivariate statistical models: regression and classification problems, principal components analysis**.** The problem of overfitting
model assessment.

Graph Theory: Isomorphism, Planar graphs, graph colouring, hamiltonian circuits and eulerian cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

Linear Algebra
Matrices and determinants, properties of matrices and determinants, Adjoint and inverse of a matrix Eigen values and Eigen vectors, Linear systems of equations and their solutions. n- dimensional Euclidean spaces, linear transformation,

Recent Trends in various distribution functions in mathematical field of Geo-informatics .

DGI 105 Recent Trends in Geoinformatics (Machine Learning and Big Data (3-0)

No. of Lectures: 40
Credit: 3

Machine Learning [25]

Overview of machine learning; Concept learning and the general-to-specific ordering; Decision tree learning; Neural networks; Support vector machines(SVM); Evaluating hypothesis; Bayesian learning; Computational learning theory; Instance based learning; Learning set of rules; Analytical learning; Combining inductive and Analytical learning; Reinforcement learning; Unsupervised learning.

Big Data Analytics[15]

Introduction to Big Data, Data Mining, Data Analytics, Predictive Analysis and Business Intelligence, Large Scale File System: Distributed File System, MapReduce, HDFS and Hadoop, Mining Big Data, Social Network Analysis, Issues, Challenges and Opportunities with Big Data and its Analytics.

References

1.Machine Learning for Spatial Environmental Data: Theory, Applications, and Software (Environmental Sciences: Environmental Engineering) 1st Edition Mikhail Kanevski, VadimTimonin, Alexi Pozdnukhov

2. Deep learning by Ian Goodfellow, Yoshua Bengio,Aaron Courville, MIT Press, 2016.

3 Neural Networks and Learning Machines (3rd Ed) by Simon Haykin, McMaster University, Canada,2008

4. Rajaraman, A., Ullman, J. D., Mining of Massive Datasets, Cambridge University Press, United Kingdom, 2012
5. Berman, J.J., Principles of Big Data: Preparing, Sharing and Analyzing Complex Information, Morgan Kaufmann, 2014
6. Pattern Recognition and Machine learning Christopher M Bishop 2006
7. Machine Learning, Tom Mitchell, McGraw Hill, 1997

DGI 191 Remote Sensing and Photogrammetry Lab – (0-2)

1. Arial photograph interpretation
2. Visual interpretation of multispectral and panchromatic image
3. Histogram stretching, linear, non linear stretching, histogram equalization
4. Image rectification
5. Image classification, supervised and unsupervised classifications
6. Image fusion
7. Stitching of scenes
8. Change detection from multi-date imagery

DGI 192 GIS Lab

1. Analog to Digital Conversion – Scanning methods
2. Introduction to software
3. Digital database creation – Point features, Line features, Polygon features
4. Data Editing-Removal of errors – Overshoot & Undershoot, Snapping
5. Data Collection and Integration, Non-spatial data attachment working with tables
6. Dissolving and Merging
7. Clipping, Intersection and Union
8. Buffering techniques
9. Spatial and Attribute query and Analysis
10. Contouring and DEM
11. Advanced Analyses – Network analyses
12. Layout Generation and report

DGI 193 Basics of GNSS, Cartography & Digital Mapping Lab – (0-2)

1. Introduction to GPS and initial setting
2. Creating codes and attribute table for GPS receiver
3. Point Data collection using GPS with different datum
4. Line data collection using GPS and measurements
5. GPS data collection for area calculation
6. GPS Data collection in DGPS mode.
7. Post processing of the GPS data
8. GPS and GIS integrations output preparation
9. Construction of different types of scales
10. Construction of different types of map projection: Conical projection, Cylindrical Projection, WGS 84
11. Preparation of UTM grid
12. Base Map
13. Designing and Symbolization
14. Analog to Digital Conversion

15. Analysis of Toposheet
16. Updation of maps from Satellite Imagery.

DGI 194 Web Technology Lab I – (0-2)

1. Introduction to computers & programming concept
2. Programming using concepts of variables, operators
3. Programming using control structures
4. Programming using functions and arrays
5. Programming using strings
6. Programming using data structure
7. Programming using file handling
8. Creation of forms and using control variables
9. Creating menus in forms
12. Connecting with database
13. Adding database of maps in the projects

DGI-195: Programming in Python(0-2)

Practical Applications of Geoinformatics in Machine Learning and Big Data